PROJECT MANUAL

for:

CMS Student & Family Support Center
CHARLOTTE, NC 28212
Issued for Construction
164.16300.04

January 18, 2024
Addendum No. 1

January 30, 2024
Addendum No. 2

October 25, 2024
Modifcation No. 3

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DIVERSIFIED ARCHITECTURAL CONSULTIN

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NOTIFICATION FOR BIDS

Formal bids for **CMS Student & Family Support Center – DMV Renovation** project located at 6635 Executive Circle, Charlotte, 28212 in Mecklenburg County, North Carolina will be received by the Owner at 3301 Stafford Drive, Charlotte, NC 28208. The General Contract scope of work includes the following: The General Contract scope of work includes demolition, architectural upfits, mechanical, electrical/low voltage, plumbing and fire protection renovations.

The Owner is:	**Charlotte-Mecklenburg Board of Education** 3301 Stafford Drive, Charlotte, NC 28208 Project Manager: Landon Robinson, Project Manager landon1.robinson@cms.k12.nc.us
Procurement Lead and point of contact for bidding:	Yolanda Fergerson Manager, Facilities and Contract Administration 3301 Stafford Drive Charlotte, NC 28208 yolandas.fergerson@cms.k12.nc.us (Email is the preferred method of communication for bid questions)

Interested bidders can download documents from the following site beginning November 16, 2026 at: https://www.cmsk12.org/operations/operations-support-services

All questions should be directed to the Procurement Lead at the email indicated above.

Prospective bidders will coordinate with the CMS Project Manager to schedule site visits.

There will be an optional pre-bid conference on November 23rd, 2026 at 11:00AM, 6635 Executive Circle, Charlotte, NC.

Bids are due by December 16th, 2026; by mail or hand delivered only by 12:00 pm to the address above where they will be publicly opened.5% Bid bond will be required with bid documents and, 100% Payment and Performance Bonds will be required for successful bidder before contract award.

The Owner reserves the right to reject any and all bids and to waive informalities should it be deemed in their best interest.

END OF SECTION

DOCUMENT 00 21 13
INSTRUCTIONS TO BIDDERS

PART 1 - GENERAL

1.1 SECURING DOCUMENTS

A. Obtain procurement documents for bidding purposes under conditions as set forth in the Advertisement for Bid.

1.2 BID FORM

A. Submit Bids on the forms provided, properly executed and with all items filled out. Modification of the Bid Form, attachment of conditions or limitation of provisions may be cause for rejection of the Bid. Alterations, erasure or interlineations must be noted with explanation on the Bid Form over the signature of the Bidder.

1.3 SUBMISSION OF BIDS

A. Deliver Bid to the location indicated in the Advertisement for Bid before time set for receipt of bids. Submit Bid in an opaque, sealed envelope and marked in the lower left-hand corner with the following information:

1. Bidder's Name
2. Bidder's Address
3. Bidder's Phone
4. Contractor's License No.
5. Title of Project
6. Date and Time of the Bid Opening

B. If not delivered in person, envelope shall be enclosed in a second envelope for posting to the location indicated for receipt of bids. Address outside envelope as follows:

Charlotte-Mecklenburg Schools
3301 Stafford Drive
Charlotte, North Carolina 28208

Label Packages “URGENT – TIME SENSITIVE BID ENCLOSED”

C. It is the sole responsibility of the Bidder to submit Bid prior to time fixed for receipt.

D. Electronic submission of Bids or Bid modifications will not be accepted. Bids received after the time fixed for receipt will be considered late and will be returned to the Bidder unopened.

1.4 BID SECURITY

A. A Bid Security in the amount of 5 percent of the Bid Sum shall be furnished with the submission of the Bid. Acceptable Bid Securities include a bid bond, certified check, or other type of security, as stipulated by the North Carolina General Statutes. Submit Bid Security should be on the Owner’s form, attached in the Project Manual.

B. Performance Bond and Labor and Material Payment Bonds, each in the amount of 100 percent of the Contract Sum, shall be furnished prior to Contract execution. Submit Bonds on the Owner's forms attached in the Project Manual.

1.5 EXAMINATION OF CONTRACT DOCUMENTS AND SITE OF WORK

A. Prior to submitting Bid, each Bidder shall carefully examine the proposed Contract Documents and visit the project site. Bidders shall fully inform themselves, prior to Bidding, as to all existing conditions and limitations under which the Work is to be performed and shall include in the Bid Sum an amount to cover the cost of all items necessary to perform the Work as set forth in the proposed Contract Documents. No allowance will be made due to lack of such examination or knowledge. The submission of a Bid shall be construed as conclusive evidence that the Bidder has made such examination.

1.6 SUBSTITUTIONS

A. Each Bidder represents that their Bid is based upon the materials and equipment described in the proposed Contract Documents. Substitutions will be considered during the Bidding process in accordance with Document 00 26 00 - Procurement Substitution Procedures. Substitutions after the execution of the Agreement will only be considered in strict accordance with Section 01 25 00 - Substitution Procedures.

1.7 MODIFICATION AND WITHDRAWAL OF BIDS

A. Bids may be withdrawn upon request from the Bidder prior to opening time. Withdrawn Bids may be resubmitted up to opening time. Negligence or error on the part of the Bidder in preparing his Bid confers no right for withdrawal of the Bid after it has been opened. No Bid may be withdrawn for 90 calendar days after opening except as provided by North Carolina G.S. 143-129.1.

1.8 AWARD OR REJECTION OF BIDS

A. Award of Contract, if awarded, will be based on, but not limited to, the following criteria:

1. Cost (best advantage for the Owner)
2. Submission of the Owner's required qualification documents before or with the Bid.
3. Acceptance of the contractor's qualifications based on the response to the contractor qualification documents demonstrating his past performance and ability to complete similar work.
4. Conformance with contract documents
5. Acceptable date of delivery
6. Acceptable Form of Bid Security
7. Other reasonable factors deemed fit, by the Owner.

B. A single Contract will be awarded.

C. All bids are subject to the Owner's right to reject any or all bids and to waive any informality in the bids or in the bidding. Failure to provide qualifications, complete all information required on the bid form, or provide adequate bid security may result in rejection of bid.

1.9 EXECUTION OF AGREEMENT

A. The Standard Form of Agreement between Owner and Contractor will as included in the Project Manual. The successful Bidder, as Contractor, will be required to execute this agreement.

B. The successful Bidder, to whom the Contract is awarded by the Owner, shall, within 10 days after Notice of Award from the Owner, sign and deliver to the Owner all required copies of the Agreement.

C. Prior to or in conjunction with delivery of the executed Agreement, the Contractor shall deliver to the Owner documents described in the Project Manual and the policies or certificates of insurance as required by the Contract Documents. The Owner shall approve all bonds and policies or certificates of insurance before the Contractor may proceed with the Work.

D. Failure or refusal to furnish Bonds or insurance policies or certificates in a form satisfactory to the Owner shall subject the Bidder to forfeiture of Bid Security.

1.10 INTERPRETATION OF CONTRACT DOCUMENTS PRIOR TO BIDDING

A. If any person contemplating submitting a Bid for the construction of the Work is in doubt as to the true meaning of any part of the proposed Contract Documents, or finds discrepancies in or omissions from any part of the Contract Documents, they may submit to the Architect a written request for interpretation or correction thereof, no later than 7 calendar days prior to the receipt of Bids.

B. Communications regarding this Work should be addressed to the Architect indicated in the Advertisement for Bids.

C. Interpretation or correction of the Contract Documents shall be made by written addendum and will be mailed, faxed or delivered to each Bidder of record. The Owner will not be responsible for any other explanations or interpretation of the Contract Documents.

D. It is the responsibility of each Bidder to verify that they have received all Addenda before submitting a Bid. It is the responsibility of all sub-bidders and material suppliers to be familiar with and to include in their price, all Addenda issued up to the time of Bid opening. Requests for clarification or additional information shall be accepted only from Bidder submitting as the General Contractor, sub-Bidders and suppliers shall coordinate their requests through these Bidders.

1.11 PRE-BID CONFERENCE

A. A pre-bid conference will be held at time and location indicated in the Advertisement for Bids. All prospective bidders are requested to attend. The conference will include a discussion of the proposed site of the work, discussion of the scope and nature of the work, review of the proposed Contract Documents, and discussion of questions submitted by the Bidders.

1.12 CONTRACTOR QUALIFICATION

A. Bidders are required to submit the Bidder’s Qualification Forms Document 00 45 13 included in the Project Manual with their Bid, regardless of previously submitted qualification information submitted to the Owner. Failure to provide this information with Bid may result in the Bid being considered non-responsive and rejected.

1.13 CONSTRUCTION TIME AND LIQUIDATED DAMAGES

A. The Conditions of the Contract include stipulations that the Work be completed within the Contract Time expressed in calendar days. The Contract also includes a stipulation that Liquidated Damages accrue per calendar day for each day each phase of the Work remains incomplete beyond the Contract Completion Date. Refer to the Document 00 31 13 - Preliminary Schedule included in the Project Manual for proposed start, completion and intermediate milestones.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

END OF DOCUMENT

DOCUMENT 00 26 00
PROCUREMENT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Administrative and procedural requirements for handling requests for substitutions prior to the Owner's receipt of bids.

B. Refer to Section 01 60 00 - Product Requirements for procedural requirements governing the Contractor's selection of products and product options.

1.2 DEFINITIONS

A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.

B. Substitutions: Requests for changes in products, materials, and equipment, of construction required by Contract Documents proposed by the Contractor are considered requests for substitutions. The following are not considered substitutions:

1. Substitutions that are requested by Bidders beyond the 10 days prior to bid opening submittal period
2. Revisions to Contract Documents requested by the Owner or Architect
3. Specified options of products and construction methods included in Contract Documents
4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities

1.3 SUBSTITUTION REQUEST

A. Request for substitution from Bidders, submitted Bid as General Contractor will be considered if received by the Architect a minimum of 10 days prior to receipt of Bids.

1. Submit three (3) copies of each request for substitution for consideration.
2. Identify the product or method to be replaced in each request. Include reference to related
Specification Sections and drawing sheet number.
3. Provide complete documentation on both the product specified and the proposed substitution including the following information as appropriate.

a. Comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.
b. Samples where applicable or requested.
c. A detailed comparison of significant qualities of the proposed substitution with those of the work specified.
d. Coordination information, including a list of changes or modifications required to other parts of the Work and to construction performed by others that will become necessary to accommodate the proposed substitution.

4. Certification by the Bidder or the manufacturer that the proposed substitution is equal-to or better in every respect to that required by the proposed Contract Documents and that it will perform equal-to or superior to product specified in the application indicated. The Contractor waives any right to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

B. Architect's Action: The Architect may request additional information or documentation necessary for evaluation of the request. The Architect will notify Bidder's of acceptance of the proposed substitution by means of an addendum to the proposed Contract Documents.

C. Architect's Substitution Approval during bidding and subsequent addenda does not void the Contractor's responsibility to submit the required shop drawings and comply with the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. The Architect will consider Bidder's substitution request when the following conditions are satisfied, as determined by the Architect; otherwise requests will be returned without action except to record noncompliance with these requirements.

1. Extensive revisions to Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of Contract Documents.
3. The request is timely, fully documented and properly submitted.
4. The request is directly related to an "or equal" clause or similar language in the Contract Documents.

PART 3 - EXECUTION

(NOT USED)

END OF DOCUMENT

BID FORM STIPULATED SUM (SINGLE-PRIME CONTRACT)

PROJECT: CMS Student and Family Support Center

DATE: _____

BIDDER:_____

Labor: $_____

Material$_____

Taxes $_____

(8.25% on labor and material lines above)

Total $_____(all lines above)

The undersigned acknowledges receipt of the following addenda:

ADDENDA # DATE

_____

_____

_____

If notice of acceptance of this bid is given to the undersigned within 90 days after the date of opening of bids, or any time thereafter before this bid is withdrawn, the undersigned will execute and deliver an Agreement in the prescribed form within 10 days after the Agreement has been presented to him for signature. Certificates of Insurance and Bonds shall be furnished to the Owner at the execution of this Agreement.

I certify that the firm signing this bid and registered under that name is legally qualified to perform all work included in the scope of the contract as determined by the State of North Carolina, in granting the registration.

Federal Tax ID Number.: _____

By (Sign.): _____

(Typed):_____

Title: _____

Business Address:_____

_____

_____

Telephone Number::_____

Partnership:

Names of Partners:

_____

_____

END OF DOCUMENT

STATE OF NORTH CAROLINA

COUNTY OF MECKLENBURG

AFFIDAVIT of COMPLIANCE
with N.C. E-Verify Statutes

I, _____ (hereinafter the "Affiant"), duly authorized by and on behalf of _____ (hereinafter the "Employer") after being first duly sworn hereby swears or affirms as follows:

1. I am the _____ (President, Manager, CEO, etc.) of the Employer and possess the full authority to speak and act on behalf of the Employer identified above.

2. Employer desires to enter into a contract (or has contracted) with the Charlotte-Mecklenburg Board of Education ("CMBE"). Employer acknowledges and understands that by law the CMBE is prohibited from entering into contracts with contractors or subcontractors that do not comply with the requirement to use E-Verify.

3. Employer understands that "E-Verify" means the federal E-Verify program operated by the United States Dept. of Homeland Security and other federal agencies, or any successor or equivalent program used to verify the work authorization of newly hired employees pursuant to federal law.

   ____ Employer employs 25 or more employees in the State of North Carolina, and is in compliance with the provisions of N.C. Gen. Stat. §64-26. Employer has verified the work authorization of its employees through E-Verify and shall retain the records of verification while the employee is employed and for a period of at least one year thereafter.

   ____ Employer employs fewer than 25 Employees and is therefore not subject to the provisions of N.C. Gen. Stat. §64-26.

4. All subcontractors engaged by or to be engaged by Employer have or will have likewise complied with the provisions of N.C. Gen. Stat. §64-26. Employer acknowledges that it has an obligation to verify and attests that it has taken every reasonable step to ensure all subcontractors it employs as part of any contract with the Charlotte-Mecklenburg Board of Education are in compliance with the requirement to E-Verify the employment status of the employees of the subcontractor.

5. Employer shall keep Charlotte-Mecklenburg Board of Education informed of any change in its status pursuant to Article 2 of Chapter 64 of the North Carolina General Statutes.

This the _____ day of _____, 20____

_____
Affiant-Sign here please

STATE OF NORTH CAROLINA
COUNTY OF _____

Sworn to and subscribed before me, this the_____day of _____ , 20____

[SEAL]

_____
Notary Public

My commission expires: _____

Unit prices indicated below in accordance with Section 01 22 00 – Unit Prices are the only unit prices applicable to the Work of this Project.

Unit Price #	Description		Cost/Unit	
UP-1	Provide price to furnish and install #57 stone structural backfill.		$	Per Bank C.Y.
UP-2	Provide price to remove and replace 4" floor slab.		$	Per Sq. Ft.
UP-3	Provide an additional standard 15-amp duplex receptacle, 50' of MC cabling, and new circuit breaker.		$	Each
UP-4	Provide price to install a new exit sign and 100' of emergency circuit wiring.		$	Each
UP-5	Provide price for an additional horn strobe device including 100' of protected wiring and FACP programming.		$	Each
UP-6	**Provide price for voice/data drop from 0 to 150', include cable, wall plate outlet, wall jack, & hangers**		$	Each
UP-7	**Provide price for voice/data drop from 150' to 295', include cable, wall plate outlet, wall jack, & hangers**.		$	Ln. Ft
UP-8	Provide price for an additional fire extinguisher and cabinet.		$	Each
UP-9	Provide price to install, finish & paint 10' tall double-sided 4" gypsum board wall.		$	Ln. Ft.
UP-10	Provide price to repaint wall to match existing paint color.		$	Sq. Ft.
UP-11	Provide price to replace exterior plaster found to be unsuitable in addition to that indicated on Drawings.		$	Sq. Ft.
UP-12	Provide price to replace joint sealant at Building 6600 in addition to that indicated on Drawings		$	Ln. Ft.

ALTERNATES

The undersigned further agrees to perform alternative work as described in Section 01 23 00 - Alternates for the sums stated below resulting in additions to or deductions from the base bid stated above. Additions and deductions shall include any modifications of the Work or additional work that may be reasonably included as part of the alternative work. All alternative work is to be completed within the same timeframe as the base bid work. All alternates must be filled out. A zero or no entry after any alternate indicates no cost change to include that Alternate. The Owner will have 90 days to accept Alternates to be included in the Contract or modified by Change Order. Contractor agrees to hold all prices for that duration of time after the bid. The undersigned acknowledges that failure to complete all information requested in this section may result in the rejection of this bid.

Note: Bracket numbers ( ) intended as deductive adjustments.

$ _____

Alternate No. A: Wood and Plastic Laminate Cabinet Quality Certification.

$ _____

Alternate No. B: Owner-Preferred Alternate – Restricted Keyway Cylinder.

$ _____
Alternate No. C: Provide solid surface countertops at all locations where plastic laminate countertops are indicated.

$ _____
Alternate No. D: Enameled cast iron lavatories.

$ _____
Alternate No. E: Controls System Extended Warranty.

$ _____
Alternate No. F: Access control card readers and electronic hardware at IDF and MDF rooms.

$ _____
Alternate No. G: Precast concrete bollards at front entrance.

The undersigned understands that time is of the essence and agrees to the Contract Time and liquidated damages as indicated in AIA Document A201, General Conditions of the Contract for Construction, 2007 Edition (as modified), apply to this Work.

The undersigned acknowledges receipt of the following addenda:

ADDENDA #	DATE

Bid Security in the sum of _____ in the form of _____ is submitted herewith in accordance with 00 21 13 – Instruction to Bidders.

If notice of acceptance of this bid is given to the undersigned within 90 days after the date of opening of bids, or any time thereafter before this bid is withdrawn, the undersigned will execute and deliver an Agreement in the prescribed form within 10 days after the Agreement has been presented to him for signature. Certificates of Insurance and Bonds shall be furnished to the Owner at the execution of this Agreement.

I certify that the firm signing this bid and registered under that name is legally qualified to perform all work included in the scope of the contract as determined by the State of North Carolina, in granting the registration.

Licensed Contractor No.: _____

Bidder: _____

By (Sign.): _____

(Typed): _____

Title: _____

Business Address: _____

_____

_____

Telephone Number: _____

Partnership:

Names of Partners:

_____

_____

END OF DOCUMENT

DOCUMENT 00 43 13
BID SECURITY FORM

Date of Execution of this bond _____

Name and Address of Principle (Bidder) _____

_____

Name and Address of Surety _____

_____

Name and Address of Contracting Body THE CHARLOTTE-MECKLENBURG COUNTY BOARD OF EDUCATION
a body corporate of the State of North Carolina,
PO Box 30035, Charlotte, North Carolina, 28230-0035

Amount of Bond
Bid Amount
and Proposal Dated: _____

_____ for _____

_____

KNOW ALL MEN BY THESE PRESENTS, that we the PRINCIPLE above named and SURETY above named who is duly licensed to act as SURETY in the State of North Carolina, are held and firmly bound unto THE MECKLENBURG COUNTY BOARD OF EDUCATION, a body corporate of the State of North Carolina, as Obligee, in the penal sum of five percent (5%) of the amount bid in the bid and proposal described in lawful money of the United States of America, for the payment of which well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such, that if the PRINCIPLE shall be awarded the contract for which the bid and proposal above described is submitted and shall execute the contract, give bond for the faithful performance of the contract, and give bond for the payment of all persons supplying labor and materials in the prosecution of the work provided for in said contract, within ten (10) days after the award of the same to the PRINCIPLE above named, then this obligation shall be null and void; but if the PRINCIPLE above named fails to so execute such contract and give performance bond and payment bond as required by Section 129 of Chapter 143 of the General Statutes of North Carolina, as amended, the Article 3 of Chapter 44-A of the General Statutes of North Carolina, as amended, the Surety shall upon demand, forthwith pay the Obligee the amount of this bond set forth above.

IN WITNESS WHEREOF, the Principle above named and the Surety above named have executed this instrument under their several seals on the date set forth above.

WITNESS:

_____
Principle (Name of individual, and trade Name, partnership, corporation, or joint venture)

_____
(Proprietorship or Partnership)

BY _____(Seal)

TITLE_____
(Owner, Partner, Office held in corporation, joint venture)

(Corporate Seal)

ATTEST
BY _____
(Corporation)

TITLE_____
(Corporation Secretary or Assistant Secretary Only)

_____
Surety (Name of Surety Company)

WITNESS:

BY _____

_____

TITLE Attorney in Fact

(Corporate Seal of Surety)

_____
(Address of Attorney in Fact)

COUNTERSIGNED:

_____

_____
N.C. Licensed Resident Agent

DOCUMENT 00 43 40
CHARLOTTE-MECKLENBURG SCHOOLS
MINORITY, WOMEN, AND SMALL BUSINESS ENTERPRISE PROGRAM

Guidelines for M/W/SBE Participation In Construction

In accordance with G.S. 143-64.31, it shall be the policy of the Charlotte-Mecklenburg Board of Education to promote full and equal access to business opportunities with Charlotte-Mecklenburg Schools. Minority-owned, women-owned, and small business enterprises (collectively "M/W/SBE") as well as other responsible vendors shall have a fair and reasonable opportunity to participate in CMS business opportunities.

The Superintendent shall implement an M/W/SBE Program which includes aspirational goals for M/W/SBE utilization in proportion to the availability of qualified vendors in particular areas of procurement. An annual report shall be made to the Board of Education regarding M/W/SBE utilization in comparison to the aspirational goals.

Policy Adopted: 01/12/93
Policy Amended: 07/09/96
Policy Amended: 02/22/05

Requirements

The fundamental requirement of the policy is that all contractors, vendors and consultants, who contact with the Board of Education, will: (i) not discriminate against any person in regard to race, color, religion, age, national origin, sex, or disability; and (ii) provide a full and fair opportunity for participation of M/W/SBEs in contracts. Participation shall be measured in terms of the actual dollars received by M/W/SBEs.

"Minority" as used in this policy means African American (all persons having origins in any of the African racial groups); Hispanic/Latino American (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish culture or origin); Asian American (all subcontinent, or the Pacific Islands); and Native American (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification.

"Woman" as used in this policy means a non-minority woman who has 51% ownership, interest, holds the professional or contractor license necessary for operation as well as management, control, and have technical expertise directly related to the primary product or service of the business.

"Small" as used in this policy means a business enterprise owned, operated, and controlled by one (1) or more eligible owners who have 51% ownership, interest, holds the professional or contractor license necessary for operation as well as management, control, and have technical expertise directly related to the primary product or service of the business, and is 25% or less of the applicable size standards established by the Small Business Administration.

"Socially and Economically Disadvantaged" as used in this policy means a minority, woman, or small business enterprise owned, operated, and controlled by one (1) or more eligible owners who have 51% ownership, interest, holds the professional or contractor license necessary for operation as well as management, control, and have technical expertise directly related to the primary product or service of the business, and is 25% or less of the applicable size standards established by the Small Business Administration.

Program Objectives

1. To provide M/W/SBEs equal access to opportunity for participation in Capital Improvement Projects construction (additions, renovations, and new construction), procurement, professional services and system-wide purchasing contracts.

2. To encourage all Charlotte-Mecklenburg Schools' personnel involved in procurement and contracting activities to maintain good faith efforts and appropriate purchasing procedures.

3. To establish aspirational goals of participation for M/W/SBE firms capable of supplying those goods and services which are necessary for school system operations.

4. To provide procedures for determining and monitoring M/W/SBE participation and compliance with M/W/SBE requirements stated in the Board of Education policy and in contract documents.

5. To evaluate and report to the Superintendent and the Board of Education the results of contract activity subject to the provisions of the M/W/SBE Program.

6. To protect Charlotte-Mecklenburg Schools from becoming a passive participant in any unlawful discrimination.

7. To promote awareness of the M/W/SBE Program throughout Charlotte-Mecklenburg Schools and the Community.

Section 2:

Procedures for Implementation

The Office of General Counsel and M/W/SBE Department will develop language to be included in bid solicitations and requests for proposals which clearly sets forth the objective of the Policy. District employees shall include the Solicitation Language in all bids, public solicitations and requests for proposals. Charlotte-Mecklenburg Schools may employ additional staffing or contract with other public or private entities to assist in the implementation of the Policy. Copies of the M/W/SBE Program may be obtained from the M/W/SBE Administrator, 3301 Stafford Drive, Charlotte, NC, 28208.

Promotion of M/W/SBEs

Charlotte-Mecklenburg Schools recognizes the importance of having meaningful and substantial M/W/SBE participation in all contracts. To that end, Charlotte-Mecklenburg Schools will take steps to ensure that M/W/SBEs are afforded a fair and equal opportunity to participate.

Grievance Procedures

It is the policy of this Local Education Administration (LEA) unit, thusly, Charlotte-Mecklenburg Schools, that disputes, which involve a person's rights, duties or privileges, should be settled through informal procedures. Any participant feeling himself/herself aggrieved by implementation of the M/W/SBE Program may present such grievance to the M/W/SBE Administrator. The grievance (internal compliant resolution) procedure is a resource available to all contractors, subcontractors, and vendors doing business with Charlotte-Mecklenburg Schools under the M/W/SBE Program. Grievance related to the administration of the M/W/SBE Program will be processed through the M/W/SBE Administrator as follows:

1. The grievance shall first be discussed with the responsible operating department. If the grievance is not resolved, exercise item #2, as stated below.

2. The grievance (complaint) must be reported in writing, a brief description and supporting documentation and evidence to Charlotte-Mecklenburg Schools, M/W/SBE Administrator, Building Services Department, 3301 Stafford Drive, Charlotte, NC 28208.

4. Charlotte-Mecklenburg Schools M/W/SBE Administrator and Departmental Representatives will review the basis and the issue(s) of the compliant and may request additional supporting evidence. A response to the grievance will be completed within fifteen (15) working days unless circumstances mandate otherwise. Parties involved will be notified of any and all delays in processing the grievance.

5. In the event the participant is not satisfied, said participant may appeal the grievance by filing a written description thereof and supporting evidence with the Assistant Superintendent of Building and Construction. The Assistant Superintendent or his designee shall hear the grievance within a reasonable period of time and shall make a decision based on upon a review of the record.

6. Any participant not satisfied with the Assistant Superintendent's decision may avail himself/herself or any remedies available under the Federal, State and Local law.

To that end, M/W/SBE disputes arising under these guidelines should be resolved.

Section 3:

Bid Provisions

The requirements of Charlotte-Mecklenburg Schools Minority, Women, Small Business Enterprise (M/W/SBE) Provisions and Guidelines are hereby made part of these contract documents. The requirements shall apply to all contractors regardless of ownership. Copies of the M/W/SBE Program may be obtained from the M/W/SBE Administrator, Building Services Department, and 3301 Stafford Drive, Charlotte, NC 28208.

The Aspirational Goals for participation established by Charlotte-Mecklenburg Schools will be included with each bid, request for proposal or public solicitation. The names and addresses of bona fide M/W/SBEs that are available for contracting or joint-venture opportunities may also be included with the solicitations. Each bidder or respondent shall be required to submit a "Minority, Women, and Small Business Identification Form and Affidavit A or B". **Submission of a blank Minority Business Identification Form may be considered an element of non-responsiveness.**

If the aspirational goals in a bid or proposal meets or exceeds the level determined by Charlotte-Mecklenburg Schools to be meaningful and substantial, there shall be a presumption of compliance with the Policy. If, however, the proposed aspirational goals fall below the level determined by Charlotte-Mecklenburg Schools to be meaningful and substantial, the bidder or respondent must prove to the satisfaction of CMS that it did not discriminate in the solicitation of potential subcontractors and/or joint venture partners.

M/W/S/BE Subcontract Aspirational Goals

The aspirational goals for participation by Minority, Women, and Small Business Enterprises as subcontractors on this project have been set at:

Category	MBE Goal	WBE Goal	SBE	Total M/W/SBE Goal
Construction	10%	6%	5%	21%
Architecture & Engineering	4%	7%	5%	16%
Professional Services	9%	9%	5%	23%
Other Services (other than Architecture & Engineering and other Professional Services)	5%	4%	5%	14%
Goods	3%	3%	5%	11%

The Bidder shall provide, with the bid the following documentation:

□ **Minority, Women, and Small Business Enterprise Identification Form** (including suppliers)
□ **Affidavit A** (if subcontracting)

OR

□ **Minority, Women, and Small Business Enterprise Identification Form**
□ **Affidavit B** (if self-performing all work with own workforce AND will not purchase any materials or supplies in the performance of the contract . Upon request, provide sufficient information for Charlotte-Mecklenburg Schools to determine that the Bidder does not customarily subcontract work on this type of project)

Within 72 hours after notification of being the apparent low bidder, the low bidder who is subcontracting anything must provide the following information:

□ **Affidavit C** (if aspirational goals are met or exceed established goal of M/W/SBE participation)

□ **Appendix I** (Signed by the M/W/SBE subcontractors, may come in after 72-hr deadline)

OR

□ **Affidavit D** and all documentation as requested on the form (if aspirational goals are not met or exceed established goal of M/WBE participation)

□ **Appendix I** (Signed by the M/WBE subcontractors, may come in after 72-hr deadline)

****With each pay request the prime contractors will submit Appendix IV listing payments made to all subcontractors.**

Compliance Documentation

All written statements, affidavits or intentions made by the Bidder shall become a part of the agreement between the Contractor and Charlotte-Mecklenburg Schools for performance on this contract. Failure to comply with any of these statements, affidavits or intentions or with the M/W/SBE Program Guidelines shall constitute a

breach of contract. A finding by Charlotte-Mecklenburg Schools that any information submitted either prior to award of the contract or during the performance of the contract is inaccurate, false, or incomplete, shall also constitute a breach of the contract. Any such breach may result in termination of the contract in accordance with the termination provisions contained in the contract. It shall be solely at the option of Charlotte-Mecklenburg Schools whether to terminate the contract for breach.

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

Good Faith Effort Documentation – The bidder's documentation to meet the goals set forth in these provisions shall include, but not limited to, the following evidence:

1. Copies of solicitations for quotes to at least three (3) M/W/SBE firms for each subcontract to be let under this contract. Each solicitation shall contain a specific description of the work to be subcontracted, location where the bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.

2. Copies of quotes or responses received from each firm responding to the solicitation.

3. A telephone log of follow-up calls to each firm sent a solicitation.

4. For subcontracts where an M/W/SBE firm is not considered to be the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.

5. Documentation of any contacts, correspondence or conversation with M/W/SBE firms made in an attempt to meet the aspirational goals.

6. The successful bidder shall maintain records relating to all commitments for a period of at least one year following acceptance of final payment.

Note: Additional Good Faith Efforts are identified in Affidavit A.

After review of the Bidder's Good Faith Efforts, the Bidder may request and be granted a Waiver of the M/W/SBE aspirational goals that have not been met for that particular project. A Waiver may be granted upon review of the Bidder's documentation and determination that, in fact, a Good Faith Effort has been put forth. The Contractor's M/W/SBE Utilization Commitment shall be incorporated into the contract.

Charlotte-Mecklenburg Schools is authorized to establish specifications requiring bidders to subcontract a certain designated percentage of the construction and repair work amount, provided that nothing contained in these requirements shall be construed to require that the award of subcontracts be made to subcontractors who do not submit the lowest responsive bid.

NOTE: Charlotte-Mecklenburg Schools reserves the right to waive any irregularities in M/W/SBE documentation if they can be resolved prior to award of the contract, and Charlotte-Mecklenburg Schools finds it to be in its best interest to do so and award the contract.

Section 4:

Responsibilities

Office of Minority, Women, and Small Business Enterprise Program

1. Review all facets of the procurement process to ensure equal access by all segments of the community.

2. Develop and maintain a database of available minority, women, and small businesses.

3. Review all participation submissions and determine whether bidder/proposers are in compliance with the policy and recommend appropriate action.

4. Monitor all contracts to determine whether contractors achieve the ranges of participation set forth on the Minority, Women, and Small Business Enterprise Identification Forms completed by the contractors.

5. Participating in vendor conferences, meetings, and other outreach activities geared to increase opportunities for M/W/SBE firms.

6. Provide technical assistance and guidance to M/W/SBE's on contracting and procurement opportunities with Charlotte-Mecklenburg Schools.

7. Maintain statistics on utilization of M/W/SBE firms.

8. Investigate violations of the policy and recommend remedial action.

Prime Contractor(s), Bidder, CM at Risk, and First-Tier Subcontractors or Offeror

Contractors performing under the Single Prime, Separate Prime, Design Builder and Construction Manager at Risk and alternative contracting methods, will be responsible for the following:

1. Attend the scheduled pre-bid conferences

2. Identify or determine those work areas where M/W/SBEs may have an interest in performing subcontractor work.

3. Submit with the bid a description of the portion of the work to be executed by the M/W/SBEs expressed as a percentage of the total contract price.

4. At least ten (10) days prior to the scheduled day of bid opening, notify certified M/W/SBEs of potential subcontracting opportunities listed in the proposal. The notification will include the following:

    a. A description of the work for which the sub-bid is being solicited.
    b. The date, time, and location where sub-bids are to be submitted.
    c. The name of the individual within the company who will be available to answer questions about the project.
    d. Where the bid documents may be reviewed.

e. Any special requirements that may exist, such as insurance, licenses, bonds and financial arrangements. If there are more than three (3) certified M/W/SBEs in the area of the project, the contractor(s) shall notify three (3), but may contact more, if the contractor(s) so desires.

5. During the bidding process, comply with the contractor(s) requirements listed in the proposal for participation in the M/W/SBE Program.

6. If the Contractor elects to use an M/W/SBE firm that is not certified by the City of Charlotte, Carolinas Minority Supplier Development Council, or other governmental entities, it will be the Contractor's responsibility to notify the M/W/SBE firm that they should submit an application for certification with thirty (30) days of signing the Letter of Intent (Appendix I). If the firm does not submit an application within the specified time frame or fails to meet the certification criteria, the contract amount with that M/W/SBE firm will not be considered as M/W/SBE participation.

7. If the Contractor elects to utilize suppliers to satisfy the goal(s) in whole or in part, the small, minority, or women-owned businesses must perform a commercially useful function. Supplier participation may be approved upon review of the following factors:

   a. The nature and amount of supplies to be furnished;
   b. Whether the minority, woman-owned, or small business firm is a manufacturer, wholesaler or distributor of the supplies and has the capabilities to deliver same in accordance with its certification;
   c. Whether the minority, woman-owned, or small business firms actually performs, manages and supervises the work to furnish the supplies; and
   d. Whether the minority, woman-owned or small business firm intends to purchase supplies from a non-minority, woman-owned or small business firm and simply resell same to the general or prime contractor for allowing those supplies to be counted towards fulfillment of the aspirational goal(s).

8. Upon being named the apparent low bidder, the Bidder shall submit to the M/W/SBE Administrator their good faith backup documentation if they <u>have not</u> met the M/W/SBE goal. Failure to comply with procedural requirements as defined in contract documents may render the bid as non-responsive and may result in rejection of the bid and award to the next lowest and responsive bidder.

9. If during the construction of a project additional subcontracting opportunities become available, the prime or general contractors must make a good faith effort to solicit sub-bids from M/W/SBEs.

M/W/SBE Responsibilities

M/W/SBE firms do not have to be certified to be listed on the bid documents; however, M/W/SBE firms that have been awarded contracts will not be credited towards CMS' M/W/SBE Program unless they are certified by a bona fide certifying entity, including by way of example and not limitation, certification from such entities as the City of Charlotte, Carolina's Minority Supplier's Development Councils, Women Business Enterprise Network Council, or other governmental entity. In addition M/W/SBE firms will be responsible for the following:

1. M/W/SBEs should make every effort to establish contacts and relationships with contractors for potential future business, including attending pre-bid conferences and subscribing to industry and trade journals.

2. M/W/SBEs should also document all contacts and communications made with Contractors above so as to be able to assist the M/W/SBE Administrator in determining whether a complaint lodged by an M/WBE firm against a Bidder for failure to use good faith efforts is valid.

3. In addition, M/W/SBEs who are contacted by Owners or Bidders should respond promptly whether or not they wish to submit a bid. If an M/W/SBE firm is listed as a subcontractor or supplier, they will be responsible for completing a Letter of Intent (Appendix I) in a timely manner and returning it to the Prime Contractor.

4. M/W/SBE who are not certified at the time the firm commits to provide services, should apply for certification with the City of Charlotte, Carolinas Minority Supplier Development Council, or other governmental entities within thirty (30) days. If the M/W/SBE firm fails to submit an application within the specified time frame or if the M/W/SBE firm is not granted certification by the Certification Committee, that M/W/SWBE firm's contract dollars will not be counted as M/W/SBE participation; however, not getting certification does not release the M/W/SBE from contractual obligations to the primary contractor.

5. M/W/SBEs are urged to take advantage of appropriate technical assistance and training when it is available.

Section 5:

Subcontractor Payment Requirements

North Carolina General Statute 143-134.1 states that the percentage of retainage on payments made by the prime contractor to the subcontractor shall not exceed the percentage of retainage on payments made by Charlotte-Mecklenburg Schools to the prime contractor. Failure to comply with this provision shall be considered a breach of the contract, and the contract may be terminated in accordance with the termination provisions of the contract.

The Contractor shall provide the Documentation of ALL Payments Form (Appendix IV) which is an itemized statement of payments to all contractors, subcontractors, suppliers, and service providers with each request for payment and before final payment is processed.

Changes In Work or Replacement of Subcontractors:

During the construction of a project, if it becomes necessary to replace an M/W/SBE subcontractor, the contractor shall submit written justification to the M/W/SBE Administrator (or designee) and Project Manager as to why the subcontractor is being replaced. The contractor shall make a Good Faith Effort to replace the subcontractor with another M/W/SBE subcontractor. Failure to comply with these provisions shall be considered a breach of the contract, and the contract may be terminated in accordance with the termination provisions of the contract.

The Contractor shall also advise Charlotte-Mecklenburg Schools or designee of any significant problems and of termination proceedings against any M/W/SBE subcontractor. Charlotte-Mecklenburg Schools representative and contact person for the M/W/SBE Program is the M/W/SBE Administrator, (980) 343-8638.

Section 6:

Closeout Documentation

The Contractor is required to submit a **Final Appendix IV** totaling all payments made to subcontractors, suppliers, and service providers for the entire project.

Dispute Resolution Procedures

Under G.S. 143-128, Senate Bill 914 states that a public entity shall use the dispute resolution process adopted by the State Building Commission pursuant to G.S. 143-135.26(11), or shall adopt another dispute resolution process, which shall include mediation, to be used an alternative to the dispute resolution process adopted by the State Building Commission. This dispute resolution process shall be available to all the parties involved in the public entity's construction project including the public entity, the architect, the construction manager, the contractor, and the first-tier and lower-tier subcontractors and shall be available for any issues arising out of the contract or construction process.

The public entity may set a reasonable threshold, not to exceed fifteen thousand dollars ($15,000), concerning the amount in controversy that must be at issue before a party may require other parties to participate in the dispute resolution process. The public entity may require that the cost of the process be divided between the parties to the dispute with at least one-third of the cost to be paid by the public entity, if the public entity is a party to the dispute. The public entity may require in its contract that a party participate in mediation concerning a dispute as a precondition to initiating litigation concerning the dispute.

Section 7:

Penalty

A finding by Charlotte-Mecklenburg Schools that any information submitted either prior to award of the contract or during the performance of the contract is inaccurate, false or incomplete, shall also constitute a breach of the contract. Any such breach may result in the assessment of a penalty equal to the dollar amount of the infraction (amount of subcontract in question), not to exceed 5% of the total contract amount, or termination of the contract in accordance with the termination provisions contained in the agreement. It shall be solely at the option of Charlotte-Mecklenburg Schools whether to assess the penalty or terminate the contract for breach.

Breach of any contract as listed above shall also be considered in the determination of the lowest responsible bidder in the award of future School Board contracts.

Charlotte- Mecklenburg Schools
M/W/SBE Documentation Overview

Form	Submission Requirements	Required Form
Subcontractor / Supplier Identification Form Lists the total dollar amount of such participation by MBEs, WBEs, and SBE subcontractors and suppliers the Bidder **will use** on the project.	Due with bid/proposal	Minority, Women, and Small Business Enterprise Identification Form
Listing of Good Faith Efforts (GFE) Indicates the actions you undertook to recruit and solicit minority vendors, subcontractors, vendors, or suppliers for this project.	Due with bid/proposal (if subcontracting)	Affidavit A
Intent to Perform Contract with Own Workforce Indicates that the Bidder does not customarily subcontract elements of this type project, normally performs all elements of work on this project with his/her own current work force **AND** will not purchase any materials or supplies in the performance of the contract.	Due with bid/proposal (self-performing)	Affidavit B
Portion of Work to be Performed by M/W/SBE Firms Identifies minority participation that is equal to or greater than the M/W/SBE total goal for construction 21%, Other Services 14%, and/or Goods 11% of the bidders total contract price (See form for additional information). **Appendix I is signed by the M/W/SBE**.	Within three (3) business days after notification of being the **apparent low bidder** Appendix I is submitted upon substantial completion of the project.	Affidavit C and Appendix I
Documentation of Good Faith Efforts (GFE) Indicates GFEs of bidders who do not achieve the total M/W/SBE goal for construction 21%, Other Services 14%, and/or Goods 11% participation by M/W/SBEs. Documentation provided should correspond with the items checked on Affidavit A. **Appendix I is signed by the M/W/SBE firms.**	Within three (3) business days after notification of being the **apparent low bidder** Appendix I is submitted upon substantial completion of the project.	Affidavit D and Appendix I
Professional Services Indicates the minimum percent of the total dollar amount of the contract with M/W/SBEs. **Appendix I is signed by the M/W/SBE firms.**	Within three (3) business days after receiving Letter of Commitment	Appendix I, II and/or III
Documentation for All Contract Payments Contractor shall provide with each pay request to CMS all payments to contractors, subcontractors, supplies and service providers.	Must submit with each pay request and final payment	Appendix IV

Minority, Women, and Small Business Enterprise Identification Form

I, _____
(Name of Bidder)

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

Firm Name, Address and Phone #	Work type	*M/W/SBE Category

*M/W/SBE categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**), Small (**S**), or Socially and Economically Disadvantaged (**D**)

The total value of M/W/SBE firms contracting will be ($)_____.

Attach this form and AFFIDAVIT A or this form and AFFIDAVIT B to the Bid

Attach AFFIDAVIT A or AFFIDAVIT B to the Bid

State of North Carolina AFFIDAVIT A – Listing of the Good Faith Effort

County of _____

Affidavit of _____
(Name of Bidder)

I have made a good faith effort to comply under the following areas checked:
Bidder must earn at least 50 points from the Good Faith Efforts list for their bid to be considered responsive.

- ❑ **1 – (10 Points)** 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 Points)** 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 Points)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- ❑ **4 – (10 Points)** 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 Points)** Attended pre-bid meetings scheduled by the public owner.
- ❑ **6 – (20 Points)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- ❑ **7 – (15 Points)** 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 Points)** 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 Points)** 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 Points)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

In accordance with GS143-128.2(d) and Board of Education Policy the undersigned will enter into a formal agreement with the firms listed in the Identification of Minority, Women, and Small Business Participation schedule conditional upon execution of a contract with the Owner. 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, Women, and Small Business Enterprise commitment and is authorized to bind the bidder to the commitment herein set forth.

Date:_____ **Name of Authorized Officer:**_____

Signature:_____

Title:_____

SEAL

State of _____ ***County*** _____

Subscribed and sworn to before me this_____***day of*** _____***20***_____

Notary Public_____***My commission expires***_____

Attach AFFIDAVIT A or AFFIDAVIT B to the Bid

DO NOT USE AFFIDAVIT 'B' UNLESS YOU ARE ONLY PROVIDING LABOR AND NOT PURCHASING ANY MATERIALS OR SUPPLIES

State of North Carolina --AFFIDAVIT B-- Intent to Perform Contract with Own Workforce.

County of _____

Affidavit of _____

_____

_____

(Name of Bidder)

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

(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform **all elements of the work** on this project with his/her own current work forces; **AND** the bidder will not purchase any materials or supplies in the performance of the contract

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:_____

SEAL

State of _____, *County of* _____

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

Notary Public _____

*My commission expires*_____

State of North Carolina --- AFFIDAVIT C --- Portion of the Work to be Performed by M/W/SBE Firms

County of _____

****** (NOTE: THIS FORM IS TO BE SUBMITTED ONLY BY THE APPARENT LOWEST RESPONSIVE BIDDER) ******

If the portion of the work to be executed by M/WBE firms as defined in GS143-128.2(g) and Board of Education M/W/SBE Policy is equal to or greater than the M/W/SBE aspirational goal of MBE 10%, WBE 6%, and SBE 5% in **Construction**, and/or MBE 5%, WBE 4%, and SBE 5% in **Other Services** and/or MBE 3%, WBE 3%, and SBE 5% in **Goods** participation of the bidders total contract price, then the bidder must complete this affidavit. This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being the **apparent low** bidder.

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

(Project Name)

Project ID#_____ Amount of Bid $_____

I will expend a minimum of _____% of the total dollar amount of the contract with minority, women, or small business enterprises. M/W/SBEs 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 Address	*M/W/SBE Category	Work description	Dollar Value

*M/W/SBE categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) Native American Indian (**N**), Female (**F**) Socially and Economically Disadvantaged (**D**), Small (**S**)

In accordance with GS143-128.2(d) and Board of Education Policy the undersigned will enter into a formal agreement with the 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 contract. The undersigned hereby certifies that he or she has read the terms of the Minority, Women, and Small Business Enterprise commitment and is authorized to bind the bidder to the commitment herein set forth.

Date:_____ **Name of Authorized Officer:**_____

SEAL

Signature:_____
Title:_____
State of _____, **County of** _____

Subscribed and sworn to before me this _____day of _____20_____

Notary Public_____

My commission expires_____

State of North Carolina **AFFIDAVIT D – Good Faith Efforts**

Project: _____ **County of** _____

If the aspirational goal of MBE 10%, WBE 6%, and SBE 5% in **Construction**, and/or MBE 5%, WBE 4%, and SBE 5% in **Other Services** and/or MBE 3%, WBE 3%, and SBE 5% in **Goods** participation by M/W/SBE businesses **is not** achieved, the apparent lowest responsible, responsive bidder shall provide the following documentation to the Owner of his good faith efforts **and** the M/W/SBE firms that **will** be used on the project. This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being the **apparent low** bidder.

(Name of Bidder)

Affidavit of: _____

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

I will expend a minimum of _____% of the total dollar amount of the contract with minority, women, or small business enterprises. M/W/SBEs 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 Address	*M/W/SBE Category	Work description	Dollar Value

*M/W/SBE categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**), Small (**S**)

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) M/W/SBE firms from the source list provided by the State for each subcontract to be let under this contract. 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. Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.

G. Letter detailing reasons for rejection of minority business due to lack of qualification.

H. 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:_____

SEAL

State of _____*, County of* _____

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

*Notary Public*_____*My commission expires* _____

APPENDIX I
LETTER OF INTENT TO PERFORM AS A SUBCONTRACTOR OR SUBCONSULTANT
(PROVIDE MATERIALS OR/& SERVICES)

PROJECT: _____
(Project Name)

TO: _____
(Name of Prime Bidder/Architect)

The undersigned intends to perform work in connection with the above project as

_____ Minority Business Enterprise _____ Women's Business Enterprise

_____ Small Business Enterprise

The M/W/SBE status of the undersigned is/is not certified by the City of Charlotte or the Carolinas Minority Suppliers Development Council or other governmental entities. Our M/W/SBE certification number is _____.

The undersigned is prepared to perform the following described work or provide materials or services in connection with the above project (specify in detail particular work items, materials or services to be performed or provided) at the following price: _____.

You have projected the following commencement date for such work, and the undersigned is projecting completion of such work as follows:

Items	Projected Commencement Date	Projected Completion Date

Subcontracting at any tier must be reported and is subject to all M/W/SBE compliance requirements. This form shall be used for M/W/SBE subcontracting at any level.

Date:_____ _____
(Name & Phone No. of M/W/SBE Company)

_____
(Name & Title of Authorized Office)

_____
(Signature)

THE PRIME CONTRACTOR OR ARCHITECT MUST GET THIS FORM COMPLETED BY THE SUBCONTRACTORS/SUPPLIERS

APPENDIX IV

DOCUMENTATION FOR All PAYMENTS TO CONTRACTORS, SUBCONTRACTORS, SUPPLIERS, AND SERVICE PROVIDERS

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: _____

Pay Application #: _____ Period: _____

Current Requested Payment Amount _____

The following is a list of payments to be made to all contractors/suppliers & other providers on this project for the above-mentioned period.

Firm Name and Address	*M/W/SBE Category	Amount to be Paid form this pay Request	Total Payments to date	Total Amount Committed
Totals				

*M/W/SBE categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) Native American Indian (N), Female (**F**), Small (**S**), or Socially and Economically Disadvantaged (**D**)

Date: _____ Approved/Certified By: _____

Name

_____

Title

_____

Signature

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

APPENDIX V
WAIVER REQUEST
FOR GOOD FAITH EFFORTS

PROJECT: _____
COMPANY: _____
ADDRESS: _____
CITY: _____**STATE:**_____**ZIP:** _____
CONTACT PERSON: _____**PHONE NO**: _____
TITLE: _____

The said company request a Full ( ) or Partial ( ) waiver for the M/W/SBE aspirational goals for this particular project for the following reasons:

Signature: _____ Date: _____

CMS USE ONLY

Good Faith Efforts Verified:_____
_____
_____

Request of Waiver Granted: YES (_____) NO (_____)

Comments: _____
_____
_____
_____

M/WBE Administrator: _____ Date:_____

DOCUMENT 00 45 13
BIDDER'S QUALIFICATIONS

The NC Statute requires that the board or governing body shall award contracts to the lowest responsible bidder. The governing authority has determined that "responsible" refers to the "quality, experience, performance, fitness and capacity of the bidder to satisfactorily perform the proposed work". It is the intent of this document to ensure that appropriate standards of experience, performance and financial integrity will be met, assist in determining "responsibility" and to aid the Owner in selecting the lowest responsible bidder.

Bidders shall complete the entire Bidder's Qualification Questionnaire and submit it with their Bid. Inclusion of any false statement is grounds for immediate disqualification. Failure to submit a completed questionnaire with the Bid may be cause for the Bid to be considered a non-responsive. The Owner reserves the right to waive minor irregularities and to make all final determinations.

The Owner and/or Architect will evaluate the information contained in each applicant's questionnaire and responses received in reference checks. Contractor will be comparatively judged on the basis of, but not limited to, responses to this questionnaire, completion of work similar in scope, performance and quality of work previously completed, organizational capacity, quality of persons and financial criteria. The sole and discretionary judgment of the awarding authority will determine if the applicant is deemed qualified. The Owner may take such reasonable investigations as deemed proper and necessary to determine the ability of the bidder to perform the work/furnish the items(s), and the bidder shall furnish to the Owner all such information and data for this purpose as may be requested. Owner reserves the right to reject any bid if the evidence submitted by, or investigations of, such Bidder fail to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the Contract, complete the work, or furnish the item(s) contemplated therein.

All information provided by the Bidder, will be used only for purposes of qualification, and will not be disclosed except as required by law. Only Bid proposals from qualified Bidders will be considered for award of a Contract.

Each Bidder must have a current and active North Carolina contractor's license at the time of the Bid opening.

The undersigned declares under penalty of perjury that all of the qualification information submitted with this form is true and correct, that the Bidder fully understands this qualification information is being considered for this project only, that being declared non-qualified for this project by the Owner excludes the Bidder from award of this project regardless of an appeal being filed, and that this declaration was executed in _____County, North Carolina, on _____ .

(Name and Title) printed or typed	(Telephone Number)
(Signature)	(FAX Number)
(Firm Name)	(Type of Firm)
(Address)	(Tax I.D. or SSN for sole proprietorships)
(City, State, Zip Code)	(Date Firm Established)

Bidder must answer all of the following questions and provide all requested information, where applicable. If the answer to any question is "none" or if the question is not applicable, please state in writing. Any Bidder failing to do so may be deemed non-responsive with respect to this qualification at the sole discretion of the Owner. All information submitted for qualification evaluation will be considered official information acquired in confidence, the Owner will maintain its confidentiality to the extent permitted by law. If the Bidder can refute some of the facts upon which the decision was based, the Bidder can ask the Owner to appeal the decision in accordance with the appeal procedure contained in Appendix "A" of the qualification document. (See Appendix A for details). The Bidder agrees and acknowledges that being rendered not qualified applies to this project. Bidder further agrees that once the Owner considers the Bidder "not qualified", award cannot be made to the Bidder on this project regardless of an appeal being filed. The decision of the Owner on an appeal is final and not appealable.

Bidder further authorizes the Charlotte-Mecklenburg Board of Education or its Designee to contact any entity named in the qualification document for purposes of verifying the information supplied by the contractor. A copy of this authorization shall have the same force and effect as the original.

PART A: ESSENTIAL REQUIREMENTS FOR QUALIFICATION

Complete Part A before proceeding to Part B

1. Contractor possesses a valid and current unlimited North Carolina General Contractor's license for the work proposed at the time of bid.

   YES☐ NO☐

2. Contractor has ~~a~~ minimum liability insurance coverage as indicated in part B paragraph 8 of this document at the time of bid.

   YES☐ NO☐

3. The Contractor agrees that if they are the apparent low bidder and if requested by the Owner, they will provide their most recent financial statement or other equivalent documentation not more than one year old at the time of the bid to support the financial strength of your company.

   YES☐ NO☐

4. Contractor has current workers' compensation insurance policy as required by the Labor Code and NC General statutes or is legally self-insured pursuant to Labor Code and NC State statutes.

   YES☐ NO☐ ☐ Contractor is exempt from this requirement, because it has no employees

5. Have you attached the surety's statement of intent as requested in paragraph 7b from an admitted surety insurer (approved by the North Carolina Department of Insurance) and authorized to issue bonds in the State of North Carolina, which states that your firm will provide a payment and performance bond sufficient for the project for which you are seeking qualification?

   YES☐ NO☐

6. Contractor has demonstrated school experience as a General Contractor and completed two or more school or university projects of similar size and complexity in North or South Carolina in the last three years.

   YES☐ NO☐

7. Contractor has been "default terminated" by an owner (other than for convenience), or Surety has completed contract within the last five (5) years.

   YES☐ NO☐

8. Contractor has been cited more than twice for failure to pay prevailing wages in the last five (5) years.

   YES☐ NO☐

9. Contractor's license has been revoked at any time in the last five (5) years.

   YES☐ NO☐

10. At the time of submitting this qualification form, is your firm ineligible to bid on or be awarded a public works contract, or perform as a subcontractor on a public contract.

    YES☐ NO☐

11. At any time during the last five years, has your firm or any of its owners or officers been convicted of a crime involving the awarding of a contract of a government construction project, or the bidding or performance of a government contract?

    YES☐ NO☐

Contractor will be immediately disqualified if answer to either statement 1, 2, 3, 4, 5 or 6 is No.

Contractor will be immediately disqualified if answer to either statement 7, 8, 9, 10 or 11 is YES.

PART B: ORGANIZATION, HISTORY, ORGANIZATIONAL PERFORMANCE, COMPLIANCE WITH CIVIL AND CRIMINAL LAWS

1. **Current Organization and Structure of the Business.** Provide company organizational chart regardless of business structure. Identify total numbers of employees in each position of the organizational chart.

For Firms That Are Corporations:

a. Date incorporated: _____

b. Type of corporation: _____

c. Under the laws of what state: _____

d. Provide all the following information for each person who is either (a) an officer of the corporation (president, vice president, secretary, treasurer), or (b) the owner of at least ten per cent of the corporation's stock.

Name	Position	Years with Company	% Ownership

e. Is this firm a certified M/W/SBE: YES ☐ NO ☐

Indicate certification authority – City of Charlotte ☐ or State of North Carolina ☐

For Firms That Are Partnerships:

a. Date of formation: _____

b. Under the laws of what state: _____

c. Provide all the following information for each partner who owns 10% or more of the firm.

Name	Position	Years with Company	% Ownership

d. Is this firm a certified M/W/SBE: YES ☐ NO ☐

Indicate certification authority – City of Charlotte ☐ or State of North Carolina ☐

For Firms That Are Sole Proprietorships:

a. Date of commencement of business: _____

b. Social security number of company owner: _____

c. Identify every construction firm that the business owner has been associated with (as owner, general partner, limited partner or officer) at any time during the last five years.
NOTE: For this question, "owner" and "partner" refer to ownership of 10% or more of the business, or 10% or more of its stock, if the business is a corporation.

Person's Name	Construction Company	Dates of Person's Participation with Company

d. Is this firm a certified M/W/SBE: YES☐ NO ☐

Indicate certification authority – City of Charlotte ☐ or State of North Carolina ☐

For Firms That Intend to Make a Bid as Part of a Joint Venture:

a. Name of the Joint Venture: _____

b. Date of commencement of joint venture: _____

c. Provide copies of formal joint venture agreement.

d. Provide all of the following information for each firm that is a member of the joint venture that expects to bid on one or more projects:

Name of firm	% Ownership of Joint Venture

e. Is this firm a certified M/W/SBE: YES☐ NO☐

Indicate certification authority – City of Charlotte ☐ or State of North Carolina ☐

2. License

Bidder must be a licensed contractor in North Carolina for the appropriate classification. Submit license number, classification, date issued, and expiration date below.

If submitting as a joint venture, provide this information for each joint venture partner.

a. Name of license holder exactly as on file with the North Carolina Contractors State License Board:

_____

b. License number: _____

c. License classification: _____

d. Date issued: _____

e. Expiration date: _____

f. Has the license ever been revoked or suspended? (Applies to all parties of a joint venture) YES☐ NO☐

If yes, provide explanation (include dates, alleged misconduct finings and terms of the revocation or suspension).

_____

g. Has a complaint ever been filed with the Contractors State License Board against your company that required a formal hearing or inquiry? YES☐ NO☐

If yes, provide explanation:

h. Have you ever been licensed in North Carolina under a different name or license number? YES☐ NO☐

If yes, provide name and/or license number. _____

Was that license ever revoked or suspended? YES☐ NO☐

If yes, provide explanation.

i. List all North Carolina construction license numbers, classifications and expiration dates of the North Carolina contractor licenses held by your business.

j. If any of your firm's license(s) are held in the name of a corporation or partnership, list below the names of the qualifying individual(s) listed on the North Carolina licensing boards' records who meet(s) the experience and examination requirements for each license. Provide resume of each individual listed and organizational position they hold in your company.

3. Construction Experience and References

a. Complete a **Type of Project** form using Exhibit "A" for five **(5)** of your firm's projects that were similar in building size, structure, contract value and complexity to the proposed project completed **within the last three years**. Two of the five (5) must be North Carolina or South Carolina school or university projects.

b. Provide a separate list of other School or University projects and/or public works projects you have completed in the past 3 years. Provide name of project, name of owner, brief project description, and dollar value of contract.

c. Was there any inspection failure charges charged to your permit account by Mecklenburg Code Enforcement officers? YES☐ NO☐

d. What is your companies Mecklenburg County inspection failure rate for the last year _____%

e. Furnish a client reference list for each project identified in (3a) using Exhibit "B" Pages 1 & 2.

4. Current workload and capacity to contract for this project. Provide the information in each category.

A. Firms average annual work $ volumes in past three years.	B. Firm's current bonding capacity $	C. Total $ amount of work under contract at time of this qualification.	D. Amount of work $ in "C" that will be completed in the next 12 months (months 1-12).	E. Amount of work $ in "C" that will be completed in the following 12 months (months 13 - 24).	F. Amount of new contract awards expected this year to be billed in the next 12 months.	G. Total number of projects in $3-$10 million category completed each year.	H. Total number of projects in $10-$20 million dollar category completed each year.

5. Safety

a. Provide your firm's current worker's compensation Experience Modification Rate (EMR): _____ (office serving this project)

b. Provide your firm's current Incident Recordable Rate (IRR): _____ (office serving this project)

c. Provide your firm's Lost Day Case Rate (LDCR): _____ (office serving this project)

d. Does your firm have a written Safety Program that complies with OSHA requirements? YES☐ NO ☐

If selected, you will be required to provide to Owner a copy of the written program upon owner request.

e. Has NC OSHA, Federal OSHA, NCDEHNR, the EPA or any Air or Water Quality Management District cited your firm for a violation or applicable regulatory requirements in the past five (5) years? YES☐ NO☐

If yes, attach a description of each citation/violation/NOV and final disposition of the action.

f. Please indicate below, the company's required frequency of documented safety meetings on projects constructed by the contractor:

Field Supervisor Weekly ☐ Bi-weekly ☐ Monthly ☐ Less than monthly ☐

Employees	Weekly ☐	Bi-weekly ☐	Monthly ☐	Less than monthly ☐
New Hires	Weekly ☐	Bi-weekly ☐	Monthly ☐	Less than monthly ☐

g. How often do you conduct documented safety inspections?

Quarterly ☐ Semi-annually ☐ Annually ☐

h. Do you have home office safety representatives who visit/audit the job site?

YES☐ NO☐

If yes, how often? Quarterly ☐ Semi-annually ☐ Annually ☐

6. Arbitration, Mediation and Litigation History

a. Has your firm had any claims, disputes ending in mediation, arbitration or litigation associated with any project (either by your company or against your company) in the past five years? If yes, attach a description of each such instance including details of total claim amount, settlement amount outcome of the dispute (settlement in the favor of the contractor or other party) and owner's name and phone number.

YES☐ NO☐

b. Has your firm been terminated for cause on any project within the past 10 years? If yes, attach a description of each instance.

YES☐ NO☐

7. Surety Bid, Performance and Payment Bonds are required for this contract

a. Please provide the following Bonding company information:

Name of Bonding Company/Surety: _____

Name of Surety Agent: _____

Surety Agent Address: _____

Surety Agent telephone number: _____

Is Surety a North Carolina-admitted surety? YES☐ NO☐

Is surety listed in the current edition of the North Carolina Department of the Treasury's Listing of approved sureties? YES☐ NO☐

Is surety approved to conduct business in the state of North Carolina? YES☐ NO☐

List surety's A.M. Best Rating: _____ (**A rating less than A is not acceptable**)

How long has the named surety provided bonding for your firm in its present name or other names of the business noted in paragraph 2? _____

In the past has your firm requested and received bonding from the named surety on projects of similar size, scope and value to the project being bid? _____

b. Provide a completed and signed copy of the surety's Statement of Intent included as Exhibit 'C' at the end of this section.

c. List below the surety companies utilized by your firm in the last three (3) years. List the surety's name, address, year used, and the number of times the surety had to complete any part of bidder's work. Provide information on a company letterhead if more space is needed. If there has been more than one surety, list reason for change.

Period **# Jobs**

Surety Name	Address (City and State)	Covered (Year)	Surety Completed

Attach a letter dated within the last 30 days from your surety company or its agent licensed to do business in North Carolina, verifying your company's capability and capacity based on your current value of work for providing sufficient performance and payment bonds for this project. Attach a copy of the surety's power of attorney. (See Exhibit "C")

8. Insurance

The successful bidder for this project will be required to furnish certificates of general liability insurance on the District's form in the minimum amounts of $1,000,000 per occurrence and $2,000,000 annual aggregate, and $1,000,000 business automobile liability and workman's compensation at the statutory requirements of the State of NC.

a. Provide a copy of your company's certificate of insurance from your insurance carriers that demonstrate the contractor is insured to the limits required. Binders are not acceptable

b. Have you ever had insurance terminated by a carrier?

YES☐ NO☐ If yes, explain on a separate signed sheet.

c. Please provide the following information for your Worker Compensation insurance:

Agency Name: _____

Contact Name: _____

Phone Number: _____

Carrier: _____

A.M. Best Rating: _____

9. Staff Roster

a. Provide a functional organizational chart identifying key personnel who will manage the project including Principals-in-Charge, Project Managers, Superintendent and Scheduler.

b. List below members of your staff (except clerical staff) who will be assigned to this project, and show their job titles or functions (attach a separate sheet if necessary). Provide a resume for each company officer, Project Manager, Superintendent that will be assigned to this project.

Name	Job Title/Function	Years of Experience in Contracting Firm

List other concurrent construction contracts obligations for staff proposed for this project during the duration of this project.

_____

_____

_____

10. Quality Assurance

a. Does your company currently have a Quality Assurance Program? YES☐ NO☐

b. If yes, provide a copy of your firm's quality assurance program.

c. If yes, provide the name of the contact person in charge of the QA Program.

d. Describe your firm's plan for handling warranty service required on this project during the warranty period.

_____

_____

_____

e. Describe your firm's plan to insure non-conforming work deficiencies identified during the construction of this project are corrected as the work progresses.

_____

_____

_____

f. Describe your firm's experience working with Owner hired third party building system commissioning firms and the processes your firm will use on this project to ensure work is completed and commissioned by the time the project is substantially complete.

_____

_____

_____

11. Prior Disqualification

a. Has your firm has ever been disqualified from performing work for the Charlotte Mecklenburg Board of Education?

YES☐ NO☐

If yes, provide the following information:

1. Project name: _____
2. Date of disqualification: _____
3. Duration of disqualification: _____
4. Reason for disqualification: _____

b. Has your firm has ever been disqualified from performing work for any contracting entity other than the Charlotte Mecklenburg Board of Education:

YES☐ NO☐

If yes, provide the following information:

1. Name and telephone number of contracting entity: _____
2. Project name: _____
3. Date of disqualification: _____
4. Duration of disqualification: _____
5. Reason for disqualification: _____
(Repeat items 11a. and 11b. for each disqualification.)

12. Criminal Matters and Related Civil Suits

a. Has your firm or any of its owners, officers or partners ever been found liable in a civil suit or found guilty in a criminal action for making any false claim or material misrepresentation to any public agency or entity?

YES☐ NO☐

If "yes," explain on a separate signed page, including identifying who was involved, the name of the public agency, the date of the investigation and the grounds for the finding.

b. Has your firm or any of its owners, officers or partners ever been convicted of a crime involving any federal, state, or local law related to construction?

YES☐ NO☐

If "yes," explain on a separate signed page, including identifying who was involved, the name of the public agency, the date of the conviction and the grounds for the conviction.

c. Has your firm or any of its owners, officers or partners ever been convicted of a federal or state crime of fraud, theft, or any other act of dishonesty?

YES☐ NO☐

If "yes," identify on a separate signed page the person or persons convicted, the court (the county if a state court, the district or location of the federal court), the year and the criminal conduct.

13. Lead Renovation Firm Certification

Provide a copy of the current certification as a Lead Renovation Firm by the NC Department of Health and Human Services or state the intention to attain certification and planned date in a letter attached to this questionnaire as a prerequisite to the award for any contract for school renovation and /or demolition project with CMS.

14. CMCSI Certification

Provide a copy of the current certification of the proposed Superintendent's CMCSI Certification (Charlotte Mecklenburg Certified Site Inspector) by Charlotte Engineering & Property Management Department or state the intention to attain certification on a letter attached to this questionnaire as a prerequisite to the award of a contract for construction, renovation and /or demolition herein the project that has a soil and sedimentation plan requirement.

15. OSHA Trained Supervisory Personnel

Contractor will have one (1) OSHA Construction Safety 30 hour trained employee on site at all times. Provide either copies of the current OSHA Construction Safety 30 hour training certification of all proposed full time supervisory personnel or a letter, on the bidder's letterhead, attached to this questionnaire stating the bidder's intention to have at least one of the proposed full time supervisory personnel attain the required OSHA training and certification as a prerequisite to the award of any contract for construction, renovation and /or demolition Letter should include the anticipated date of training and certification.

16. Contractor's Comments

The following space is provided for further explanations of the answers to any questions asked in this Pre-qualification Questionnaire:

_____

_____

_____

_____

_____

I, the undersigned, certify and declare that I have read all the foregoing answers to this qualification questionnaire and know their contents. The matters stated in the questionnaire answers are true of my own knowledge and belief, except as to those matters stated on information and belief, and as to those matters I believe them to be true. I declare under penalty of perjury under the laws of the State of North Carolina, that the foregoing is correct.

Dated: _____

_____
(Signature)

_____
(Printed Name/Title)

Appendix "A"
Request for Contractor Qualifications

A. Suspension, Revocation or Rejection
The Board or its Designee may, for good cause, suspend a contractor from working for CMS or bidding on CMS projects for a specified period of time, revoke a qualification certificate or reject a qualification application submitted by a contractor with any bid solicitation requested by the Board of Education. Causes for suspension, revocation or rejection shall include, but are not limited to, one or more of the following:

(1) Inaccurate or misleading statements in the application.
(2) Declared in default by the Board.
(3) Adjudged to be bankrupt.
(4) Performance, in connection with contract work, becomes unsatisfactory, based on the assertion and recovery of liquidated damages in an action against the contractor.
(5) Payment record, in connection with contract work, becomes unsatisfactory, based on the contractor's failure to comply with the Construction Prompt Pay Act after payment from the owner.
(6) Becomes delinquent on a construction project pursuant to Section B below.
(7) Contractor's license is suspended or revoked.
(8) No longer meets the uniform qualification criteria established in this policy.
(9) Declared unqualified based on information contained in qualification documents submitted with a bid.

B. Delinquency Disqualification
The decision to declare a contractor delinquent or disqualified may be made by the Associate Superintendent of Auxiliary services or his Designee. Should the contractor be determined to be delinquent or disqualified, the Board or its Designee shall notify the contractor in writing, that the contractor is disqualified from bidding, proposing or otherwise receiving consideration, for work with the Board as long as the delinquency exists. A delinquent condition exists when one (1) or more of the following conditions occur without justifiable cause:

(1) A substantial or repeated failure on past or current projects to comply with contract documents after written notice of such non-compliance.
(2) A substantial or repeated failure on past or current projects to provide supervision and coordination of subcontractor's work after written notice of such failure.
(3) Substantial deviation from project time schedules on past or current projects which is not corrected within a reasonable time after written notice of non-compliance.
(4) Substantial or repeated failure to pay subcontractors on past or current projects after the Board has paid the contractor for the work performed by the subcontractors in accordance with approved requisitions for payment.
(5) Substantial or repeated failure on past or current projects to provide the quality for workmanship compatible with the trades' standards for the community after written notice of such failure.
(6) Substantial or repeated failure on past or current projects to comply with the warranty requirements of previous contracts after written notice of such failure.
(7) Failure to maintain the required insurance coverage on past or current projects after written notice of such failure.
(8) Failure to follow safety codes and standards on past or current projects.
(9) Any of the above conditions (1-8) found present in construction work performed for other owners.

C. Appeal

A contractor whose qualification application has been rejected or whose certificate or right to bid has been suspended, revoked or rejected by the Board or its Designee shall be given the benefit of reconsideration and appeal as follows:

1. The contractor may within ten (10) calendar days after receiving notification of such action submit a formal written Notice of Protest to the CMS Associate Superintendent of Auxiliary Services and CMS Building Program Director. The notice shall contain the following information:

   a. Contents: The formal written protest shall contain the following information:
      (1) Project(s) name, number and title.
      (2) The name and address of the protesting party and the title or position of the person submitting the protest.
      (3) A statement of the facts alleged and the rules, regulations, statutes and constitutional provisions entitling the protesting party to relief.
      (4) A statement indicating the relief sought by the protesting party.
      (5) Such other information as the protesting party deems to be material to the issues.

   b. Cost Deposit: The protesting party shall deposit $2,000 in the form of a cashier's check, made payable to the Charlotte Mecklenburg Board of Education.

      (1) Said amount shall be deposited with the Director of Purchasing to defray the costs incurred in considering the protest.
      (2) Said amount shall be recovered if the protesting party shall prevail.

   c. The Board shall act upon the contractor's request within thirty (30) calendar days after the filing and shall notify the contractor of its action to adhere to, modify or reverse its original action. The Board may require additional information to justify the reconsideration.

2. Waiver of Remedies: Failure to file the protest within ten (10) calendar days shall constitute a waiver of the right to seek any remedy provided under the protest procedure.

Exhibit "A"
Type of Project Form
Request for Contractor Qualifications

Complete the following information for similar projects completed **within the last three years** by your firm**.** A maximum of five projects will be evaluated. (Copy additional sheets as needed)

A. Project Name: _____

Address: _____

Date completed: _____

Name of contractor's senior executive in charge of project:

Name of contractor's project manager:

Name of contractor's project superintendent:

Are these individuals still working for your firm? YES☐ NO☐

If yes, provide resume

If no, provide reason for their leaving:

B. Building information:

Gross Square Footage: _____

Project Type: _____

Similarities to the proposed project: _____

_____

C. Owner's / Owner's Representative Name: _____

Contact: _____

Address: _____

Phone number: _____

D. Design Professional Name: _____

Contact: _____

Address: _____

Phone number: _____

G. Your Company's base contract amount: $_____

H. Final contract amount (with your firm): $_____
Explain the difference from Base Contract amount, if any. If any amount of the difference represents a delay claim against the project owner (plus +), or a liquidated damages charge made by the owner (negative -) or other deduction made by the owner against the contractor provide explanation of the charge.

I. Initial contract duration/time: _____ calendar days

J. Final contract duration/time: _____ calendar days

K. Time extensions: _____ calendar days (authorized)

Exhibit "A"
Type of Project Form
Request for Contractor Qualifications

L. Days past contract completion date (exclude authorized time extensions): _____ days. Please explain reason for additional time. Liquidated damages: _____ days

M. How long from date of substantial completion of the project did it take to close out the project and reach final completion: _____ calendar days. Has final payment been made? YES☐ NO☐

N. If this was a multi-prime project, were there any claims made against your firm by other primes or claims made by your firm against other primes? YES☐ NO☐ Provide explanation of each:

_____

_____

O. Were there any pay claims made against your payment or performance bond on this project? YES☐ NO☐ Provide explanation of each:

_____

_____

P. List any major warranty claims made by the owner on this project. Have any warranty calls made by owner gone unaddressed?
YES☐ NO☐

_____

_____

Q. Were any Stop Notices filed by Code Enforcement officials? YES☐ NO☐

If yes, how many Stop Work order were filed and what was the reason for the action?

_____

How much time required to lift the Stop Work order?

_____

R. List the percentage of your contract amount that was paid to:

Minority Firms _____%

Women Owned Business _____%

Total _____%

S. Were there any claims made against your firm for failure to make prompt payment? YES☐ NO☐

T. Were any NOV citations filed by NCDENR or others having jurisdiction on the project? YES☐ NO☐

If yes, describe circumstances and final disposition of the NOV.

Exhibit "B"
Client Reference List
Request for Contractor Qualifications

1. Company Name: _____

Contact Person _____ Telephone _____

Address _____

Description of Services Provided _____

_____

_____

Value of contract: _____

2. Company Name: _____

Contact Person _____ Telephone _____

Address _____

Description of Services Provided _____

_____

_____

Value of contract: _____

3. Company Name: _____

Contact Person _____ Telephone _____

Address _____

Description of Services Provided _____

_____

_____

Value of contract: _____

Exhibit "B"
Client Reference List
Request for Contractor Qualifications

4. **Company Name:** _____

Contact Person _____ Telephone _____

Address _____

Description of Services Provided _____

_____

_____

Value of contract: _____

5. **Company Name:** _____

Contact Person _____ Telephone _____

Address _____

Description of Services Provided _____

_____

_____

Value of contract: _____

Exhibit "C"
Statement of Surety Intent
Request for Contractor Qualifications

To: _____
(Owner)

We are aware of the bid of: _____
(Contractor)

_____
(Address)

For the following project_____

For which bids will be received on _____ and wish to advise that should this bid of the Contractor be accepted and the Contract awarded to said Contractor, it is our present intention to become Surety on the Performance Bond and Labor and Material Payment Bond required by the Contract.

Any arrangement for the Bonds required by the Contract is a matter between the Contractor and ourselves and we assume no liability to you or third parties if for any reason we do not execute the requisite Bonds.

We _____ are duly authorized to do business in the State of North Carolina.
(Name of Surety)

Date: _____ By: _____
(Attorney- in-Fact)

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Section 00 52 13

OWNER-CONTRACTOR CONTRACT

SCHOOL NAME: **CMS Student & Family Support Center**

THIS CONTRACT, in four (4) copies, made this day of , Two Thousand and Eighteen by and between The Charlotte Mecklenburg Board of Education **IF BOND FUNDED** ***as agent for, and on behalf of Mecklenburg County*** (herein referred to as the "Owner"), whose mailing address is Post Office Box 30035, Charlotte, NC 28230 and **{Company.Name}**. (herein referred to as the "Contractor"), whose mailing address is **{Addresses.Address1} {Addresses.City}, {Addresses.State} {Addresses.Zip}**.
Correspondence, submittals, and notices relating to or required under this Contract shall be sent in writing to the above addresses; unless either party is notified in writing by the other, of a change in address.

WITNESSETH:

WHEREAS, it is the intent of the Owner to obtain the services of the Contractor in connection with the construction of **CMS Student & Family Support Center**.

hereinafter referred to as the "Project" or the "Work"; and

WHEREAS, the Contractor desires to perform such construction in accordance with the terms and conditions of this Contract,

NOW, THEREFORE, in consideration of the promises made herein and other good and valuable consideration, the following terms and conditions are hereby mutually agreed to, by and between the Owner and Contractor:

Article 1

DEFINITIONS

1.1 All terms in this Contract which are defined in the Bid documents and the General Conditions shall have the meanings designated therein.

1.2 The Contract Documents are as defined in the General Conditions. Such documents form the Contract, and all are as fully a part thereof as if attached to this Contract or repeated herein.

Article 2

STATEMENT OF THE WORK

2.1 The Project is the Work identified in the plans **(Exhibit C)** and specifications **(Exhibit B)** prepared by **Little Diversified Architectural Consulting** dated **December 8, 2023,** for the Charlotte-Mecklenburg Board of Education. This project involves renovating three existing office buildings (Business Occupancy) for new office, storage, and meeting use (Business, Storage S-1, and Assembly A-3 Occupancies) by Charlotte Mecklenburg schools. The new renovations include constructing the new upfit elements to the requirements of the current Building Code and Accessibility Code, and renovating the existing parking, building access, and remaining portions of the existing buildings to meet the requirements of the current Existing Building Code Section for Accessibility for Change of Occupancy, including the following addenda:

Addendum No:	**Dated:**	

2.2 The parties agree that the Project shall include the following alternates: *If none, delete this language list "None"*

		$
		$
		$
		$
		$
		$
		$

2.3 The parties agree to the following modifications to the Project's plans and specifications, including the noted value engineering items: *If none, delete this language list "None"*

		$
		$
		$
		$
		$
		$
		$

2.4 The Contractor shall provide and pay for all materials, tools, equipment, labor and professional and non-professional services, and shall perform all other acts and supply all other things necessary, to fully and properly perform and complete the Work, as required by the Contract Documents.

2.5 The Contractor shall further provide and pay for all related facilities described in any of the Contract Documents, including all work expressly specified therein and such additional work as may be reasonably inferred therefrom, saving and excepting only such items of work as are specifically stated in the Contract Documents not to be the obligation of the Contractor. The totality of the obligations imposed upon the contractor by this Article and by all other provisions of the Contract Documents, as well as the structures to be built and the labor to be performed, is herein referred to as the "Work".

Article 3

DESIGN CONSULTANT

3.1 The Design Consultant (as defined in the General Conditions) is whose address is , however, that the Owner may, without liability to the Contractor, unilaterally amend this Article from time to time by designating a different person or organization to act as its Design Consultant and so advising the Contractor in writing, at which time the person or organization so designated shall be the Design Consultant for purposes of this Contract.

Article 4

TIME OF COMMENCEMENT AND COMPLETION

4.1 The Contractor shall commence the Work promptly upon the date established in the Notice to Proceed. If there is no Notice to Proceed, the date of commencement of the Work shall be the date of this Contract or such other date as may be established herein.

4.2 Time is of the essence. The Contractor shall achieve Final Completion, as defined in the General Conditions on or before the date established for Final Completion in the Supplementary Conditions.

4.3 The Supplementary Conditions contains certain specific dates that shall be adhered to and are the last acceptable dates unless modified in writing by mutual agreement between the Contractor and the Owner. All dates indicate midnight unless otherwise stipulated. The only exceptions to this schedule are defined in the General Conditions under 8.3 DELAYS AND EXTENSIONS OF TIME.

4.4 Should the Contractor fail to complete the Work on or before the dates stipulated for Substantial Completion and/or Final Completion, or such later date as may result from an extension of time granted by the Owner, he shall pay the Owner, as liquidated damages the sums set forth in the General and Supplementary Conditions.

Article 5

CONTRACT SUM

5.1 Provided that the Contractor shall strictly and completely perform all of its obligations under the Contract Documents, and subject only to additions and deductions by Modification or as otherwise provided in the Contract Documents, the Owner shall pay to the Contractor, in current funds and at the time and in the installments hereinafter specified, the sum of Dollars ($) herein referred to as the "Contract Sum". This amount includes the base bid and the Alternates in Section 2.2, Value Engineering in Section 2.3, and Allowances in Section 5.3. **See Exhibit A Calculation of Contract Award Amount.**

5.2 Unit Prices are established as follows for the Project:

		$
		$
		$
		$
		$
		$
		$

5.3 Allowances included are as follows:

		$
		$
		$
		$
		$
		$
		$

Article 6

PROGRESS PAYMENTS

6.1 The Contractor hereby agrees that on or about the First day of the month for every month during the performance of the Work he will deliver to the Owner's Project Manager an Application for Payment in accordance with the provisions of Article 9 of the General Conditions. This date may be changed upon mutual agreement, stated in writing, between the Owner and Contractor. Payment under this Contract shall be made as provided in the General Conditions. Payments due and unpaid under the Contract Documents shall not bear interest.

Article 7

OTHER REQUIREMENTS

7.1 The Contractor shall submit the Performance Bond, Labor and Material Payment Bond and Certification of Insurance as required by the Contract Documents.

7.2 The Contractor will make a good faith effort to utilize Minority Business per N.C. Gen. Stat. 143-128 as subcontractors in the performance of this Contract.

IN WITNESS WHEREOF, the Charlotte-Mecklenburg Board of Education and the Contractor have executed this Contract on the day and year first written above.

{Company.Name}
Contractor Name

Signature of Authorized Representative

Originator/Fund Owner

This instrument has been preaudited in the manner required by the School Budget and Fiscal Control Act.

Deputy Superintendent of Operations

Finance Officer

APPROVED AS TO FORM:

REVIEWED BY:

School Board Attorney

Division of Insurance and Risk Management

THE CHARLOTTE-MECKLENBURG BOARD OF EDUCATION

Superintendent

THE CHARLOTTE MECKLENBURG BOARD OF EDUCATION CHAIR (if applicable)

SUPPLEMENTARY CONDITIONS

GENERAL CONDITIONS

Document GC, GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, constitutes the General Conditions of this Contract, and is hereinafter called "General Conditions." The General Conditions are further revised and supplemented by the provisions of these Supplementary Conditions. The General Conditions and the Supplementary Conditions are applicable to all of the Work under this Contract and shall apply to the Contractor and all Subcontractors and Sub-subcontractors.

SUPPLEMENTS:

The following supplements modify, change, delete, or add to the General Conditions. Where any article of the General Conditions is modified or any paragraph deleted, subparagraph or clause thereof is modified, or deleted by these supplements, the unaltered provisions of such article, paragraph, subparagraph or clause shall remain in effect. If there is a discrepancy between the General Conditions and these Supplementary Conditions, the Supplementary Conditions shall control.

ARTICLE 8 - TIME

ADD THE FOLLOWING TO PARAGRAPH 8.2:

8.2.5 The schedule below contains certain specific dates in addition to date of Notice to Proceed and Time for Completion. These dates shall be adhered to and are the last acceptable dates unless modified by mutual agreement between the Contractor and the Owner. All dates indicate midnight unless otherwise stipulated. The only exceptions to this schedule are defined in the General Conditions and Supplementary Conditions under Paragraph 8.3 DELAYS AND EXTENSIONS OF TIME.

Notice of Intent to Award – **March 13, 2024**
Return of Owner Contractor Contract by Contractor – **April 1, 2024**
Notice to Proceed - **April 5, 2024**
Substantial Completion 6600 Building: **January 10, 2025**
Substantial Completion 6623 & 6635 Building: **November 15, 2024**
Final Completion (Entire Project): **February 21, 2025**

8.2.5.1 The Owner reserves the right to withhold the issuance of Notice to Proceed by up to thirty (30) days. For each day that Notice to Proceed is withheld pursuant to this Subparagraph, the dates established for Substantial Completion and Final Completion shall be adjusted. The Contractor shall not be entitled to additional compensation if the Owner withholds the issuance of Notice to Proceed pursuant to this Subparagraph.

ADD THE FOLLOWING TO PARAGRAPH 8.5:

8.5.1.1 Substantial Completion Liquidated Damages shall be the sum of **$1,000.00** dollars per calendar day, and this amount shall be assessed in accordance with Subparagraph 8.5.1 of the General Conditions.

8.5.2.1 Final Completion Liquidated Damages shall be the sum of **$1,000.00**dollars per calendar day, and this amount shall be assessed in accordance with Subparagraph 8.5.2 of the General Conditions.

ARTICLE 9 - PAYMENTS AND COMPLETION

ADD THE FOLLOWING TO PARAGRAPH 9.8:

9.8.6.1 Additional services and dispute resolution services by the Design Consultant shall be paid by the Contractor at the rate of **$190.00** dollars per hour.

END OF SUPPLEMENTARY CONDITIONS

This page intentionally blank.

Site Name:

Contractor Responsibility					***** IP Address***	**CMS Responsibility**	
Device	***Device #***	***Device Location***	***Cable ID***	***MAC Address***	***** IP Address***	***Switch ID***	***Switch Port #***

**** IP Address Responsibility is dictated by System Processes Flowchart***

DOCUMENT 00 61 10
PAYMENT BOND

Date of Execution of this bond _____

Name and Address of Principal (Bidder) _____

_____

Name and Address of Surety _____

_____

Name and Address of Contracting Body THE CHARLOTTE-MECKLENBURG COUNTY BOARD OF EDUCATION

a body corporate of the State of North Carolina,

PO Box 30035, Charlotte, North Carolina, 28230-0035

Amount of Bond _____

Contract That certain contract by and between the Principal and the Contracting Body above named dated

_____

_____ for _____

_____

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

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal entered into a certain contract with the Contracting Body, identified as shown above and hereto attached;

NOW THEREFORE, if the Principal shall promptly make payment to all persons supplying labor and material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications and extensions of time of said contract may be here-after be made, notice of which modification and extension of time to the Surety being hereby waived, then this obligation to be void; otherwise, to remain in full force and virtue.

THIS PAYMENT BOND is made and given pursuant to the requirements and provisions of Section 129 of Chapter 143 of the General Statutes of North Carolina and pursuant to Article 3 of Chapter 44-A of the General Statutes of North Carolina, and each and every provision set forth and contained in Article 3 of Chapter 44-A of the General Statutes of North Carolina is incorporated herein, made a part hereof, and deemed to be conclusively written into this Bond.

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

WITNESS:

_____
Principal (Name of individual, and trade Name, partnership, corporation, or joint venture)

_____
(Proprietorship or Partnership)

BY_____(Seal)

TITLE_____
(Owner, Partner, Office held in corporation, joint venture)

(Corporate Seal)

ATTEST (Corporation)
BY_____

TITLE_____
(Corporation Secretary or Assistant Secretary Only)

_____
Surety (Name of Surety Co.)

WITNESS:

BY_____

TITLE _____Attorney in Fact_____

_____

(Corporate Seal of Surety)

_____
(Address of Attorney in Fact)

COUNTERSIGNED:

_____

_____
N.C. Licensed Resident Agent

DOCUMENT 00 61 13
PERFORMANCE BOND

Date of Execution of this bond	_____
Name and Address of Principal (Bidder)	_____
	_____
Name and Address of Surety	_____
	_____
Name and Address of Contracting Body	THE CHARLOTTE MECKLENBURG COUNTY BOARD OF EDUCATION a body corporate of the State of North Carolina PO Box 30035, Charlotte, North Carolina, 28230-0035
Amount of Bond	_____
Contract named dated	That certain contract by and between the Principal and the Contracting Body above
	_____
	_____ for _____
	_____

KNOW ALL MEN BY THESE PRESENTS, that we, the PRINCIPAL and SURETY above named, are held and firmly bound unto the above-named Contracting Body, hereinafter called the Contracting Body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successor, 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 of the Surety, and during the life of any guarantee required under the contract, and shall also well and truly perform and fulfil all the undertakings, covenants, terms, conditions, and agreements of any and all duly authorized modifications of the 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.

THIS PERFORMANCE BOND is made and given pursuant to the requirements and provisions of Section 129 of Chapter 143 of the General Statutes of North Carolina and pursuant to Article 3 of Chapter 44-A of the General Statutes of North Carolina, and each and every provision set forth and contained in Article 3 of Chapter 44-A of the General Statutes of North Carolina is incorporated herein, made a part hereof, and deemed to be conclusively written into this Bond.

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

WITNESS:

_____
Principal (Name of individual, and trade Name, partnership, corporation, or joint venture)

_____
(Proprietorship or Partnership)

BY_____(Seal)

TITLE_____
(Owner, Partner, Office held in corporation, joint venture)

(Corporate Seal)

ATTEST (Corporation)

BY_____

TITLE_____
(Corporation Secretary or Assistant Secretary Only)

_____
Surety (Name of Surety Co.)

WITNESS:

BY_____

TITLE Attorney in Fact

_____

(Corporate Seal of Surety)

_____
(Address of Attorney in Fact)

COUNTERSIGNED:

_____

_____
N.C. Licensed Resident Agent

DOCUMENT 00 62 76.13
STATE AND COUNTY SALES/USE TAX STATEMENT AND CERTIFICATION

Contractor: _____ Sheet #_____

Project Name: _____ For Sales Taxes Paid from: _____to _____

Payment Application Number: _____

Invoice #	Invoice Date	Vendor	Type of Materials	Total Amount of Invoice (w/o Taxes)	NC Tax	Meck. County Tax	Other NC County Tax	Total Taxes
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
TOTALS								

We certify that the above listing includes all materials purchased by us and incorporated into the above referenced project for the period stated, became a permanent part of the project, and that the sales tax shown has been paid. The above represents a complete listing of these sales taxes paid for the pay application number.

SWORN AND SUBSCRIBED BEFORE ME THIS _____ DAY OF _____20____

NOTARY PUBLIC

MY COMMISSION EXPIRES _____

By: _____

Title: _____

END OF DOCUMENT

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SECTION 00 65 14
CERTIFICATION OF ASBESTOS-FREE COMPLIANCE

SCHOOL NAME:_____

PROJECT DESCRIPTION: _____

MECKLENBURG COUNTY, NORTH CAROLINA

The undersigned Contractor hereby certifies that no asbestos-containing materials of any kind were used in the construction of

_____, at _____ North Carolina.

Signed:_____

Name:_____

Title:_____

Date:_____

(Corporate Seal)

Subscribed and sworn before me this

_____ day of _____, 20____

_____
(Notary Public)

END OF DOCUMENT

This page intentionally blank.

SECTION 00 65 15
CERTIFICATION OF DISPOSAL OF MERCURY CONTAINING MATERIALS

SCHOOL NAME: _____

PROJECT DESCRIPTION: _____

MECKLENBURG COUNTY, NORTH CAROLINA

The undersigned Contractor hereby certifies that all mercury containing materials of any kind encountered during the renovation work were removed and properly disposed of during the construction/renovation of

_____, at _____ North Carolina.

Signed: _____

Name: _____

Title: _____

Date: _____

(Corporate Seal)

Subscribed and sworn before me this

_____ day of _____, 20____

_____
(Notary Public)

END OF DOCUMENT

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DOCUMENT 00 65 36
WARRANTY FORM

SCHOOL NAME: _____

PROJECT DESCRIPTION: _____

MECKLENBURG COUNTY, NORTH CAROLINA

The undersigned Contractor hereby warrants, in accordance with the applicable provisions and terms set forth in the Contract Documents, all materials and workmanship incorporated in the _____ contract of the _____ School, _____, Mecklenburg County, North Carolina, against any and all defects due to faulty materials or workmanship or negligence for a period of twelve (12) months, or such longer periods as set forth in the Contract Documents, from the effective date **of this warranty(_____) as defined by the date of substantial completion** . This warranty supercedes any and all dates listed in the enclosed subcontractor warranties thus honoring warranty work one year from the date of substantial completion listed here. This contractor further warrants all work incorporated in this project to remain leak proof and watertight at all points for a period of twenty-four (24) months from the effective date of this Warranty.

This Warranty shall be binding where defects occur due to normal usage conditions and does not cover willful or malicious damage, damage caused by acts of God or other casualties beyond the control of the Contractor.

This Warranty shall be in accordance to other warranties and guarantees set forth in the Contract Documents, and shall not act to constitute a waiver of additional protection of the Owner afforded, where applicable, by consumer protection and product liability provisions of law, and these stipulations shall not constitute waiver of any additional rights or remedies available to the Owner under the law.

Date of Substantial Completion: _____

Signed: _____

Name: _____

Title: _____

Date: _____

(Corporate Seal)

Subscribed and sworn before me this

_____day of _____, 20___

_____
(Notary Public)

DOCUMENT 00 65 37
ROOFING WARRANTY FORM

SCHOOL NAME: _____

PROJECT DESCRIPTION: _____

MECKLENBURG COUNTY, NORTH CAROLINA

KNOW ALL MEN BY THESE PRESENTS, that we, (_____) having installed roofing, flashing, and sheet metal work on _____School under contract between the Charlotte Mecklenburg Board of Education and _____, warrant to the Charlotte-Mecklenburg Board of Education with respect to said work that for a period of two (2) years from date of Substantial Completion of said Work by Charlotte Mecklenburg Board of Education, the roofing membrane, flashing, and sheet metal work shall be watertight and free from all leaks, provided however, the following are excluded from this warranty:

a) Defects or failures resulting from abuse by the Owner.
b) Defects 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, (_____), agree that should any leaks occur in the roofing system we will perform emergency repairs within twenty-four (24) hours notice and perform permanent repairs within thirty (30) days in a manner to restore the roof to a watertight condition by methods such as to restore the work to a condition comparable to that at date of final acceptance, all at no expense to the Owner.

We (_____), further agree that for a period of two (2) years from date of final acceptance referred 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 blisters, wrinkles, fish-mouths, ridges, splits, warped insulation, loose flashing, in such a way as to restore the work to a condition comparable to that at date of final acceptance.

This two (2) year warranty shall be extended one (1) day for each day there has been an established leak and the leak goes without being successfully corrected.

IN WITNESS WHEREOF, we have caused this instrument to be duly executed this ____ day of _____, 20 _____.

_____
(Contractor)

(Seal if a Corporation)

BY: _____
(President)

WITNESS:

_____

_____
(Notary Public)

END OF DOCUMENT

SECTION 00 72 13
GENERAL CONDITIONS

NOTICE OF DISCLAIMER

TAKE NOTICE, that these General Conditions may contain language and Article, Section or Paragraph headings or names which appear similar to or the same as the provisions of the "General Conditions of the Contract for Construction", published by the American Institute of Architects, AIA Document A-201.

TAKE NOTICE, however, that these General Conditions are substantially and materially different in many respects from the AIA Document A-201 and that certain additions, deletions or other modifications have been made to provisions similar to those contained in the AIA Document. This document, further, contains provisions, which do not appear in the AIA document.

The use of any language or Article or Paragraph format similar to or the same as AIA Document A-201 does not constitute an endorsement by the American Institute of Architects of this document.

GENERAL CONDITIONS OF THE
CONTRACT FOR CONSTRUCTION

TABLE OF ARTICLES

1. CONTRACT DOCUMENTS
2. DESIGN CONSULTANT
3. OWNER
4. CONTRACTOR
5. SUBCONTRACTORS
6. WORK BY OWNER OR BY SEPARATE CONTRACTORS
7. MISCELLANEOUS PROVISIONS
8. TIME
9. PAYMENTS AND COMPLETION
10. PROTECTION OF PERSONS AND PROPERTY
11. INSURANCE
12. CHANGES IN THE WORK
13. UNCOVERING AND CORRECTION
14. TERMINATION OF THE CONTRACT
15. DISPUTE RESOLUTION

ARTICLE 1

CONTRACT DOCUMENTS

1.1 DEFINITIONS

1.1.1 AS SHOWN, AS INDICATED, AS DETAILED: These words, and words of like implication, refer to information contained in Drawings and Specifications describing the Work, unless explicitly stated otherwise in the Contract Documents.

1.1.2 CLAIM: A Claim as used in the Contract is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of contract terms, payment of money, a credit against the 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 Owner's construction and repair projects arising out of or relating to the Contract or the construction process.

1.1.3 CONTRACT: The Contract is the sum of all the Contract Documents. The Contract represents the entire

and integrated agreement between the Owner and the Contractor and supersedes all prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification as defined in Paragraph 1.1.4. The Contract may also be referred to in the Contract Documents as “this Contract”, “this Agreement” or “the Agreement”.

1.1.4 CONTRACT DOCUMENTS: The Contract Documents consist of the Owner-Contractor Agreement, the Conditions of the Contract (General and Supplemental Conditions), the Plans, Drawings, and Specifications, and all Addenda thereto issued prior to and all Modifications thereto issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties; (2) a Change Order or a Construction Change Directive issued pursuant to the provisions of Article 12; (3) a written interpretation issued by the Design Consultant pursuant to Paragraph 2.2.7; or (4) a written order for a minor Change in the Work issued pursuant to Section 12.4. The Contract Documents do not include any other documents including but not limited to soils, geotechnical or other reports, surveys and analysis, which may be printed, bound or assembled with the Contract Documents, or otherwise made available to the Contractor for review or information under this Contract, unless specifically enumerated and directly incorporated by reference in the Contract Documents.

1.1.5 HE/HIS: The term He or His is not intended to be gender specific.

1.1.6 MANUFACTURER: An individual, company, or corporation who manufactures, fabricates, or assembles a standard product. A standard product is one that is not made to special design, and if furnished by either direct sale or by contract to the Contractor, Subcontractor or Vendor.

1.1.7 MATERIAL SUPPLIER OR VENDOR: A person or organization who supplies, but who is not responsible for the installation of, materials, products and equipment.

1.1.8 NOTICE: The term Notice as used herein shall mean and include written notice. Notice shall be deemed to have been given when delivered to the address of the person, firm or corporation for whom intended, or to his, their or its duly authorized agent, representative or officer; or when enclosed in a postage prepaid wrapper or envelope addressed to such person, firm or corporation at his, their or its Notice Address and deposited in a United States mailbox by registered or certified mail. To “Notify” means to give Notice. The Notice Addresses for the Owner and Contractor are stated in the Owner-Contractor Agreement and may be changed by a party by giving Notice to the other of such change.

1.1.9 PLANS OR DRAWINGS: All drawings or reproduction of drawings pertaining to the Work.

1.1.10 PRODUCT: The term Product includes materials, systems and equipment.

1.1.11 PROJECT: The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part.

1.1.12 PROPOSAL: A complete and properly signed document whereby the Contractor proposes to provide additional or a reduced scope of construction work on the Project for the sums stipulated therein, supported by data required by the Design Consultant or Owner.

1.1.13 PROVIDE: As a directive to the Contractor, and as pertaining to labor, materials or equipment, "provide" means "furnish and install completely".

1.1.14 SPECIFICATIONS: Descriptions, provisions and requirements, pertaining to method and manner of performing the Work, or to quantities and qualities of materials or equipment to be furnished under terms of the Contract.

1.1.15 WORK: The Work comprises the construction and services required of the Contractor by the Contract Documents and includes all labor, supplies and other facilities or things necessary to produce such construction, and all materials, equipment, and supplies incorporated or to be incorporated in such

construction.

1.2 EXECUTION, CORRELATION AND INTENT

1.2.1 The Contractor and Owner acknowledge that neither these General Conditions, nor any other Contract Document shall be construed against the Owner due to the fact that they may have been drafted by the Owner or the Owner's agent. For the purposes of construing these General Conditions, and any other Contract Document, both the Contractor and the Owner shall be considered to have jointly drafted them.

1.2.2 The Owner-Contractor Agreement shall be signed in not less than three (3) copies by the Owner and Contractor, and each of which shall be deemed an original, but all of which shall constitute one and the same instrument.

1.2.3 By executing the Contract, the Contractor represents that he has visited the site, familiarized himself with the local conditions under which the Work is to be performed, and correlated his observations with the requirements of the Contract Documents.

1.2.4 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work. The Contract Documents are complementary, and what is required by any one shall be as binding as if required by all. Performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results. Words and abbreviations which have well-known technical or trade meanings are used in the Contract Documents in accordance with such recognized meanings unless otherwise specifically defined herein. The table of contents, titles, headings, running headlines and marginal notes contained herein and in said documents are solely to facilitate reference to various provisions of the Contract Documents and in no way affect, limit or cast light upon the interpretation of the provisions to which they refer.

1.2.5 The organization of the Specifications into divisions, sections and articles, and the arrangement of Drawings are for convenience only. The Contractor may subcontract the Work in such divisions as he sees fit consistent with applicable law and he is ultimately responsible for furnishing all of the Work.

1.2.6 Anything shown on the Drawings and not mentioned in the Specifications or mentioned in the Specifications and not shown on the Drawings shall have the same effect as if shown or mentioned respectively in both. Detailed specifications take priority over general specifications and detailed drawings take precedence over general drawings. Any Work shown on one drawing shall be construed to be shown in all drawings. If any portion of the Contract Documents shall be in conflict with any other portion, the various documents comprising the Contract Documents shall govern in the following order of precedence: The Owner-Contractor Agreement; the Supplemental Conditions; the General Conditions; the Specifications; the Drawings. The Contractor shall notify the Design Consultant and the Owner of all such inconsistencies promptly. Any such conflict or inconsistency between or in the Drawings or Specifications shall be submitted by the Contractor promptly to the Owner and Design Consultant and the Design Consultant's decision thereon shall be final and conclusive.

1.2.7 The Contractor agrees that nothing contained in the Contract Documents or any contract between the Owner and the Design Consultant shall create any contractual relationship between the Design Consultant and the Contractor, or between the Design Consultant and any Subcontractor or Sub-subcontractors. The Contractor acknowledges and agrees that this Contract is not intended to create, nor shall any provision be interpreted as creating, any contractual relationship between the Owner or Contractor and any third parties.

1.2.8 The provisions of this Contract cannot be amended, modified, varied or waived in any respect except by a Modification. The Contractor is hereby given notice that no person has authority to orally waive, or to release the Contractor from any of the Contractor's duties or obligations under or arising out of this Contract. Any waiver, approval or consent granted by Modification to the Contractor shall be limited to

those matters specifically and expressly stated thereby to be waived, approved or consented to and shall not relieve the Contractor of the obligation to obtain any future waiver, approval or consent.

1.2.9 Any material or operation specified by reference to published specifications of a Manufacturer, a society, an association, a code, or other published standard, shall comply with requirements of the listed document which is current on date the Owner received bids for the construction of the Project. In case of a conflict between referenced document and the Specifications, Specifications shall govern. In case of a conflict between such listed documents, the one having more stringent requirements shall govern.

1.2.10 The Contractor, if requested, shall furnish an affidavit from each or any Manufacturer certifying that materials or products delivered to the job meets requirements specified.

1.3 OWNERSHIP AND USE OF DOCUMENTS

1.3.1 All Drawings, Specifications and copies thereof furnished by the Design Consultant are and shall remain the property of the Owner. They are to be used by Contractor only with respect to the Project and are not to be used by Contractor on any other project. With the exception of one contract set for each party to the Contract, such documents are to be returned or suitably accounted for to the Owner on request at the completion of the Work. Submission or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of Owner’s rights or the Design Consultant's common law copyright or other reserved rights.

ARTICLE 2

THE DESIGN CONSULTANT

2.1 DEFINITIONS

2.1.1 The term "Design Consultant" or "A/E" or "Architect" or "Engineer" as used or set forth in the Contract Documents, shall mean the entity and its consultants or agents, or their duly authorized representatives, that is responsible for designing or engineering the Work, and performing the activities specified herein, and in the Agreement for Design Consultant Services, including any consultants to said entity or firm acting within the scope of their agreements with the Design Consultant. Such firm or agency and its representatives shall act severally within the scope of particular duties entrusted to them, unless otherwise provided for in the Contract Documents or in the Agreement for Design Consultant Services.

2.1.2 The Design Consultant may be identified in the Owner-Contractor Agreement and is referred to throughout the Contract Documents as if singular in number and masculine in gender. The Design Consultant is further described as and, throughout this document, shall mean one or both of the following:

2.1.2.1 ARCHITECT, a person or other legal entity lawfully licensed to practice architecture in the State wherein the Project is located; or

2.1.2.2 ENGINEER, a person or other legal entity lawfully licensed to practice engineering in the State wherein the Project is located.

2.2 SERVICES OF THE DESIGN CONSULTANT

2.2.1 The Design Consultant will provide certain services as hereinafter described and further described in the Agreement for Design Consultant Services.

2.2.2 Should errors, omissions, or conflicts in the Drawings, Specifications, or other Contract Documents prepared by or on behalf of the Design Consultant be discovered, the Design Consultant will prepare such amendments or supplementary documents and provide consultation as may be required.

2.2.3 The Design Consultant will visit the site at intervals appropriate to the stage of construction to familiarize itself generally with the progress and quality of the Work and to determine in general if the Work is proceeding in accordance with the Contract Documents. The Design Consultant will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work, but it shall make as many inspections as may reasonably be required to fulfill its obligations to the Owner. On the basis of such on-site observations, the Design Consultant and his consultants shall endeavour to guard the Owner against defects and deficiencies in the Work. The Design Consultant will conduct the construction meeting and shall be responsible for preparing accurate and complete minutes of all such meetings and other Project meetings and distributing same to all participants.

2.2.4 The Design Consultant will render written field reports to the Owner in the form required by the Owner relating to the periodic visits and inspections of the Project required by Paragraph 2.2.3.

2.2.5 The Design Consultant will not be responsible for and will not have control or charge of construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, and he will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Design Consultant will not be responsible for or have control or charge over the acts or omissions of the Contractor, Subcontractors, or any of their agents or employees, or any other persons performing any portion of the Work.

2.2.6 The Design Consultant shall at all times have access to the Work wherever it is in preparation or progress.

The Contractor shall provide safe facilities for such access so the Design Consultant may perform his functions under the Contract Documents.

2.2.7 As required, the Design Consultant will render to the Owner, within a reasonable time, interpretations concerning the design and other technical aspects of the Work and the Contract Documents.

2.2.8 All communications, correspondence, submittals, and documents exchanged between the Design Consultant and the Contractor in connection with the Project shall be in the manner prescribed by the Owner. Further, all communications, correspondence, submittals and documents transmitted from the Owner or Design Consultant will be directed to the Contractor and copied to the Owner or Design Consultant.

2.2.9 All interpretations and decisions of the Design Consultant shall be consistent with the intent of and reasonably inferable from the Contract Documents.

2.2.10 The Design Consultant's decisions in matters relating to artistic effect will be final if consistent with the intent of the Contract Documents.

2.2.11 If the Design Consultant observes any Work that does not conform to the Contract Documents, the Design Consultant shall report this observation to the Owner. The Design Consultant will prepare and submit to the Owner and Contractor a list of the Contractor's work which is not in conformance with the Contract Documents.

2.2.12 The Design Consultant has the authority to condemn or reject any or all of the Work on behalf of the Owner when, in its opinion, the Work does not conform to the Contract Documents. Whenever, in the Design Consultant's reasonable opinion, it is considered necessary or advisable for the implementation of the intent of the Contract Documents, the Design Consultant will have the authority to require special inspection or testing of any portion of the Work in accordance with the provisions of the Contract Documents whether or not such portion of the Work be then fabricated, installed or completed.

2.2.13 The Design Consultant will review the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for conformance with the design concept of the Work and for general compliance with the Contract Documents. Such action shall be taken within fourteen (14) days of receipt unless otherwise authorized by the Owner.

2.2.14 The Owner will establish with the Design Consultant procedures to be followed for review and processing of all Shop Drawings, catalogue submittals, project reports, test reports, maintenance manuals, and other necessary documentation, as well as requests for changes and applications for extensions of time.

2.2.15 The Design Consultant will prepare Change Orders and Construction Change Directives when requested by the Owner.

2.2.16 The Design Consultant and the Owner will conduct inspections to determine the dates of Substantial Completion and Final Completion. The Design Consultant will provide a final Certification of Payment.

2.2.17 The Design Consultant will prepare record documents showing significant Changes in the Work made during the construction process, based on neatly and clearly marked-up Drawings, prints, and other data furnished by the Contractor(s) and the applicable Addenda, clarifications and Change Orders which occurred during the Project.

2.2.18 In case of the termination of the employment of the Design Consultant, the Owner may appoint a Design Consultant whose status under the Contract Documents shall be that of the former Design Consultant.

ARTICLE 3

OWNER

3.1 DEFINITION

3.1.1 The Owner is the person or entity identified as such in the Owner-Contractor Agreement and may be referred to throughout the Contract Documents as if singular in number and masculine in gender. The term Owner means the Owner or his authorized representative or agent. The phrase "Owner or its agent" as used in this Agreement, does not include the Separate Contractors or their Subcontractors.

3.1.2 Owner: Charlotte-Mecklenburg Board of Education
Post Office Box 30035
Charlotte, North Carolina, 28230

3.2 INFORMATION, SERVICES AND RIGHTS OF THE OWNER

3.2.1 The Owner will provide administration of the Contract as herein described. The Design Consultant shall also provide aspects of administration of the Contract as herein described or as specified in the Agreement for Design Consultant Services.

3.2.2 The Owner shall at all times have access to the Work whenever it is in preparation or progress. The Contractor shall provide safe facilities for such access.

3.2.3 The Owner shall not be responsible for or have control or charge of the construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs in connection with the Work, and will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents.

3.2.4 The Owner will have authority to require special inspection or testing of portions of the Work to the same extent as the Design Consultant in accordance with Paragraph 2.2.12 whether or not such portion of the Work be then fabricated, installed, or completed. However, neither the Owner's authority to act under Paragraph 3.2.4, nor any decision made by the Owner in good faith either to exercise or not to exercise such authority shall give rise to any duty or responsibility of the Owner to the Contractor, any Subcontractor, any of their agents or employees, or any other person performing any of the Work.

3.2.5 The Owner shall have the authority and discretion to call, schedule, and conduct job meetings to be attended by the Contractor, representatives of his Subcontractors, and the Design Consultant, to discuss such matters as procedures, progress, problems, and scheduling.

3.2.5.1 The Contractor is requested and required to attend job site progress conferences as called by the Design Consultant. The Contractor shall be represented at these job progress conferences by project personnel authorized by the Contractor to make schedule and financial decisions and by project personnel representatives. These meetings shall be open to Subcontractors, Material Suppliers, and any others who can contribute shall be encouraged by the Contractor to attend. It shall be the principal purpose of these meetings, or conferences, to affect coordination, cooperation and assistance in every practical way toward the end of maintaining progress of the Project on schedule and to complete the Project within the specified Contract Time. The Contractor shall be prepared to assist progress of the Work as required in his particular contract and to recommend remedial measures for the correction of progress as may be appropriate. The Design Consultant shall be the coordinator of the conferences and shall preside as chairman.

3.2.5.2 If the Project is awarded as a single prime construction contract, the Design Consultant shall determine which, if any, Subcontractors and/or Material Suppliers shall be required to attend job site progress conferences. The Contractor shall comply with this request and the meeting shall be conducted as described in Subparagraph 3.2.5.1.

3.2.6 The Owner will establish procedures to be followed for processing all Shop Drawings, catalogues, and other project reports, and other documentation, test reports, and close-out manuals.

3.2.7 The Owner and Design Consultant will review all requests for changes and shall implement the processing of Change Orders, including applications for extension of the Contract Time.

3.2.8 The Owner, will not be responsible for the failure of the Contractor to plan, schedule, and execute the Work in accordance with the approved schedule or the failure of the Contractor to meet scheduled Completion Dates or the failure of the Contractor to schedule and coordinate the Work of his own trades and Subcontractors or to coordinate and cooperate with any Separate Contractors.

3.2.9 The Owner, in consultation with the Design Consultant, will review and process all Applications for Payment by the Contractor, including the final Application for Payment.

3.2.10 The Owner and Design Consultant shall not be responsible or liable to Contractor for the acts, errors or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons performing any of the Work or working on the Project.

3.2.11 The Owner shall furnish surveys describing the physical characteristics and legal limitations for the site of the Project, which are in its possession and are relevant to the Work.

3.2.12 The Owner shall secure and pay for necessary easements, required for permanent structures or for permanent changes in existing facilities.

3.2.13 The Owner shall furnish information or services under the Owner’s control with reasonable promptness to avoid unreasonable delay in the orderly progress of the Work.

3.2.14 The Owner will make reasonable efforts to make available for the Contractor's reasonable review, at the Owner's offices or together with the Contract Documents, certain boring logs, geotechnical, soils and other reports, surveys and analyses pertaining to the Project site of which the Owner is aware, has in its possession and are relevant to the Work. Any boring logs that are provided to the Contractor are only intended to reflect conditions at the locations of the borings and do not necessarily reflect site conditions at other locations. Any reports, surveys and analyses provided by Owner are for the Contractor's information only, and their accuracy and completeness are not guaranteed or warranted by the Owner or the Design Consultant, and such reports are not adopted by reference into, nor are they part of the Contract Documents. Notwithstanding any factual statement, conclusion, or any language or recommendations contained in such reports, the Contractor shall not rely upon the accuracy or completeness of any reports, surveys and analyses.

3.2.15 The foregoing rights are in addition to other rights of the Owner enumerated herein and those provided by law.

3.3 OWNER'S RIGHT TO STOP OR TO SUSPEND THE WORK

3.3.1 If the Contractor fails to correct defective Work as required by Section 13.2 or fails to carry out the Work or supply labor and materials in accordance with the Contract Documents, the Owner by a written Notice may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the Owner to stop the Work shall not give rise to any duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity.

3.3.2 The Owner may order the Contractor in writing to suspend, delay, or interrupt all or any part of the Work for such period of time as he may determine to be appropriate for the convenience of the Owner.

3.3.3 If the performance of all or any part of the Work (including the work of the Contractor and its

Subcontractors) is, for an unreasonable period of time, suspended, delayed, or interrupted by an act of the Owner or the Design Consultant , or by failure of any one of them to act within the time specified in this Contract (or if no time is specified, within a reasonable time), an adjustment shall be made for an increase in the actual time required for performance of the Work by the Contractor, due solely to such unreasonable suspension, delay, or interruption and the Contract modified in writing accordingly. However, no Claim shall be made under this Paragraph for any suspension, delay, or interruption pursuant to Paragraph 3.4.1, or for which Claim is provided or excluded under any other provision of this Contract. No Claim under this Paragraph shall be allowed on behalf of the Contractor or its Subcontractors, unless within twenty (20) days after the act or failure to act involved, and for continuing or ongoing acts or failures to act within twenty (20) days of the first day of the act or failure to act, the Contractor submits to the Owner a written statement setting forth, as fully as then practicable, the extent of such Claim, and unless the Claim is asserted in writing within thirty (30) days after the termination of such suspension, delay, or interruption. For continuing or ongoing acts or failures to act, the Contractor shall update its written statement every twenty (20) days until the suspension, delay or interruption is terminated. The Contractor shall waive any and all Claims under this Paragraph 3.3.3 which are not filed in strict conformance with Paragraph 3.3.3. The Contractor shall indemnify, defend and hold the Owner harmless from any Claim by a Subcontractor that is waived because it is not filed in strict conformance with this Paragraph 3.3.3 or any other provision of the Contact regarding Claims.

3.3.4 In the event of a suspension of the Work or delay or interruption of the Work per Paragraph 3.3.3, the Contractor will and will cause his Subcontractors to protect carefully his, and their, materials and Work against damage, loss or injury from the weather and maintain completed and uncompleted portions of the Work as required by the Contract Documents. If, in the opinion of the Owner, any Work or material shall have been damaged or injured by reason of failure on the part of the Contractor or any of his Subcontractors to so protect same, such Work and materials shall be removed and replaced at the expense of the Contractor.

3.3.5 No Claim by the Contractor under Paragraph 3.3.3 shall be allowed if asserted after final payment under this Contract or if it is not asserted in strict conformance with Paragraph 3.3.3.

3.4 OWNER'S RIGHT TO CARRY OUT THE WORK

3.4.1 If the Contractor defaults or otherwise neglects to carry out the Work in accordance with the Contract Documents and fails within ten (10) days after the date written Notice is given by the Owner, with a copy of such Notice sent to the Contractor's Surety, to commence and continue remedy of such default or neglect with diligence and promptness, the Owner may, without prejudice to any other remedy he may have, make good such deficiencies and may further elect to complete all Work thereafter through such means as the Owner may select, including the use of a new contractor pursuant to Paragraph 3.4.2. In such case, the Owner shall provide Notice to the Contractor's Surety and an appropriate Change Order shall be issued deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Design Consultant's additional services made necessary by such default, neglect or failure and any other damages suffered by Owner as a result of Contractor’s breach, including but not limited to Owner’s reasonable attorney’s fees and litigation costs and expenses. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor or its Surety shall pay the difference to the Owner. Notwithstanding the Owner's right to carry out a portion of the Work, warranty, maintenance and protection of the Work remains the Contractor's and Surety's responsibility. Further, the provisions of this Paragraph do not affect the Owner's right to require the correction of defective or non-conforming Work in accordance with Section 13.2.

3.4.2 Whenever the Contractor shall be, and declared by the Owner to be in default under the Contract, the Owner having substantially performed Owner's obligations thereunder, the Surety shall promptly remedy the default, or shall be liable to Owner for damages pursuant to the Performance Bond and as provided by law. Any action by Surety or by Owner against the Surety shall not relieve Contractor of its duties, responsibilities and liabilities to Owner pursuant to the Contract or as allowed by law.

ARTICLE 4

CONTRACTOR

4.1 DEFINITION

4.1.1 The Contractor is the person or organization identified as such in the Owner-Contractor Agreement and may be referred to throughout the Contract Documents as if singular in number and masculine in gender. The term Contractor means the Contractor or his authorized representative, who shall have authority to bind the Contractor in all matters pertinent to the Contract.

4.1.2 The Contract is not one of agency by the Contractor for Owner but one in which Contractor is engaged independently in the business of providing the services and performing the Work herein described as an independent contractor.

4.2 REVIEW OF CONTRACT DOCUMENTS

4.2.1 The Contractor represents that prior to executing this Contract, the Contractor carefully reviewed and studied the Contract Documents and notified the Owner and Design Consultant of any errors, inconsistencies or omissions of which the Contractor is aware. The Contractor agrees to continuously and carefully study and compare the Contract Documents after the execution of this Contract and shall at once report to the Owner and Design Consultant any error, inconsistency or omission he may discover, including, but not limited to, any requirement which may be contrary to any law, ordinance, rule, regulation, building code, or order of any public authority bearing on the Work. If the Contractor has reported in writing an error, inconsistency or omission, has promptly stopped the affected Work until otherwise instructed, and has otherwise followed the instructions of the Owner, the Contractor shall not be liable to the Owner or the Design Consultant for any damage resulting from any such errors, inconsistencies or omissions in the Contract Documents. The Contractor shall perform no portion of the Work at any time without it being specified in Contract Documents and, where required, approved Shop Drawings, Product Data or Samples for such portion of the Work.

4.2.2 The Contractor and his Subcontractors shall keep at the site of the Work at least one copy of the Drawings and Specifications and shall at all times give the Owner, the Design Consultant, inspectors, as well as other representatives of the Owner access thereto.

4.3 SUPERVISION AND CONSTRUCTION PROCEDURES

4.3.1 The Contractor shall supervise and direct the Work, using his best skill and attention. He shall be solely responsible for and have control over all construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract.

4.3.1.1 It shall be the Contractor's responsibility to schedule the Work; to maintain a progress schedule for the Project; and to notify the Design Consultant and the Owner of any changes in the progress schedule. He shall be responsible for providing adequate notice to all Subcontractors to insure efficient continuity of all phases of the Project. The Contractor is responsible for keeping the Owner and Design Consultant fully informed as to the work progress, including immediate notification of any work progress changes.

4.3.2 The Contractor shall be responsible to the Owner for the acts and omissions of his employees, Subcontractors and Sub-subcontractors, Suppliers, their agents and employees, and other persons performing any of the Work and for their compliance with each and every requirement of the Contract Documents, in the same manner as if they were directly contracted by the Contractor.

4.3.3 The Contractor shall not be relieved from his obligations to perform the Work in accordance with the Contract Documents either by the acts, failures to act or duties of the Owner or the Design Consultant in

their administration of the Contract, or by inspections, tests or approvals (or the lack thereof) required or performed under Section 7.6 by persons other than the Contractor.

4.3.4 Before starting a section of the Work, the Contractor shall carefully examine all preparatory work that has been executed to receive his work to see that it has been completed in accordance with the Contract Documents. He shall check carefully, by whatever means are required, to ensure that his work and adjacent, related work will finish to proper and required standards for quality, contours, planes, and levels.

4.3.5 The Contractor understands and agrees that the Owner and Design Consultant will not be responsible for and will not have control or charge of construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, and they will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Owner and the Design Consultant will not be responsible for or have control or charge over the acts or omissions of the Contractor, Subcontractors, or any of their agents or employees, or any other persons performing any of the Work.

4.3.6 The Contractor shall not use or provide Subcontractor equipment, materials, methods or persons to which Owner and Design Consultant have a reasonable objection and shall remove no portion of the Work or stored materials from the site of the Work, except for defective Work the Contractor may be required to replace or repair as set forth herein.

4.3.7 The Contractor shall verify all grades, lines, levels and dimensions as indicated and shown on the Drawings and in the Specifications prior to beginning any portion of the Work and shall immediately report in writing any errors or inconsistencies to the Design Consultant before commencing that portion of the Work.

4.4. CONTRACTOR'S REPRESENTATIONS

4.4.1 By entering into this Contract with the Owner, the Contractor represents and warrants the following, together with all other representations and warranties in the Contract Documents:

.1 That he is experienced in and competent to perform the type of work required and to furnish the Subcontractors, materials, supplies, equipment and services to be performed or furnished by him;

.2 That he is financially solvent, able to pay his debts as they mature, and possessed of sufficient working capital to initiate and complete the Work required under the Contract;

.3 That he is familiar with all Federal, State, County, municipal and department laws, ordinances, permits, regulations, building codes and resolutions which may in any way affect the Work or those employed therein, including but not limited to any special laws or regulations relating to the Work or any part thereof;

.4 That such temporary and permanent Work required by the Contract Documents will be satisfactorily constructed and fit for use for its intended purpose and that such construction will not injure any person, or damage any property;

.5 That he has carefully examined the Contract Documents and the site of the Work and that from his own investigations, he has satisfied himself and made himself familiar with: (1) the nature and location of the Work; (2) the character, quality and quantity of surface and subsurface materials likely to be encountered, including, but not limited to, all structures and obstructions on or at the Project site, both natural and man-made; (3) the character of equipment and other facilities needed for the performance of the Work; (4) the general and local conditions including without limitation its climatic conditions, the availability and cost of labor and the availability and cost of materials, tools and equipment; (5) the quality and quantity of all materials, supplies, tools, equipment, labor and professional services necessary to complete the Work in the manner required by the Contract

Documents; and (6) all other matters or things which could in any manner affect the performance of the Work;

.6 That he will fully comply with all requirements of the Contract Documents;

.7 That he will perform the Work consistent with good workmanship, sound business practice, and in the most expeditious and economical manner consistent with the best interests of the Owner;

.8 That he will furnish efficient business administration and experienced project management and supervision, and an adequate supply of workers, equipment, tools and materials at all times;

.9 That he has carefully reviewed the Work required and that the Work can be planned and executed in a normal and orderly sequence of Work and reasonably scheduled so as to ensure completion of the Work in accordance with the Contract Documents, allowing for normal and reasonably foreseeable weather, labor and other delays, interruptions and disruptions of the Work;

.10 That he will complete the Work within the Contract Time and all portions thereof within any required Completion Dates;

.11 That his Contract Sum is based upon the labor, materials, systems and equipment required by the Contract Documents, without exception; and

.12 That he and all subcontractors acting on his behalf have obtained and shall retain throughout the duration of this Agreement all required licenses and certifications required in order to perform the work identified in the Contract Documents, that he will not permit any such licenses or certifications to lapse at any time during the course of his work on this Project, and that he and all subcontractors acting on his behalf are fully licensed and certified to perform all work required by the Contract Documents and this Agreement.

4.5 LABOR AND MATERIALS

4.5.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all labor, materials, equipment, supplies, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary or proper for or incidental to the execution and completion of the Work required by and in accordance with the Contract Documents and any applicable code or statute, whether specifically required by the Contract Documents or whether their provision may reasonably be inferred as necessary to produce the intended results, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work. Final payment will not be made until the Work is so completed and Contractor has otherwise complied with the Contract Documents in full.

4.5.2 The Contractor shall at all times enforce strict discipline and good order among his employees and Subcontractors performing any of the Work and shall not employ or contract with on the Work any unfit person or entity or anyone not skilled in the task assigned to him. The Owner may, by Notice, require the Contractor to remove from the Work any employee or employee of a Subcontractor performing any of the Work, that the Owner deems incompetent, careless or otherwise objectionable.

4.5.3 The Contractor shall be responsible for ensuring that the Work is completed in a skillful and workmanlike manner.

4.5.4 All equipment, apparatus and/or devices of any kind to be incorporated into the Work that are shown or indicated on the Drawings or called for in the Specifications or required for the completion of the Work shall be entirely satisfactory to the Owner and the Design Consultant as regards operations, capacity and/or performance. No approval, either written or verbal, of any drawings, descriptive data or samples of such equipment, apparatus and/or device shall relieve the Contractor of his responsibility to turn over the same in good working order for its intended purpose at the completion of the Work in complete

accordance with the Contract Documents. Any equipment, apparatus and/or device not fulfilling these requirements shall be removed and replaced by proper and acceptable equipment, etc. or put in good working order satisfactory to the Owner and Design Consultant without additional cost to the Owner.

4.6 WARRANTY

4.6.1 The Contractor warrants to the Owner and the Design Consultant that all materials and equipment furnished under this Contract will be new unless otherwise specified, and that all workmanship will be in accordance with generally accepted industry standards, free from faults and defects and in conformance with the Contract Documents and all other warranties and guaranties specified therein. Where no standard is specified for such workmanship or materials, they shall be the best of their respective kinds. All Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Owner or the Design Consultant, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. This warranty is not limited by the provisions of Article 13.

4.6.2 The Contractor will be required to complete the Work specified and to provide all items needed for construction of the Project, complete and in good order.

4.6.3 The warranties set forth in this Section 4.6 and elsewhere in the Contract Documents shall survive Final Completion of the Work under Section 9.9.

4.6.4 The Contractor guarantees and warrants to the Owner all Work as follows:

.1 That all materials and equipment furnished under this Contract will be new and the best of its respective kind unless otherwise specified;

.2 That all Work will be in accordance with generally accepted industry standards and free of omissions and faulty, poor quality, imperfect and defective material or workmanship;

.3 That the Work shall be entirely watertight and leak proof in accordance with all applicable industry customs and practices, and shall be free of shrinkage and settlement;

.4 That the Work, including but not limited to, mechanical and electrical machines, devices and equipment, shall be fit and fully usable for its intended and specified purpose and shall operate satisfactorily with ordinary care;

.5 That consistent with requirements of the Contract Documents, the Work shall be installed and oriented in such a manner as to facilitate unrestricted access for the operation and maintenance of fixed equipment;

.6 That the Work will be free of abnormal or unusual deterioration which occurs because of poor quality materials, workmanship or unsuitable storage; and

.7 That the products or materials incorporated in the Work will not contain asbestos.

4.6.5 All Work not conforming to guarantees and warranties specified in the Contract Documents, including substitutions not properly approved and authorized, may be considered defective. If required by the Design Consultant or Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

4.6.5.1 The Contractor will submit a written affidavit certifying that none of the materials incorporated in the Project contain asbestos.

4.6.6 If, within one (1) year after the date of Substantial Completion of the Work or designated portion thereof

as defined in Paragraph 8.1.3 or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be defective, not in accordance with the Contract Documents, or not in accordance with the guarantees and warranties specified in the Contract Documents, the Contractor shall correct it within five (5) working days or such other period as mutually agreed, after receipt of Notice from the Owner to do so. The Owner shall give such Notice with reasonable promptness after discovery of the condition. For items that remain incomplete or uncorrected on the date of Substantial Completion, the one (1) year warranty shall begin on the date of Final Completion of the Work or upon correction of the defective Work.

4.6.7 If at any time deficiencies in the Work are discovered which are found to have resulted from fraud or misrepresentation, or an intent or attempt to or conspiracy to defraud the Owner by the Contractor, any Subcontractor or Supplier, the Contractor will be liable for replacement or correction of such Work and any damages which Owner has incurred related thereto, regardless of the time limit of any guarantee or warranty.

4.6.8 Any materials or other portions of the Work, installed, furnished or stored on site which are not of the character or quality required by the Specifications, or are otherwise not acceptable to the Design Consultant or the Owner, shall be immediately removed and replaced by the Contractor to the satisfaction of the Design Consultant and Owner, when notified to do so by the Design Consultant or Owner.

4.6.9 If the Contractor fails to correct defective or non-conforming Work as required by Paragraph 4.6.6, or if the Contractor fails to remove defective or non-conforming Work from the site, as required by Paragraph 4.6.8, the Owner may elect to either correct such Work in accordance with Section 3.4 or remove and store materials and equipment at the expense of the Contractor. If the Contractor does not pay the cost of such removal and storage within ten (10) days thereafter, the Owner may upon ten (10) additional days written Notice sell such Work at auction or at private sale and shall account for the net proceeds thereof, after deducting all the costs that should have been borne by the Contractor, including compensation for the Design Consultant's additional services and Owner's reasonable attorney's fees made necessary thereby. If such proceeds of sale do not cover all costs, which the Contractor should have borne, the difference shall be charged to the Contractor and an appropriate Change Order shall be issued. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

4.6.10 The Contractor shall bear the cost of making good all of the Work of the Owner, Separate Contractors or others, destroyed or damaged by such correction or removal required under this Article 4, Article 13 or elsewhere in the Contract Documents.

4.7 TAXES

4.7.1 The Contractor shall pay all sales, consumer, use and other similar taxes for the Work or portions thereof provided by the Contractor which are legally enacted at the time the Owner received bids for the construction of the Project, whether or not yet effective.

4.7.2 Sales and Use Tax. Contractor shall be responsible for complying with any applicable sales and use tax obligations imposed by Chapter 105, Article 5 of the North Carolina General Statutes. Where Contractor has been contracted with to oversee "new construction" or "reconstruction" as defined in G.S. 105-164.4H, Contractor shall be responsible for issuing and maintaining an Affidavit of Capital Improvement.

4.8 PERMITS, FEES AND NOTICES

4.8.1 Unless otherwise provided in the Contract Documents, The initial building permit fees required by the Charlotte Mecklenburg Building Standards (CMBS) to commence the work will be paid by the Owner. The Contractor shall, immediately following award of the Contract apply for and secure the building permit and shall secure and pay for all other permits, fees, so as not to delay the progress of the Work. The Contractor shall furnish the Owner with copies of all permits, certificates, licenses, and inspections

necessary for the proper execution and completion of the Work, including, without limitation, all building permits and other similar items. All utility company connection charges (including water & sewer tap, and associated impact fees), assessments or CMBS re-inspection fees as may be imposed by CMBS or inspections fees of any other governmental agency or utility company are included in the Contract Sum and shall be the Contractor's responsibility.

4.8.2 The Contractor is responsible for all fees, permits and other costs associated with temporary utilities, including but not limited to installation, use, disconnection, removal and/or relocation.

4.8.3 The Contractor will pay for his own license, inspection and re-inspection fees for the proper execution and completion of the Work.

4.8.4 The Contractor shall give all notices and comply with all laws, ordinances, rules, regulations and lawful orders of any public authority bearing on the performance of the Work, including but not limited to all applicable building codes. If Contractor believes that any part of the Drawings or Specifications are inconsistent with applicable laws, rules, regulations, lawful orders of public authorities or building codes, Contractor shall Notify the Owner and Design Consultant of such inconsistencies immediately.

4.9 ALLOWANCES

4.9.1 The Contractor shall include in the Contract Sum all Allowances stated in the Contract Documents. Items covered by these Allowances shall be supplied for such amount and by such persons as the Owner may direct, but the Contractor will not be required to employ persons against whom he makes a reasonable objection.

4.9.2 Unless otherwise provided in the Contract Documents:

.1 Allowances for Work: These allowances shall cover the cost to the Contractor for the materials and equipment required by the allowance delivered at the site, all applicable taxes, unloading, uncrating and storage, protection from elements, labor, installation and finishing and other expenses required to complete the installation, time, and a fixed percentage for overhead and profit as defined in Article 12.

.2 Allowances for Products/Materials: Allowance includes the cost of the product, delivery to the site and applicable taxes. The Contractor's costs for unloading and handling on the site, labor, installation, time, overhead, profit and other expenses contemplated for the material allowance shall be included in the Contract Sum and not in the allowance;

.3 Whenever the cost is more than or less than the Allowance, the Contract Sum shall be adjusted accordingly by Change Order, the amount of which will recognize changes, if any, in handling costs on the site, labor, installation costs, overhead, profit and other expense.

4.9 SUPERINTENDENT

4.10.1 The Contractor shall employ, and have approved by the Owner, a competent superintendent and necessary assistants who shall be in attendance at the Project site during the progress of the Work. The superintendent shall represent the Contractor and all communications given to the superintendent shall be as binding as if given to the Contractor. If the Contractor employs more than a single individual in this role, the Owner shall be provided an organizational chart and personnel listing for the staff performing the functions of a superintendent. In such event, all references to the superintendent elsewhere in the Contract Documents shall mean the staff performing the functions of a superintendent.

4.10.2 It is understood that such superintendent shall be acceptable to the Owner and shall be the one who will be continued in that capacity for the duration of the Project, unless he ceases to be on the Contractor's payroll or the Owner otherwise agrees. The superintendent shall not be employed on any other project for or by Contractor or any other entity during the course of the Work. The Contractor, as soon as

practicable after award of the Contract but not more than 14 days after the award of the Contract, shall furnish in writing to the Owner through the Architect the name and qualifications of the proposed project manager and superintendent. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed project manager or superintendent or (2) that the Architect requires additional time to review. Notwithstanding the above, the Owner and Architect reserve the right to notify the Contractor of their reasonable objection to the project manager and/or superintendent based upon their performance or failure to perform their duties and responsibilities.

4.11 PROGRESS SCHEDULE

4.11.1 The Contractor shall prepare and submit to the Owner for the Owner's review and approval an estimated progress schedule for the Work pursuant to the Specifications.

4.12 RESPONSIBILITY FOR COMPLETION

4.12.1 The Contractor shall furnish such manpower, materials, facilities and equipment and shall work the required hours to ensure the performance of the Work within the Completion Dates specified in the Owner-Contractor Agreement.

4.12.2 If it becomes apparent to the Design Consultant or Owner that the Work will not be completed within required Completion Dates, the Contractor agrees to undertake some or all of the following actions, at no additional cost to the Owner, in order to ensure, in the opinion of the Design Consultant and Owner, that the Contractor will comply with all Completion Date requirements:

.1 Increase manpower, materials, crafts, equipment and facilities;

.2 Increase the number of working hours per shift, shifts per working day, working days per week, or any combination of the foregoing, including but not limited to night shifts, overtime operations and Sundays and holidays;

.3 Reschedule activities to achieve maximum practical concurrence of accomplishment of activities;

.4 Require that his superintendent be at the Project site not less than ten (10) hours per day, six (6) days per week; and

4.12.3 In undertaking the actions required under Paragraph 4.12.1, Contractor shall provide and comply with a recovery schedule as set forth in the Specifications.

4.12.4 If the actions taken by the Contractor are not satisfactory, the Design Consultant or Owner may direct the Contractor to take any and all actions necessary to ensure completion within the required Completion Dates, without additional cost to the Owner. In such event, the Contractor shall continue to assume responsibility for his performance and for completion within the required dates.

4.12.5 If, in the opinion of the Design Consultant or Owner, the actions taken by the Contractor pursuant to this Article or the progress or sequence of the Work are not accurately reflected on the construction schedule, the Contractor shall revise such schedule to accurately reflect the actual progress and sequence of the Work.

4.12.6 Failure of the Contractor to substantially comply with the requirements of this Article and the Specifications, may be considered grounds for a determination by the Owner, pursuant to Article 14, that the Contractor is failing to prosecute the Work with such diligence as will ensure its completion within the time specified.

4.12.7 The Owner may, at its sole discretion and for any reason, other than due to the fault of Contractor require

the Contractor to accelerate the Work by providing overtime, Saturday, Sunday and/or holiday work and/or by having all or any Subcontractors designated by the Owner provide overtime, Saturday, Sunday, and/or holiday work. In the event that the Owner requires such acceleration a Change Order shall be issued in accordance with Article 12.

4.12.8 This Section 4.12 does not eliminate the Contractor's responsibility to comply with the local noise ordinances, all highway permit requirements and all other applicable laws, regulations, rules, ordinances, resolutions, and permit requirements.

4.13 DOCUMENTS AND SAMPLES AT THE SITE

4.13.1 The Contractor shall maintain at the site for the Owner one record copy of all Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to record all changes made during construction, and approved Shop Drawings, Product Data and Samples. These shall be delivered to the Design Consultant upon completion of the Work.

4.14 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

4.14.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or any Subcontractor, Manufacturer, Supplier or distributor to illustrate some portion of the Work.

4.14.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate a material, product or system for some portion of the Work.

4.14.3 Samples are physical examples, which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

4.14.4 Manuals are manufacturer's installation, start-up, operating, and maintenance and repair instructions together with parts lists, pictures, sketches and diagrams, which set forth the manufacturer's requirements for the benefit of the Contractor and the Owner.

4.14.5 The Contractor shall prepare or have prepared at its expense and shall review, indicate approval thereupon, and submit, with reasonable promptness and in such sequence as to cause no delay in the Work or in the other work of the Owner or any Separate Contractor, all Shop Drawings, Product Data, Manuals and Samples required by the Contract Documents.

4.14.5.1 Where the Contract calls for the submittal of manufacturer's data to the Design Consultant for information only, such submittals shall be made before the commencement of any portion of the Work requiring such submission. Work performed without benefit of approved Shop Drawings for any portion of the Work is subject to removal and replacement at no cost to the Owner.

4.14.5.2 When the Shop Drawings are checked "revise and resubmit", the Contractor shall make corrections and submit new copies for review. The Shop Drawings shall contain the Contractor’s "approval" and corrections.

4.14.5.3 Contractor shall submit names of proposed Manufacturers, Material Suppliers, dealers, who are to furnish materials, fixtures, appliances or other fittings for approval as early as possible, to afford proper investigation and checking.

4.14.5.4 Whenever item or class of material is specified exclusively by trade name, manufacturer's name, or by catalogue reference, Contractor shall use only such item, unless written approval for substitution is secured. Contractor shall not order materials until receipt of written approval. Contractor shall furnish materials equal in every respect to approved samples.

4.14.6 By approving and submitting Shop Drawings, Product Data, Manuals and Samples, the Contractor represents that he has determined and verified all materials, field measurements, and field construction criteria related thereto, and that he has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents. The Contractor shall adhere to any supplementary processing and scheduling instructions pertaining to Shop Drawings, which may be issued by the Design Consultant.

4.14.6.1 Parts and details not fully indicated on the Drawings shall be detailed by the Contractor in accordance with standard engineering practice. Dimensions on the Drawings, as well as detailed drawings themselves are subject in every case to measurements of existing, adjacent, incorporated and completed, which shall be taken by the Contractor before undertaking any Work dependent on such data.

4.14.7 The Contractor shall not be relieved of responsibility for any deviation from the requirements of the Contract Documents by the Design Consultant's review of Shop Drawings, Product Data, Samples or Manuals unless the Contractor has specifically informed the Design Consultant in writing of such deviation at the time of submission and the Design Consultant has given written approval to the specific deviation. The Contractor shall not be relieved from responsibility to Owner for errors or omissions in the Shop Drawings, Product Data, Samples, or Manuals by virtue of the Design Consultant's review or approval thereof.

4.14.8 The Contractor shall make corrections required by the Design Consultant and shall resubmit the required number of corrected copies of Shop Drawings or new Product Data or Samples. The Contractor shall direct specific attention, in writing on resubmitted Shop Drawings, Product Data or Samples or Manuals, to revisions other than those requested by the Design Consultant on previous submittals. Re-submittals necessitated by required corrections due to Contractor's errors or omissions shall not be cause for extension of Contract Time or an increase in the Contract Sum.

4.14.8.1 No portion of the Work requiring submission of Shop Drawings, Product Data, Samples or Manuals shall be commenced until the submittal has been approved by the Design Consultant as provided in Article 2. All such portions of the Work shall be in accordance with approved submittals.

4.14.9 Shop Drawings, Product Data and Samples shall be dated and shall bear the name of the Project; a description or the names or equipment, materials and items; and complete identification of locations at which materials or equipment are to be installed. Shop Drawings shall be stamped and signed stating that the Contractor has determined and verified all materials, field measurements, and field construction criteria related thereto and that he has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

4.15 EQUAL PRODUCTS AND SUBSTITUTIONS

4.15.1 All materials, supplies and articles furnished under the Contract shall, whenever specified and otherwise practicable, be the standard products of recognized, reputable manufacturers. Unless otherwise specifically provided in the Contract Documents, the naming of a certain brand, make, manufacturer or article, device, product, material, fixture or type of construction shall convey the general style, type, character and standard of quality of the article desired and shall not be construed as limiting competition. The Contractor, in such cases, may with Owner’s written approval, use any brand, make, manufacturer, article, device, product, material, fixture, form or type of construction which in the judgment of the Design Consultant is equal to that specified. An item may be considered equal to the item so named or described if, in the opinion of the Owner and Design Consultant (1) it is at least equal in quality, durability, appearance, strength, and design; (2) it will perform at least equally the specific function imposed by the general design for the Work being contracted for or the material being purchased; and (3) it conforms substantially, even with deviations, to the detailed requirements for the item in the Specifications. Approval by the Owner and Design Consultant will be granted based upon considerations of quality, workmanship, economy of operation, suitability for the purpose intended, warranty and

acceptability for use on the Project.

4.15.2 To obtain such approval on makes or brands of material other than those specified in Contract Documents, and not previously approved at the time the Owner received bids for the construction of the Project, the Contractor's request for approval of any substitution shall include:

.1 Complete data substantiating compliance of the proposed substitution with the Contract Documents;

.2 Product identification including manufacturers' name, address, and phone number;

.3 Manufacturer's literature showing complete product description, performance and test data, and all reference standards;

.4 Samples and colors in the case of articles or products;

.5 Names and addresses of similar projects on which the product was used and date of installation;

.6 For construction methods, include a detailed description for the proposed method and drawings illustrating same;

.7 Itemized comparison of proposed substitution with product or method specified and any cost reduction, which shall benefit the Owner;

.8 Accurate cost data on proposed substitution in comparison with product or method specified;

.9 All directions, specifications, and recommendations by manufacturers for installation, handling, storing, adjustment, and operation; and

.10 Item by item comparison of characteristics of substitution item with those items specified.

4.15.3 The Contractor shall also submit with his request for approval a sworn and notarized statement which shall include all of the following representations by the Contractor, namely that:

.1 He has investigated the proposed product or method and determined that it is equal or better in all respects to that specified and that it fully complies with all requirements of the Contract Documents;

.2 He will meet all contract obligations with regard to this substitution;

.3 He will coordinate installation of accepted substitutions into the Work, making all such changes and any required schedule adjustments, at no additional cost to the Owner, as may be required for the Work to be complete in all respects;

.4 He waives all Claims for additional costs and additional time related to substitutions, which consequently become apparent. He also agrees to hold the Owner harmless from Claims for extra costs and time incurred by other Subcontractors and suppliers, or additional services which may have to be performed by the Design Consultant, for changes for extra work that may, at some later date, be determined to be necessary in order for the Work to function in the manner intended in the Contract Documents;

.5 He will provide the same warranty and guarantee, and perform any work required in accordance therewith, for the substitution that is applicable to the specified item for which the substitution is requested;

.6 Material will be installed, handled, stored, adjusted, tested, and operated in accordance with the manufacturers' recommendation and as specified in the Contract Documents.

.7 In all cases new materials will be used unless this provision is waived by Notice from the Owner or his Design Consultant, or unless otherwise specified in the Contract Documents;

.8 All material and workmanship will be in every respect in accordance with that which, in the opinion of the Owner or Design Consultant, is in conformity with approved modern practice; and

.9 He has provided accurate cost data on the proposed substitution in comparison with the product or method specified.

4.15.4 Subject to the provisions of any applicable laws, approval for substitutions or equal products shall be at the sole discretion of the Owner, shall be in writing to be effective, and the decision of the Owner shall be final. The Owner or Design Consultant may require tests of all materials proposed for substitution so submitted to establish quality standards, at the Contractor's expense. After approval of a substitution, if it is determined that the Contractor submitted defective information or data regarding the substitution upon which Owner's approval was based, and that unexpected or uncontemplated extensive redesign or rework of the Project will be required in order to accommodate the substitution, or that the substituted item will not perform or function as well as the specified item for which substitution was requested, the Contractor will be required to furnish the original specified item or obtain approval to use another substitution; the Contractor shall pay all costs, expenses or damages associated with or related to the unacceptability of such a substitution and the resultant utilization of another item and no time extension shall be granted for any delays associated with or related to such substitution.

4.15.5 If a substitution is approved, no further change in brand or make will be permitted unless satisfactory, written evidence is presented to and approved by the Owner that the manufacturer cannot make scheduled delivery of the approved substituted item. The Owner will not consider substitutions for approval if:

.1 The proposed substitution is indicated or implied on the Contractor's Shop Drawing or product data submittal and has not been formally submitted for approval by the Contractor in accordance with the above-stated requirements, or

.2 Acceptance of the proposed substitution will require substantial design revisions to the Contract Documents or is otherwise not acceptable to the Owner and Design Consultant.

4.15.6 Except as otherwise provided for by the provisions of any applicable laws, the Contractor shall not have any right of appeal from the decision of the Owner rejecting any materials submitted if the Contractor fails to obtain the approval for substitution under this Article.

4.16 USE OF SITE

4.16.1 The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits, easements, right-of-way agreements and within the limits of construction as shown on the Contract Documents. The Contractor shall not unreasonably encumber the site, in the opinion of the Owner, with any materials, equipment or trailers nor shall he block the entrances or otherwise prevent reasonable access to the site, other working and parking areas, completed portions of the Work and/or properties, storage areas, areas of other facilities that are adjacent to the worksite. If the Contractor fails or refuses to move said material, equipment or trailers within twenty four (24) hours of notification by the Owner, to so do, the Owner shall have the right, without further notice, to remove, at the Contractor's expense, any material, equipment and/or trailers which the Owner deems are in violation of this Paragraph.

4.17 CUTTING AND PATCHING OF WORK

4.17.1 The Contractor shall be responsible for all cutting, fitting or patching that may be required to complete the Work or to make its several parts fit together properly and in accordance with the Contract Documents.

4.17.2 The Contractor shall not damage or endanger any portion of the Work or the work of the Owner or any Separate Contractors by cutting, patching or otherwise altering any work, or by excavation. The Contractor shall not cut or otherwise alter the work of the Owner or any Separate Contractor except with the written consent of the Owner and of such Separate Contractor. The Contractor shall not unreasonably withhold from the Owner or any Separate Contractor his consent to cutting or otherwise altering the Work. The Owner shall not be required to accept work with a cut, splice, or patch when such cut, splice or patch is not generally accepted practice for the particular work involved or is otherwise unworkmanlike in the opinion of the Design Consultant or the Owner.

4.17.3 Existing structures and facilities including but not limited to building, utilities, topography, streets, curbs, walks, etc., that are damaged or removed due to required excavations or other construction work, shall be patched, repaired or replaced by the Contractor to satisfaction of the Design Consultant and the Owner of such structures and facilities and authorities having jurisdiction. In event the local jurisdictional authorities require that such repairing and patching be done with their own labor and materials, the Contractor shall abide by such regulations and pay for such work with no increase in the Contract Sum.

4.18 CLEANING UP

4.18.1 The Contractor at all times shall keep the premises free from accumulation of waste materials or rubbish caused by his operations. At the completion of the Work and before final payment is made, he shall remove all his waste materials and rubbish from and about the Project as well as all his tools, construction equipment, machinery and surplus materials.

4.18.2 If the Contractor fails to clean up during or at the completion of the Work, the Owner may do so as provided in Section 6.3 and the cost thereof shall be charged to the Contractor.

4.19 COMMUNICATIONS

4.19.1 All communications from the Contractor relating to the Contract Documents or the construction schedule will be directed to the Design Consultant and copied to the Owner. Similarly, all correspondence from the Owner or Design Consultant will be directed to the Contractor and copied to the Owner or Design Consultant.

4.20 ROYALTIES AND PATENTS

4.20.1 The Contractor shall pay all royalties and license fees. He shall defend all suits or claims for infringement of any patent rights arising out of the Work and shall save the Owner harmless from loss on account thereof.

4.21 INDEMNIFICATION

4.21.1 To the fullest extent permitted by law, the Contractor shall, at its sole cost and expense, indemnify, defend, and hold harmless the Owner and its agents, representatives, and employees from and against all claims, actions, judgments, costs, liabilities, penalties, damages, losses and expenses, including but not limited to attorneys' fees, arising out of and/or resulting from the performance of the Work, provided that any such claim, action, judgment, cost, liability, penalty, damage, loss or expense is caused by any negligent act, error or omission of the Contractor, any Subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be legally liable. The above obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person described in this Section 4.21.1. The parties agree that this indemnification clause is an "evidence of indebtedness" for purpose of N.C. Gen. Stat. § 6-21.2. The parties also specifically acknowledge that the Owner is a public body and it is the intent of the parties that the Owner not incur any expenses when the Contractor is solely responsible for the claims.

4.21.2 In any and all claims against the Owner or the Design Consultant or any of their agents, representatives,

or employees by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this Section 4.21 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

4.21.3 No provision of this Section 4.21 shall give rise to any duties on the part of the Design Consultant or the Owner, or any of their agents, representatives, or employees.

4.22 PERSONS AUTHORIZED TO SIGN DOCUMENTS

4.22.1 The Contractor, within five (5) days after the earlier of the date of a Notice to Proceed or the date of the Owner-Contractor Agreement, shall file with the Owner a list of all persons who are authorized to sign documents such as contracts, certificates, and affidavits on behalf of the Contractor and to fully bind the Contractor to all the conditions and provisions of such documents, except that in the case of a corporation he shall file with the Owner a certified copy of a resolution of the Board of Directors of the corporation in which are listed the names and titles of corporation personnel who are authorized to sign documents on behalf of the corporation and to fully bind the corporation to all the conditions and provisions of such documents.

4.23 CONDITIONS AFFECTING THE WORK

4.23.1 The Contractor shall be responsible for taking all steps necessary to ascertain the nature and location of the Work and the general and local conditions that can affect the Work or the cost thereof. Failure by the Contractor to fully acquaint himself with conditions which may affect the Work, including, but not limited to conditions relating to transportation, handling, storage of materials, availability of labor, water, roads, weather, topographic and subsurface conditions, Multi-Prime Contract conditions, applicable provisions of law, and the character and availability of equipment and facilities needed prior to and during the execution of the Work, shall not relieve the Contractor of his responsibilities under the Contract Documents and shall not constitute a basis for an adjustment in the Contract Sum or the Contract Time under any circumstances. The Owner assumes no responsibility for any understanding or representation about conditions affecting the Work made by any of his officers, employees, representatives, or agents prior to the execution of the Contract, unless such understandings or representations are expressly stated in the Contract Documents.

4.23.2 If in the execution of the Work any valuable items or materials of any kind are discovered buried or hidden within the Work, such items or materials shall be the property of the Owner. The Contractor shall take reasonable precautions to prevent any persons from removing or damaging such items or materials and shall immediately upon discovery thereof and before removal, acquaint the Owner or the Design Consultant with such discovery and carry out, at the expense of the Owner, the Owner's or the Design Consultant's orders as to disposal of the same.

4.24 COMPLIANCE WITH BOARD POLICIES AND PROCEEDURES

The Contractor acknowledges that Board policies are available for review at www.cms.k12.nc.us and agrees to comply with the policies. The Contractor also agrees to comply with the following provisions:

4.24.1 The Contractor, its Subcontractors and employees shall not possess or carry, whether openly or concealed, any gun, rifle, pistol, or explosive on any property owned by the Owner. This includes firearms locked in containers, vehicles or firearm racks within vehicles. The Contractor, its Subcontractors and employees shall not cause, encourage or aid a minor, who is less than 18 years old to possess or carry, whether openly or concealed, any weapons on any property owned by the Owner.

4.24.2 The Contractor, its Subcontractors and employees, are prohibited from profane, lewd, obscene or offensive conduct or language, including engaging in sexual harassment.

4.24.3 The Contractor and its Subcontractors shall not manufacture, transmit, conspire to transmit, possess, use or be under the influence of any alcoholic or other intoxicating beverage, narcotic drug, hallucinogenic drug, amphetamine, barbiturate, marijuana or anabolic steroids, or possess, use, transmit or conspire to transmit drug paraphernalia on any property owned by the Owner.

4.24.4 The Contractor and its Subcontractors may not at any time use or display tobacco or nicotine-containing products, including but not limited to electronic cigarettes (e-cigarettes), on school premises, both indoor and outdoor. The prohibition of the display of tobacco or nicotine products shall not extend to a display that has a legitimate instructional or pedagogical purpose. For purposes of this Contract, "tobacco product" is defined to include cigarettes, cigars, blunts, bidis, pipes, chewing tobacco, snuff, and any other items containing or reasonably resembling tobacco, tobacco products, or any facsimile thereof. "Tobacco use" includes smoking, chewing, dipping, or any other use of tobacco products.

4.24.5 The Contractor, its Subcontractors and employees shall not solicit from or sell to students or staff within the Owner's facilities or campuses, and shall not give gifts of any value to school system employees.

4.24.6 Operators of all commercial vehicles on any property owned by the Owner shall be subject to post-accident, random, reasonable suspicion and follow-up testing for drugs and alcohol.

4.24.7 The Contractor, its Subcontractors and employees are prohibited from using access to the site pursuant to this Agreement as a means to date, court, or enter into a romantic or sexual relationship with any student enrolled in the Charlotte-Mecklenburg Schools. The Contractor agrees to indemnify the Owner for claims against the Owner resulting from relationships which have occurred or may occur between a student and an employee of the Contractor or Subcontractor.

4.24.8 Lunsford Act/Criminal Background Checks. The Contractor shall conduct at its own expense sexual offender registry checks on each of its owners, employees, agents, or Subcontractors ("contractual personnel") who will engage in any service on or delivery of goods to school system property or at a school-system sponsored event, except checks shall not be required for individuals who are solely delivering or picking up equipment, materials, or supplies at: (1) the administrative office or loading dock of a school; (2) non-school sites; (3) schools closed for renovation; or (4) school construction sites.. The checks shall include at a minimum checks of the State Sex Offender and Public Protection Registration Program, the State Sexually Violent Predator Registration Program, and the National Sex Offender Registry ("the Registries"). For the Contractor's convenience only, all of the required registry checks may be completed at no cost by accessing the United States Department of Justice Sex Offender Public Website at http:// www. nsopw.gov/. The Contractor shall provide certification that the registry checks were conducted on each of its contractual personnel providing services or delivering goods under this Agreement prior to the commencement of such services or the delivery of such goods. The Contractor shall conduct a current initial check of the registries (a check done more than 30 days prior to the date of this Agreement shall not satisfy this contractual obligation). In addition, Contractor agrees to conduct the registry checks and provide a supplemental certification before any additional contractual personnel are used to deliver goods or provide services pursuant to this Agreement. Contractor further agrees to conduct annual registry checks of all contractual personnel and provide annual certifications at each anniversary date of this Agreement. Contractor shall not assign any individual to deliver goods or provide services pursuant to this Agreement if said individual appears on any of the listed registries. Contractor agrees that it will maintain all records and documents necessary to demonstrate that it has conducted a thorough check of the registries as to each contractual personnel, and agrees to provide such records and documents to the school system upon request. Contractor specifically acknowledges that the school system retains the right to audit these records to ensure compliance with this Section at any time in the school system's sole discretion. Failure to comply with the terms of this provision shall be grounds for immediate termination of the Agreement. In addition, the Owner may conduct additional criminal records checks at the Owner's expense. If the school system exercises this right to conduct additional criminal records checks, Contractor agrees to provide within seven (7) days of request the full

name, date of birth, state of residency for the past ten years, and any additional information requested by the school system for all contractual personnel who may deliver goods or perform services under this Agreement. Contractor further agrees that it has an ongoing obligation to provide the school system with the name of any new contractual personnel who may deliver goods or provide services under the Agreement. The Owner reserves the right to prohibit any contractual personnel of Contractor from delivering goods or providing services under this Agreement if the Owner determines, in its sole discretion, that such contractual personnel may pose a threat to the safety or well-being of students, school personnel or others.

4.24.9 Contractor shall not employ any individuals to provide services to the Owner who are not authorized by federal law to work in the United States. Contractor represents and warrants that it is aware of and in compliance with the Immigration Reform and Control Act and North Carolina law (Article 2 of Chapter 64 of the North Carolina General Statutes) requiring use of the E-Verify system for employers who employ twenty-five (25) or more employees and that it is and will remain in compliance with these laws at all times while providing services pursuant to this Agreement. Contractor shall also ensure that any of its Subcontractors (of any tier) will remain in compliance with these laws at all times while providing subcontracted services in connection with this Agreement. Contractor is responsible for providing affordable health care coverage to all of its full-time employees providing services to the School System. The definitions of "affordable coverage" and "full-time employee" are governed by the Affordable Care Act and accompanying IRS and Treasury Department regulations.

4.24.10 The Contractor, its Subcontractors and employees shall not interact with any students. Nothing in Paragraph 4.24 shall be construed to prevent the Contractor, its Subcontractors and employees from taking necessary measures to protect students, staff or other employees.

4.24.11 The Contractor shall at all times enforce strict discipline and good order among its employees and shall not employ any unfit person or anyone not skilled in the task assigned to it. The Owner may require the Contractor to remove any employee the Owner deems incompetent, careless or otherwise objectionable.

4.24.12 All agents and workers of the Contractor and its Subcontractors shall wear identification badges provided by the Contractor at all times they are on the Owner's property. The identification badges shall at a minimum display the company name, telephone number, employee name and a picture of the employee.

4.24.13 The Contractor shall comply with the Owner's site or school building access procedures when working on any existing school campus.

4.24.14 Anti-Nepotism. The Contractor warrants that, to the best of its knowledge and in the exercise of due diligence, none of its corporate officers, directors, or trustees and none of its employees who will directly provide services under this Agreement are immediate family members of any member of the Owner's Board of Education or of any principal or central office staff administrator employed by the Owner. For purposes of this provision, "immediate family" means spouse, parent, child, brother, sister, grandparent, or grandchild, and includes step, half, and in-law relationships. Should Contractor become aware of any family relationship covered by this provision or should such a family relationship arise at any time during the term of this Agreement, Contractor shall immediately disclose the family relationship in writing to the Superintendent. Unless formally waived by the Owner, the existence of a family relationship covered by this Agreement is grounds for immediate termination by Owner without further financial liability to Contractor.

4.24.15 Restricted Companies Lists. Contractor represents that as of the date of this Agreement, Contractor is not included on the Final Divestment List created by the North Carolina State Treasurer pursuant to N.C. Gen. Stat. § 147-86.58. Contractor also represents that as of the date of this Agreement, Contractor is not included on the list of restricted companies determined to be engaged in a boycott of Israel created by the North Carolina State Treasurer pursuant to N.C. Gen. Stat. § 147-86.81.

ARTICLE 5

SUBCONTRACTORS

5.1 DEFINITION

5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform any of the Work at the site. The term Subcontractor may be referred to throughout the Contract Documents as if singular in number and masculine in gender and means a Subcontractor or his authorized representative. The term Subcontractor does not include any Separate Contractor or his subcontractors.

5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform any of the Work at the site or who contracts to perform or supply any of the Work under the scope of a Subcontractor's subcontract. The term Sub-subcontractor may be referred to throughout the Contract Documents as if singular in number and masculine in gender and means a Sub-subcontractor or an authorized representative thereof.

5.1.3 Nothing contained in the Contract Documents is intended to, nor shall it create, any contractual relationship between the Owner, the Design Consultant, or any of their agents, consultants, employees, independent contractors, or representatives and any Subcontractor, Sub-subcontractor, Supplier or Vendor of the Contractor, except the relationship between Owner and Contractor, but the Owner shall be entitled to performance of all obligations intended for his benefit, and to enforcement thereof.

5.1.4 The Owner and Design Consultant will not deal directly with any Subcontractor, Sub-subcontractor or Material Supplier. Communication will be made only through the Contractor. Subcontractor, Sub-subcontractors or Material Suppliers shall route requests for information or clarification through the Contractor to the Design Consultant.

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

5.2.1 The Contractor, in compliance with the requirements of the Contract Documents and within ten (10) days after the Notice to Proceed, shall furnish in writing to the Owner the names of the persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work. The Owner will promptly reply to the Contractor in writing stating whether or not the Owner, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner to reply within a reasonable time shall constitute notice of no reasonable objection. The Contractor understands and agrees that no contractual agreement exists for any part of the Work under this Contract between the Owner and any of the Contractor's Subcontractors or Sub-subcontractors. Further, the Contractor understands and agrees that he alone is responsible to the Owner for the Work under this Contract and that any review of Subcontractors or Sub-subcontractors by the Owner will not in any way make the Owner responsible to any Subcontractor, nor responsible for the actions or failures of any Subcontractor or Sub-subcontractor.

5.2.1.1 The Contractor shall identify in the list of names of the Subcontractors proposed, those Subcontractors that are MWSBE Businesses and indicate the portion of the Work that each Subcontractor will perform.

5.2.2 The Contractor shall not contract with any such proposed person or entity to whom the Owner has made reasonable objection under the provisions of Paragraph 5.2.1. The Contractor shall not be required to contract with anyone to whom he has a reasonable objection.

5.2.3 If the Owner has reasonable objection to any proposed person or entity under Paragraph 5.2.1, the Contractor shall name a substitute to whom the Owner has no reasonable objection. The Contract Sum shall be increased or decreased by the difference in cost occasioned by such substitution and an appropriate Change Order shall be issued, subject to an audit of said difference by the Owner; provided,

however, that no increase in the Contract Sum shall be allowed for any such substitution unless the Contractor has acted promptly and responsively in submitting names as required by Paragraph 5.2.1 and the original proposed Subcontractor was: (i) able to carry out his work under his proposed subcontract, (ii) able to comply with all applicable laws, (iii) was an ongoing business in the field of his proposed subcontract, and (iv) had a labor force, capital and a means of supply compatible with the scope of his proposed subcontract.

5.2.4 If the Owner requires a change of any proposed Subcontractor or person or organization previously accepted by him on the Project, the Contract Sum shall be increased or decreased by the difference in cost occasioned by such change and an appropriate Change Order shall be issued, subject to an audit by Owner.

5.2.5 The Contractor shall notify the Owner and the Design Consultant of any substitution for any Subcontractor identified in accordance with Subparagraph 5.2.1.1. The Contractor shall make no substitution for any Subcontractor, person or entity previously selected if the Owner or the Design Consultant makes reasonable objection to such substitution. Also, Contractor may make no substitution of Subcontractors in violation of applicable law.

5.2.6 If during the duration of the Project, the Contractor effects a substitution for any Subcontractor per Paragraph 5.2.5, or if additional subcontract opportunities become available, the Contractor shall make a good faith effort to utilize MWSBE Businesses.

5.3 SUBCONTRACTUAL RELATIONS

5.3.1 By an appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Contract Documents, assumes toward the Owner. Said agreement shall preserve and protect the rights of the Owner under the Contract Documents with respect to the Work to be performed by the Subcontractor so that the subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the agreement between the Contractor and Subcontractor, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by these Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with his Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract, copies of the Contract Documents to which the Subcontractor will be bound by this Section 5.3, and identify to the Subcontractor any terms and conditions of the proposed Subcontract which may be at variance with the Contract Documents. Each Subcontractor shall similarly make copies of such Contract Documents available to his Sub-subcontractors.

5.3.2 The provisions herein regarding Subcontractor approvals shall in no way affect the liability of the Contractor to the Owner regarding performance of all obligations by or payment of Subcontractors. Approval to subcontract with any given Subcontractor shall not to any degree relieve the Contractor of his obligation to perform or have performed to the full satisfaction of the Owner the Work required by this Contract.

5.3.3 The Contractor shall submit Notice to the Owner of any Claims by Subcontractors for which the Owner is believed to be responsible, in strict conformance with the same time requirements and other procedures established for the submission of the Contractor's Claims to the Owner.

5.4 QUALIFICATION SUBMITTALS

5.4.1 Specific qualification submittals may be required of Subcontractors, installers and suppliers for certain critical items of the Work. Required qualification submittals are set forth in detail in the Specifications and shall be collected and submitted by the Contractor for review and approval by the Design Consultant.

All information required of a single Subcontractor, installer or supplier shall be contained in a single, complete submittal.

5.4.2 The Owner and Design Consultant shall reject any proposed Subcontractor, installer or supplier, or any qualification submittals related thereto, for the following reasons:

.1 The Contractor's failure to submit requested information within the specified time; or

.2 The Contractor's failure to provide all of the requested information; or

.3 The Contractor's submission of a Subcontractor, installer or supplier, or qualifications thereof, which are unacceptable in the judgment of the Owner or Design Consultant.

5.4.3 Should the Owner or Design Consultant have reasonable objection to any proposed Subcontractor, installer or supplier, the Contractor shall submit another person or firm who are reasonably acceptable to the Owner and Design Consultant.

5.5 PREPARATORY WORK

5.5.1 Before starting a portion of the Work, the Contractor and the responsible Subcontractor shall carefully examine all preparatory work that has been executed to receive his work. The Subcontractor shall check carefully, by whatever means are required, to ensure that his work and adjacent related work will finish to proper contours, planes and levels. He shall promptly notify the Contractor and the Design Consultant of any defects or imperfections in preparatory work, which will, in any way, affect satisfactory completion of his work. Absence of such notification will be construed as an acceptance of preparatory work and later Claims of defects therein will not be recognized.

5.5.2 Under no conditions shall a portion of the Work proceed prior to preparatory work having been completed, cured, dried, and otherwise made satisfactory to receive such related work. Responsibility for timely installation of all materials rests solely with the Contractor, who shall maintain coordination control at all times.

ARTICLE 6

WORK BY OWNER OR BY SEPARATE CONTRACTORS

6.1 OWNER'S RIGHT TO PERFORM WORK AND TO AWARD SEPARATE CONTRACTS

6.1.1 The Owner reserves the right to perform work related to the Project with his own forces, and to award separate contracts in connection with other portions of the Project or other work on the site under these or similar conditions of the Contract.

6.1.2 When separate contracts are awarded for different portions of the Project or other work on the site, the term Contractor in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

6.2 MUTUAL RESPONSIBILITY

6.2.1 The Contractor shall afford Separate Contractors and the Owner reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work and shall properly connect and coordinate the Work with that of the Owner and other contractors to store his apparatus, materials, supplies and equipment in such orderly fashion at the site of the Work as will not unduly or unreasonably interfere with the progress of the Work or the work of any other contractors.

6.2.1.1 If the execution or result of any part of the Work depends upon any work of the Owner or of any Separate Contractor, the Contractor shall, prior to proceeding with the Work, inspect and promptly report to the Owner in writing any apparent discrepancies or defects in such work of the Owner or of any Separate Contractor that render it unsuitable for such proper execution or result of any part of the Work.

6.2.1.2 Failure of the Contractor to so inspect and report shall constitute an acceptance of the Owner's or Separate Contractor's work as fit and proper to receive the Work, except as to defects which may develop in the Owner's or Separate Contractor's work after completion of the Work and which the Contractor could not have discovered by its inspection prior to completion of the Work.

6.2.2 Should the Contractor cause damage to the Work or property of the Owner or of any Separate Contractor on the Project, or to other work on the site, or delay or interfere with the Owner's work on ongoing operations or facilities or adjacent facilities or said Separate Contractor's work, the Contractor shall be liable for the same; and, in the case of another contractor, the Contractor shall attempt to settle said Claim with such other contractor prior to such other contractor's institution of litigation or other proceedings against the other contractor.

6.2.2.1 Should a Separate Contractor be declared in default by the Owner, the Owner shall not be obligated to hire a contractor to perform the work of the Separate Contractor during the time the Separate Contractor's surety is remedying the default pursuant to Paragraph 3.4.2.

6.2.2.2 If such Separate Contractor sues the Owner or Design Consultant on account of any damage, delay or interference cause or alleged to have been caused by the Contractor, the Owner shall notify the Contractor, who shall defend the Owner and Design Consultant in such proceedings at the Contractor's expense. If any judgment or award is entered against the Owner or Design Consultant in such proceedings, the Contractor shall satisfy the same and shall reimburse the Owner and Design Consultant for all damages, expenses, attorney's fees and other costs which the Owner or Design Consultant incurs as a result thereof.

6.2.3 Should a Separate Contractor cause damage to the Work or to the property of the Contractor or cause delay or interference with the Contractor's performance of the Work, the Contractor shall present directly to said Separate Contractor any Claims it may have as a result of such damage, delay or interference (with an information copied to the Owner) and shall attempt to settle its Claim against said Separate Contractor prior to the institution of litigation or other proceedings against said Separate Contractor.

6.2.3.1 In no event shall the Contractor seek to recover from the Owner or the Design Consultant, and the Contractor hereby waives any Claims against the Owner and Design Consultant relating to any costs, expenses (including, but not limited to, attorney's fees) or damages or other losses incurred by the Contractor as a result of any damage to the Work or property of the Contractor or any delay or interference caused by any Separate Contractor.

6.2.4 Whenever Contractor receives items from another contractor or from Owner for storage, erection or installation, the Contractor receiving such items shall give receipt for items delivered, and thereafter will be held responsible for care, storage and any necessary replacing of item or items received.

6.2.5 When certain items of equipment and other work are indicated as "NIC" (not in contract), or to be furnished and installed under other contracts, any requirements set forth in the Contract Documents for preparation of openings, provision of backing, etc., for receipt of such "NIC" work will be furnished upon written request of the Contractor who shall properly form and otherwise prepare his work in a satisfactory manner to receive such "NIC" work.

6.3 OWNER'S RIGHT TO PERFORM DISPUTED WORK

6.3.1 If a dispute arises between the Contractor and Separate Contractors as to their responsibility for cleaning up as required by Section 4.18 or for accomplishing coordination or doing required cutting, filling, excavating or patching as required by Section 4.17, the Owner may carry out such work and charge the

cost thereof to the responsible party as the Owner shall determine to be just.

6.4 COORDINATION OF THE WORK

6.4.1 By entering into this Contract, Contractor acknowledges that there may be other contractors on the site whose work will be coordinated with that of his own. Contractor expresses, warrants and guarantees that he will cooperate with other contractors and will do nothing to delay, hinder or interfere with the work of other Separate Contractors, the Owner or Design Consultant. Contractor also expressly agrees that, in the event his work is hindered, delayed, interfered with or otherwise affected by a Separate Contractor, his sole remedy will be a direct action against the Separate Contractor as described in this Article 6. Contractor will have no remedy, and hereby expressly waives any remedy, against the Owner and/or the Design Consultant on account of delay, hindrance, interference or other event caused by a Separate Contractor.

ARTICLE 7

MISCELLANEOUS PROVISIONS

7.1 GOVERNING LAW

7.1.1 This Contract shall be governed by the laws of the State of North Carolina. The Contractor and Owner agree that Mecklenburg County, North Carolina shall be the proper venue for any litigation arising out of this Agreement.

7.1.2 Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein and the Contract shall be read and enforced as though it were included herein. If through mistake or otherwise, any such provision is not inserted or is not correctly or fully inserted, then upon the application of either party, the Contract shall forthwith be physically amended to make such insertion.

7.2 SUCCESSORS AND ASSIGNS

7.2.1 The Owner and the Contractor each binds himself, his partners, successors, assigns and legal representatives to the other party hereto and to the partners, successors, assigns and legal representatives of such other party in respect to all covenants, agreements and obligations contained in the Contract Documents. The Contractor shall not assign the Contract or sublet it as a whole without the written consent of the Owner, nor shall the Contractor assign any moneys due or to become due to him hereunder, without the previous written consent of the Owner and the Contractor's Surety.

7.3 CLAIMS AND DAMAGES

7.3.1 Should the Contractor, Subcontractor or any Sub-subcontractor suffer injury or damage to person or property because of any act or omission of the Owner or Design Consultant, or of any of their employees, agents or others for whose acts either is legally liable, the Claim on behalf of the Contractor its Subcontractors or Sub-subcontractors shall be made by giving Notice to the Owner, as provided in Article 15 ; otherwise, the Contractor, Subcontractors and Sub-subcontractors shall have waived any and all rights he may have against the Owner or the Design Consultant, or their employees, representatives and agents. The Contractor shall indemnify, defend and hold the Owner harmless from any Claim by a Subcontractor that is waived because it is not filed in strict conformance with this Paragraph or any other provision of the Contract regarding Claims.

7.4 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

7.4.1 The Contractor shall furnish bonds covering the faithful performance of the Contract and the payment of

all obligations arising thereunder in a form and with a Surety satisfactory to the Owner.

7.4.2 The Contractor is required to furnish in duplicate a Performance Bond and a Labor and Material Payment Bond, each in the amount of one hundred percent (100%) of the Contract Sum, written by a surety company licensed to do business in North Carolina and with a minimum AM Best "A" rating or comparable rating from another service reasonably acceptable to Owner.

7.5 RIGHTS AND REMEDIES

7.5.1 The duties and obligations of the Contractor imposed by the Contract Documents and the rights and remedies of the Owner available thereunder shall be in addition to and not a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law.

7.5.2 Except as may be specifically agreed in writing, the failure of the Owner or the Design Consultant to insist in any one or more instances upon the strict performance of any one or more of the provisions of the Contract, or to exercise any right herein contained or provided by law, shall not be construed as a waiver or relinquishment of the performance of such provisions or right(s) or of the right to subsequently demand such strict performance or exercise such right(s), and the rights shall continue unchanged and remain in full force and effect.

7.5.3 The Contractor agrees that he can be adequately compensated by money damages for any breach of the Contract which may be committed by the Owner and hereby agrees that no default, act, or omission of the Owner or the Design Consultant, except for failure to make progress payments as required by the Contract Documents, shall constitute a material breach of the Contract entitling the Contractor to cancel or rescind the provisions of the Contract or (unless the Owner shall so consent or direct in writing) to suspend or abandon performance of all or any part of the Work. The Contractor hereby waives any and all rights and remedies to which he might otherwise be or become entitled, save only his right to money damages.

7.6 TESTS AND INSPECTIONS

7.6.1 If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any portion of the Work to be inspected, tested, or approved, the Contractor shall give the Owner and Design Consultant timely Notice of its readiness so the Design Consultant and the Owner may observe such inspection, testing or approval. Unless otherwise specifically provided in the Contract Documents, the Contractor shall bear all costs of such inspections, tests or approvals, except that Owner shall pay for "special inspections" as defined and required in Section 1704, the North Carolina State Building Code, or successor section. In the event that such "special inspections" reveal a failure of the Work to comply with the Contract Documents or applicable laws, ordinances, regulations or orders of public authorities having jurisdiction, Contractor shall reimburse the Owner for the costs of such "special inspections".

7.6.1.1 Unless otherwise stipulated in the Contract Documents, the Contractor shall pay for all utilities required for testing of installed equipment of all of his work and work of each Subcontractor. Boiler fuel other than gas shall be provided by Subcontractor furnishing boilers. Labor and supervision required for making such tests shall be provided at no additional cost to the Owner.

7.6.2 If the Design Consultant or the Owner determines that any portion of the Work requires additional inspection, testing, or approval which Paragraph 7.6.1 does not include, the Owner will instruct the Contractor to order such additional inspection, testing or approval, and the Contractor shall give Notice as provided in Paragraph 7.6.1. If such additional inspection or testing reveals a failure of any portion of the Work to comply (1) with the requirements of the Contract Documents, or (2) with respect to the performance of the Work, with laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction, the Contractor shall bear all costs thereof, including compensation for the Design Consultant's and Owner's additional construction management expenses made necessary by such failure.

7.6.3 With regard to inspections and tests, the costs of which the Owner is responsible for paying, they will be made by a pre-qualified, independent testing agency selected by the Owner. The cost of the initial services of such agency will be paid by the Owner. When the initial tests indicate non-compliance with the Contract Documents, any subsequent testing occasioned by non-compliance shall be performed by the same agency and the cost thereof shall be borne by the Contractor. Representatives of the testing agency shall have access to the Work at all times. The Contractor shall provide facilities for such access in order that the agency may properly perform its functions.

7.6.4 The independent testing agency, contracted by the Owner, shall prepare the test reports, logs, and certificates applicable to the specific inspections and tests and promptly deliver the specified number of copies to the designated parties. Certificates of inspection, testing or approval required by public authorities shall be secured by the Contractor and promptly delivered by him to the Owner, in adequate time to avoid delays in the Work or final payment therefore.

7.6.5 If the Design Consultant or the Owner is to observe the inspections, tests or approvals required by the Contract Documents, laws, ordinances, rules, regulations, or order of any public authority having jurisdiction or that are required to establish compliance with the Contract Documents, he will do so promptly and, where practicable, at the normal place of testing.

7.6.6 The Contractor shall pay for and have sole responsibility for inspections or testing performed exclusively for his own convenience.

7.7 UNENFORCEABILITY OF ANY PROVISION

7.7.1 If any provision of this Contract is held as a matter of law to be unenforceable or unconscionable, the remainder of the Contract shall be enforceable without such provision.

7.8 ATTORNEYS' FEES AND OTHER EXPENSES

7.8.1 The Contractor hereby agrees that he will not submit, assert, litigate or otherwise pursue any frivolous or unsubstantiated Claims or Claims he has specifically waived under the terms of the Contract Documents. In the event that the Contractor's or its Subcontractor’s or Sub-subcontractor’s Claims, or any separate item of a Claim, is without substantial justification, the Contractor shall reimburse the Owner or Design Consultant for all costs and expenses associated with defending such Claim or separate item, including but not limited to, attorneys' fees, audit costs, accountants' fees, expert witness' fees, additional Design Consultant expenses, additional construction management expenses, or services and any other consultant costs.

7.8.2 If the Contractor breaches any obligation under the Contract Documents, the Contractor shall reimburse the Owner and Design Consultant for all costs and expenses incurred by the Owner relating to such breach, including but not limited to attorneys' fees, audit costs, accountants' fees, expert witness' fees, additional Design Consultant expenses, additional construction management expenses, and any other consultant costs.

7.8.3 If the Owner or Design Consultant substantially prevails in a Claim brought against the Contractor, or in defending a Claim brought by the Contractor, including but not limited to, Claims for fraud or misrepresentation, overpayment, defective work, delay damages, and recovery of termination expenses, the Contractor shall reimburse the Owner and/or Design Consultant for all costs and expenses incurred by them relating to such Claim, including but not limited to attorneys' fees, audit costs, accountants' fees, expert witness' fees, additional Design Consultant expenses, additional construction management expenses, and any other consultant costs.

ARTICLE 8

TIME

8.1 DEFINITIONS

8.1.1 Unless otherwise provided, the Contract Time is the period of time allotted in the Contract Documents for Final Completion of the Work as defined in Paragraph 8.1.4, including authorized adjustments thereto. The Contractor shall achieve Final Completion within the Contract Time.

8.1.2 The date of commencement of the Work is the date established in the Notice to Proceed. If there is no Notice to Proceed, it shall be the date of the Owner-Contractor Agreement or such other date as may be established therein. The Contractor shall not commence work or store materials or equipment on site until written Notice to Proceed is issued or until the Contractor otherwise receives the Owner's written consent.

8.1.3 The date of Substantial Completion of the Work or designated portion thereof is the date certified by the Design Consultant and the Owner when the Work or a designated portion thereof is sufficiently complete, in accordance with the Contract Documents, so the Owner can fully and legally occupy and utilize the Work or designated portion thereof for the use for which it is intended, with all of the parts and systems operable as required by the Contract Documents, including a test and balance report for the mechanical system. Only incidental corrective work and any final cleaning beyond that needed for the Owner's full use may remain for Final Completion. The Contractor acknowledges and agrees that the intercom, telephone, data security, building automation system (including functional graphics at the site), MATV, and other educational operational systems are required for the Owner’s use of the building for its intended purpose. The Contractor shall provide operation and maintenance manuals to the Owner as required by the Contract Documents prior to Substantial Completion and shall provide the required training on the operation of the equipment and systems within two weeks of Substantial Completion or later date as approved by the Owner. The Contractor shall achieve Substantial Completion by the date specified in the Supplemental Conditions including authorized adjustments thereto. The Owner’s occupancy of incomplete work shall not alter the Contractor’s responsibilities pursuant to this paragraph. Only incidental corrective work and any final cleaning beyond that needed for the Owner’s full use may remain for Final Completion. The issuance of a temporary or final certificate of occupancy shall not, in itself, constitute Substantial Completion.

8.1.4 Final Completion of the Work occurs on the date certified by the Design Consultant and the Owner when the Work is totally complete, to include punch list work, in accordance with the Contract Documents and the Owner may fully occupy and utilize the Work for the use for which it is intended. The issuance of a temporary or final certificate of occupancy shall not, in itself, constitute Final Completion.

8.1.5 The term Day as used in the Contract Documents shall mean calendar day unless otherwise specifically designated. All dates shall mean midnight of the indicated day unless otherwise stipulated.

8.1.6 Completion Dates shall mean the dates set forth in the Supplemental Conditions for Substantial Completion and Final Completion.

8.2 PROGRESS AND COMPLETION

8.2.1 All time limits stated in the Contract Documents are of the essence of the Contract with respect to the Contractor’s performance.

8.2.2 The Contractor shall begin the Work on the date of commencement as defined in Paragraph 8.1.2. He shall carry the Work forward expeditiously with adequate forces and shall achieve Substantial Completion and Final Completion within the time frames stated in the Contract Documents.

8.2.3 Attention is directed to the fact that the Work is urgently needed by the Owner; for this reason, it shall be

agreed that the Contractor and its Subcontractors will achieve Substantial Completion of the Work under the Contract within the time established under Paragraph 8.2.4 of the Supplemental Conditions after award of Contract, or Notice to Proceed, and that he will achieve Final Completion of the Work in all its details for final acceptance within the time established under Paragraph 8.2.4 of the Supplemental Conditions.

8.3 DELAYS AND EXTENSIONS OF TIME

8.3.1 The time during which the Contractor or any of the Subcontractors is delayed in the performance of the Work by the issuance of any required permits, acts of god, excessive inclement weather, fires, floods, epidemics, quarantine restrictions, strikes, riots, civil commotions or freight embargoes, or other conditions beyond the Contractor's or the Subcontractors' control and which the Contractor or the Subcontractors could not reasonably have foreseen and provided against, except for delays caused solely by the Owner, Design Consultant or their consultants, shall be added to the time for completion of the Work stated in the Contract. Neither the Owner nor the Design Consultant shall be obligated or liable to the Contractor or the Subcontractors for indirect or direct damages, costs or expenses of any nature which the Contractor, the Subcontractors, or any other person may incur as a result of any of the delays, interferences, changes in sequence in the Work included in this Section 8.3.1. The Contractor hereby expressly waives any Claims against the Owner and the Design Consultant on account of any indirect or direct damages, lost profits, costs or expenses of any nature which the Contractor, the Subcontractors or any other person may incur as a result of any delays, interferences, changes in sequence or the like, and it is understood and agreed that the Contractor's sole and exclusive remedy in any such events shall be an extension of the Contract time in accordance with the Contract Documents.

8.3.2 In the event Project delays arise from or out of any act or omission of the Owner, Design Consultant or their consultants, the time during which the Project is delayed shall be added to the Contract and the Contractor may be reimbursed for its direct Project damages, excluding general overhead expenses and indirect costs, if the Contractor strictly complies with this Article 8.3. Notwithstanding the previous sentence, if the Contractor or Subcontractor in any way shares in responsibility for the delay, neither the Owner nor the Design Consultant shall be obligated or liable to the Contractor or the Subcontractors for indirect or direct damages, costs or expenses of any nature which the Contractor, the Subcontractors, or any other person may incur as a result of any of the delays, interferences, changes in sequence of the Work, and the Contractor's sole remedy, if any, shall be an extension of the Contract time.

8.3.3 In the event Project delays arise solely from or out of any act or omission of the Contractor, Subcontractors or their agents, the Contractor shall not be entitled to extension of the Contract time and shall be subject to the payment of Liquidated Damages as provided in this Contract.

8.3.4 The Contract time shall be adjusted only for changes pursuant to section 12.1, suspension of the Work pursuant to paragraph 3.3.2 or paragraph 3.3.3, and excusable delays pursuant to paragraph 8.3.4. In the event the Contractor requests an extension of the Contract time or files a Claim related to any form of delay, it shall furnish such justification and supporting evidence as the Owner may deem necessary for a determination of whether or not the Contractor is entitled to an extension of time under the provisions of the Contract, and shall further conform to all of the requirements of the specifications. The burden of proof to substantiate a Claim shall rest with the Contractor, including evidence that the cause was beyond its control. The Owner shall base its findings of fact and decision on such justification and supporting evidence, including a finding that the alleged delay impacted the Project's critical path, and shall advise the Contractor in writing thereof. If the Owner finds that the Contractor is entitled to any extension of the Contract time, the Owner's determination of the total number of days of extension shall be based upon the currently approved progress schedule and on all data relevant to the extension. Such data will be incorporated into the schedule in the form of a revision thereto, accomplished in a timely manner. The Contractor acknowledges and agrees that actual delays (due to said changes, suspension of Work or excusable delays) in activities which, according to the schedule, do not affect the Contract time, do not have any effect upon the Contract time and therefore will not be the basis for a change therein. The Contractor acknowledges and agrees that time extensions will be granted only to the extent that excusable delays exceed the available float in the critical path activities in the Contractor's currently approved schedule.

8.3.4.1 Extensions in the Contract time by Change Orders are subject to extension-in-time audit by the Owner as follows:

8.3.4.1.1 The Contractor agrees that, even though the Owner, Contractor and Design Consultant have previously signed a Change Order containing an extension-in-time resulting from a change in or addition to the Work that said extension in the Contract time may be adjusted by an audit after the fact by the Owner. If such an audit is to be made, the Owner must undertake the audit and make a ruling within thirty (30) days after the completion of the Work under the Change Order.

8.3.4.1.2 The Contractor agrees that any extension of the Contract time to which it is entitled arising out of a Change Order undertaken on a force accounting (labor and materials) basis, shall be determined by an extension-in-time audit by the Owner after the Work of the Change Order is completed. Such rulings shall be made by the Owner within thirty (30) days after a request for same is made by the Contractor or Design Consultant, except said thirty (30) days will not start until the Work under the Change Order is completed.

8.3.4.1.3 Should a time extension be granted for Substantial Completion, the date for Final Completion shall be appropriately adjusted unless specifically stated otherwise.

8.3.4.2 Subject to other provisions of the Contract, the Contractor may be entitled to an extension of the Contract time (but no increase in the Contract sum) for delays arising from unforeseeable causes beyond the control and without the fault or negligence of the Contractor, the Subcontractors or suppliers as follows:

8.3.4.2.1 Labor disputes and strikes (including strikes affecting transportation), that do, in fact, directly delay the progress of the Work on the critical path; however, an extension of Contract time on account of an individual labor strike shall not exceed the number of days of said strike;

8.3.4.2.2 Acts of nature: tornado, fire, hurricane, blizzard, earthquake, or flood that damage Work in place or stored materials or adversely impact the schedule's critical path;

8.3.4.2.3 Excessive inclement weather; however, the Contract time will not be extended due to reasonably anticipated inclement weather or for delays in the aftermath of inclement weather, reasonably anticipated or excessive. The time for performance of this Contract, as stated in the Contract Documents, includes an allowance for calendar days which may not be available for construction out-of-doors; for the purposes of this Contract, the Contractor agrees that the number of calendar days per month stated below are to be considered reasonably anticipated inclement weather and planned for in the construction schedule per the specifications, , construction schedules and reports. Unless the Contractor can substantiate to the satisfaction of the Owner that there was greater than the reasonably anticipated inclement weather considering the time from the notice-to-proceed until the building is enclosed using data from the national weather service station at Charlotte Airport (CLT), North Carolina, or a weather station acceptable to the Owner and that such alleged greater than reasonably anticipated inclement weather actually delayed the Work or portions thereof which had an effect upon the Contract time, the Contractor shall not be entitled to an extension of time.

For the purpose of this Contract, the Contractor agrees to anticipate and plan for inclement weather for the number of calendar days in accordance with the following table:

	Planned days/month
Jan	7
Feb	6
Mar	7
Apr	6
May	7
Jun	6
Jul	8
Aug	6

Sep	5
Oct	5
Nov	5
Dec	6

Also the Contractor agrees that the calculation of the number of excessive inclement weather days shall be the number of days in excess of those shown for each month in the table above, in which precipitation exceeded one tenth (.10) inch, or in which the highest temperature was 32 degrees F or less as recorded at the approved weather station. Rain days from hurricanes not causing damage in Mecklenburg County shall be deemed inclement weather days.

If the total accumulated number of calendar days lost to excessive inclement weather, from the notice-to-proceed until the building is enclosed, exceeds the total accumulated number to be reasonably anticipated for the same period from the table above, time for completion will be extended by the number of calendar days needed to include the excess number of calendar days lost. No extension of time will be made for days due to excessive inclement weather occurring after the building is enclosed. For the purpose of this Contract, the term "enclosed" is defined to mean when the building is sufficiently roofed and sealed, either temporarily or permanently, to permit the structure to be heated and the plastering and dry-wall trades to work. The Design Consultant shall determine when the structure is "enclosed". Upon the request of either party, the Design Consultant shall issue a letter certifying to the Owner, with a copy to the Contractor, stating the date the building became enclosed. No change in Contract sum will be authorized because of adjustment of Contract time due to excessive inclement weather; and

8.3.4.2.4 Delays in the issuance of the building permit required for construction of the Project, acts of the public enemy, acts of the State, Federal or local government in its sovereign capacity, and acts of another Contractor in the performance of a Contract with the Owner relating to the Project.

8.3.5 If the Contractor shall neglect, fail or refuse to complete the Work within the time herein specified, or any proper extension thereof granted by the Owner, then the Contractor does hereby agree, as a part consideration for the awarding of this Contract, to pay the Owner the amount specified in the Contract, not as a penalty but as Liquidated Damages for such breach of Contract as hereinafter set forth, for each and every calendar day that the Contractor shall be in default after the time stipulated in the Contract for completing the Work. The said amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such event sustain, and said amount is agreed to be the amount of damages which the Owner would sustain and said amount shall be retained from time to time by the Owner from current periodical estimates.

8.3.6 The Contractor and the Subcontractors shall not be entitled to and hereby expressly waive any extension of time resulting from any condition or cause unless said Claim for extensions of time is made in writing to the Owner within ten (10) days of the first instance of delay for all delays, except excessive inclement weather which shall be made in writing to the Owner within forty-five (45) days after the date the structure is enclosed. Circumstances and activities leading to such Claim shall be indicated or referenced in a daily field inspection report for the day(s) affected. In every such written Claim, the Contractor shall provide the following information:

8.3.6.1 Nature of the delay;

8.3.6.2 Date (or anticipated date) of commencement of delay;

8.3.6.3 Activities on the progress schedule affected by the delay, and/or new activities created by the delay and their relationship with existing activities;

8.3.6.4 Identification of person(s) or organization(s) or event(s) responsible for the delay;

8.3.6.5 Anticipated extent of the delay; and

8.3.6.6 Recommended action to avoid or minimize the delay.

8.3.7 If no schedule or agreement is made stating the dates upon which written interpretations as set forth in Section 2.2 shall be furnished, then no Claim for delay shall be allowed on account of failure to furnish such interpretations until twenty (20) days after request is made for them, and not then unless such Claim is reasonable.

8.3.8 No Claim by the Contractor for an extension of time for delays will be considered unless made in strict compliance with the requirements of this Article. All Claims not filed in accordance with this Article shall be waived by the Contractor.

8.4 RESPONSIBILITY FOR COMPLETION

8.4.1 The Contractor shall be responsible for completion in accordance with Paragraph 4.12.1.

8.4.2 The Owner may require the Contractor to submit a recovery schedule in accordance with Specifications, Construction Schedules and Reports demonstrating his program and proposed plan to make up the lag in scheduled progress and to ensure completion of the Work within the Contract Time. If the Owner finds the proposed plan not acceptable, he may require the Contractor to submit a new plan. If the actions taken by the Contractor or the second plan proposed are not satisfactory, the Owner may require the Contractor to take any of the actions set forth in Paragraph 4.12.2 without additional cost to the Owner, to make up the lag in scheduled progress.

8.4.3 Failure of the Contractor to substantially comply with the requirements of this Section 8.4 may be considered grounds for a determination by the Owner, pursuant to Section 14.3, that the Contractor is failing to prosecute the Work with sufficient diligence to ensure its completion within the Contract Time.

8.5 LIQUIDATED DAMAGES FOR DELAY

8.5.1 Owner and Contractor agree that the damages incurred by the Owner due to the Contractor's failure to achieve Substantial Completion by the date specified in the Supplemental Conditions for Substantial Completion, including any extensions thereof, shall be in the amounts set forth in the Supplemental Conditions, for each consecutive day beyond the date of Substantial Completion that Contractor achieves Substantial Completion, and that the damages incurred by the Owner due to the Contractor's failure to achive Final Completion by the date specified in the Supplemental Conditions for Final Completion, including any extensions thereof, shall be in the amount set forth in the Supplemental Conditions for each consecutive day beyond the date of Final Completion that Contractor achieves Final Completion. The Liquidated Damages are a reasonable estimate by Contractor and Owner of the damages to be suffered by Owner and are not to be construed as a penalty, it being recognized by the Owner and the Contractor that the injury to the Owner which could result from a failure of the Contractor to complete on schedule is uncertain and cannot be computed exactly or that it would be unreasonably expensive for Owner to calculate its damages exactly.

8.5.2 The amount specified for Substantial Completion is the minimum measure of damages the Owner will sustain due to delay in the completion of the Work, which shall inlcude, but not be limited to the loss of use of the facilities, the relocation of students and services, the cost of the Owner’s time and resourses, damage to the Owner’s reputation, and storage of furniture and other materials. The amount specified for Final Completion is a reasonable and proper measure of the damages the Owner will sustain due to the delay in the completion of remedial work. This amount includes the disruption to the school and the learning environment, the cost of the Owners time and resources, damage to the Owner’s reputation, and the inability to fully use the facilities. The inability of the Owner to quantify actual damages shall not prevent the recovery of Liquidated Damages.

8.5.3 Not withstanding any other provisions of these General Conditions, if there is concurrent delay in the completion of the Work, the Contractor shall be liable for Liquidated Damages as specified in the General

Conditions and Supplemental Conditions during such period of concurrent delay. For the purpose of this Paragraph, concurrent delay means (a) a delay event caused in part by the Owner or its agent and in part by the Contractor or its agents, Subcontractors or Sub-subcontractors, or (b) one or more delay event caused solely by the Owner, its agents, or the Design Consultant, and one or more delay event caused in part by the Contractor, its agents, Subcontractors or Sub-subcontractors, each of which would have resulted in a delay without the other and which delays run concurrently, or at the same time. In the event that the foregoing provision making the Contractor liable for Liquidated Damages during a period of concurrent delay is found to be unenforcable, then the parties agree that in the event of a concurrent delay, the extent of the delay will be apportioned between the Owner and the Contractor, and the Contractor will be responsible for Liquidated Damages as set forth in the General Conditions and Supplemental Conditions for those portions of the delay which are apportioned to the Contractor, its agent, Subconctractors, Sub-subcontractors, or Material Suppliers.

8.5.4 The provisions for Liquidated Damages do not bar or limit Owner's other rights and remedies against Contractor, for damages other than for failure to achieve the Substantial Completion date or the Final Completion date as required. The amount of Liquidated Damages set forth in Section 8.5 shall not include additional legal or design professional costs that may result from the Contractor's default. If such legal or design professional costs are incurred by the Owner, the Contractor shall be liable to the Owner for those costs in addition to the Liquidated Damages amount set forth in Section 8.5.

8.5.5 The Liquidated Damages assessed for failure to meet Substantial Completion by the specified date and the Liquidated Damages assessed for failure to meet Final Completion by the specified date shall be assessed cumulatively.

ARTICLE 9

PAYMENTS AND COMPLETION

9.1 CONTRACT SUM

9.1.1 The Contract Sum is stated in the Owner-Contractor Agreement and, including authorized adjustments thereto, is the total amount payable by the Owner to the Contractor for the performance of the Work under the Contract Documents.

9.2 SCHEDULE OF VALUES

9.2.1 Before the first Application for Payment, the Contractor shall submit to the Owner a schedule of values allocated to the various portions of the Work, as set forth in the Specifications, Construction Schedules and Reports, and supported by such data to substantiate its accuracy as the Owner may require. This schedule, unless objected to by the Owner, shall be used as a basis for the Contractor's Applications for Payment and only for this purpose. If approved by the Owner, the Contractor may include in his schedule of values a line item for mobilization which shall include a reasonable amount of mobilization for the Contractor and his Subcontractors. The Contractor shall not front-end load his schedule of values.

9.3 APPLICATIONS FOR PAYMENT

9.3.1 Prior to the date for each progress payment established in the Owner-Contractor Agreement, the Contractor, in accordance with the Specifications, Construction Schedules and Reports, shall submit to the Design Consultant an itemized Application for Payment, notarized if required, supported by such data substantiating the Contractor's right to payment as the Design Consultant and the Owner may require, including but not limited to the Contractor's certification that all work for which payment is requested has been completed in full in accordance with the Contract Documents, and reflecting retainage, if any, as provided elsewhere in the Contract Documents. If requested by the Owner, the Contractor shall also

certify that he has paid all due and payable amounts for which previous Applications for Payment were issued and payments received from the Owner, by providing waivers of liens for said payments.

9.3.1.1 The Contractor shall submit with the Application for Payment a list of those MWSBE Subcontractors whose work is included in the application and the amount due each. In addition, the MWSBE Business must itself perform satisfactory work or services or provide supplies under the Contract and not act as a mere conduit.

9.3.2 The Owner will withhold retainage from Contractor on all Applications for Payment to the maximum extent and in the maximum amount allowed by law (currently codified at N.C.G.S. 143-134.1) and in accordance with that statute or applicable successor statute. In the event that N.C.G.S 143-134.1 or applicable successor statute are not in effect or do not apply at the time the Contract is executed, Owner will retain ten percent (10%) of the amount of each Application for Payment from the Contractor as retainage, until Contractor achieves Final Completion, whether or not the Owner has occupied any or all of the Project before such time. However, if the Owner, at any time after fifty percent (50%) of the Work has been completed, finds that satisfactory progress is being made, he may authorize payment to the Contractor in full of each Progress Payment for work performed beyond the fifty percent (50%) stage of completion. If a reduction in retainage has been made, the Owner may increase the retainage back to original percentage at any time if the Owner concludes that the Contractor is not progressing with the Work in a timely or satisfactory manner.

9.3.3 Payments may be made by the Owner, at its sole discretion, on account of materials or equipment not incorporated in the work but delivered and suitably stored at the site or in a bonded warehouse by the Contactor. Payments for materials or equipment stored shall only be considered upon submission by the Contractor of satisfactory evidence (for example, releases or paid invoices from the seller) that the Contractor has acquired title to such material, that it will be utilized on the work under this Contract and that it is satisfactorily stored, protected, and insured or that other procedures satisfactory to the Owner that will protect the Owner's interests have been taken. In the event the materials are stored in a bonded warehouse that is not located in the county of the project, the Contractor shall reimburse the travel cost and hourly billing expenses incurred by the Design Consultant for travel to view and assess whether the materials meet the requirements of the Contract Documents. Materials once paid for by the Owner become the property of the Owner and may not be removed from the work site or bonded warehouse, other than to be delivered from the warehouse to the site, without the Owner's written permission. Responsibility for such stored materials and equipment shall remain with the Contractor regardless of ownership.

9.3.3.1 Owner will not make payment to the Contractor on account of materials or equipment not incorporated in the Work but delivered and stored at the site if the Contractor, in his schedule of values, does not includes line items for such delivered and stored materials or equipment.

9.3.3.2 It is specifically understood and agreed that an inspection and approval of the materials by the Owner, the Design Consultant or any agency retained by any of them shall not in any way subject the Owner to pay for the said materials or any portion thereof, even though incorporated in the Work, if said materials shall in fact turn out to be unfit to be used in the Work, nor shall such inspection be considered as any waiver of objection to the Work on account of the unsoundness or imperfection of the material used.

9.3.4 The Contractor warrants that title to all work, materials and equipment covered by an Application for Payment will pass to the Owner either by incorporation in the construction or upon the receipt of payment by the Contractor, whichever occurs first, free and clear of all liens, claims, security interests or encumbrances, hereinafter referred to in this Article 9 as "liens"; and that no work, materials or equipment covered by an Application for Payment will have been acquired by the Contractor, or by any other person performing work at the site or furnishing materials and equipment for the Project, subject to an agreement under which an interest therein or an encumbrance thereon is retained by the seller or otherwise imposed by the Contractor or such other person.

9.3.5 The Contractor shall submit with the Application for Payment a notarized Contractor's Sales Tax Report of N.C. State and County sales taxes paid during the payment period with respect to building materials, supplies, fixtures, and equipment that have become a part of, or annexed to, a building or structure erected, altered or repaired for the Owner. The Sales Tax Report shall include the vendor from whom the property was purchased, the dates and number of invoices covering the purchase, the total amount of the invoices of each vendor, the North Carolina State and County sales and use tax paid thereof, and the cost of the property withdrawn from the warehouse stock and North Carolina sales or use taxes paid thereof. Items that should not be included are: scaffolding, forms for concrete, fuel for operation of machinery and equipment, tools, equipment, equipment repair parts and equipment rentals.

9.3.6 Unless an interest rate is required by law, Owner shall not pay any interest on an amount owed to Contractor. No interest shall accrue on amounts Owner is authorized by law or by the Contract to withhold or backcharge to Contractor.

9.4 CERTIFICATION OF PAYMENT

9.4.1 The Design Consultant will, after receipt of the Contractor's Application for Payment either issue a Certification of Payment to the Owner, with a copy to the Contractor, for such amount as the Design Consultant determines is properly due, or notify the Contractor in writing of their reasons for withholding a Certification as provided in Paragraph 9.6.1.

9.4.2 The submission and approval of the progress schedule and monthly updates thereof as required by the Specifications, Construction Schedules and Reports, shall be an integral part and basic element of the application upon which progress payment shall be made. The Contractor shall be entitled to progress payments only as determined from the currently approved and updated schedule.

9.4.3 The signing of a Certification of Payment will constitute a representation by the Design Consultant to the Owner, based on their observations at the site pursuant to their agreements with the Owner, and the data comprising the Application for Payment, that the Work has progressed to the point indicated; that, to the best of their knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents (subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to the results of any subsequent tests required by or performed under the Contract Documents, to minor deviations from the Contract Documents correctable prior to completion, and to any specific qualifications stated in their Certification); and that the Contractor is entitled to payment in the amount certified. However, by signing a Certification of Payment, the Design Consultant shall not thereby be deemed to represent that it has made exhaustive or continuous on-site inspections to check the quality or quantity of the Work or that it has reviewed the construction means, methods, techniques, sequences, or procedures, or that it has made any examination to ascertain how or for what purpose the Contractor has used the moneys previously paid on account of the Contract Sum.

9.5 PROGRESS PAYMENTS

9.5.1 After a Certification of Payment has been issued, the Owner shall make payment in the manner and within the time provided in the Contract Documents, unless Contractor is in breach of the Contract or otherwise owes the Owner, in which case Owner may withhold an appropriate amount.

9.5.2 The Contractor shall promptly pay each Subcontractor (including suppliers, laborers, and material-men) performing labor or furnishing material or equipment for the Work, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's work, the amount to which said Subcontractor is entitled, reflecting the percentage actually retained, if any, from payments to the Contractor on account of such Subcontractor's work. The Contractor shall, by an appropriate agreement with each Subcontractor, also require each Subcontractor to make payments to his Sub-subcontractors in similar manner. The Owner may at any time require proof of payment to a Subcontractor or Sub-subcontractor for work paid by the Owner. Notwithstanding any other provision of the General Conditions, no Contractor, Subcontractor, Sub-subcontractor or Material Supplier shall have

any Claim against the Owner, by virtue of the Contract, under any theory, including breach of contract, or third party beneficiary. The Owner shall not be in privy of any contract with any Subcontractor, Sub-subcontractor or Material Supplier pertaining to the Work, the Project and these General Conditions. Also, neither the Contractor, or any Subcontractor or Sub-subcontractor shall have any right to assert a lien on Owner's real property or on any funds held by Owner.

9.5.3 The Owner may, on request and at his discretion, furnish to any Subcontractor, if practicable, information regarding the percentages of completion or the amounts applied for by the Contractor and the action taken thereon by the Design Consultant on account of work done by such Subcontractor.

9.5.4 Neither the Owner nor the Design Consultant shall have any obligation to pay or to see to the payment of any moneys to any Subcontractor except as may otherwise be required by law.

9.5.5 No Certification for a progress payment, nor any progress payment or final payment, nor any partial or entire use or occupancy of the Project by the Owner, shall constitute an acceptance of any Work not in accordance with the Contract Documents.

9.5.6 The Contractor agrees to keep the Work and the site of the Project free and clear of all liens related to labor and materials furnished in connection with the Work. Furthermore, pursuant to and in compliance with requirements of Paragraph 9.3.4, the Contractor waives any right he may have to file any type of lien in connection with the Work. Notwithstanding anything to the contrary contained in the Contract Documents, if any such lien is filed or there is evidence to believe that any lien may be filed at any time during the progress of the Work or within the duration of this Contract, the Owner may refuse to make any payment otherwise due the Contractor or may withhold from any payment due the Contractor a sum sufficient in the opinion of the Owner to pay all obligations and expenses necessary to satisfy such lien or the underlying claim represented by such lien. The Owner may withhold such payment unless or until the Contractor, within ten (10) days after demand thereof by the Owner, shall furnish satisfactory evidence that the indebtedness and any lien in respect thereof has been satisfied, discharged and released of record, or that the Contractor has legally caused such lien to be released of record pending the resolution of any dispute between the Contractor and the person or persons filing such lien. If the Contractor shall fail to furnish such satisfactory evidence within ten (10) days of the demand thereof, the Owner may discharge such indebtedness and deduct the amount thereof, together with any and all losses, costs, damages and attorney's fees suffered or incurred by the Owner from any sum payable to the Contractor under the Contract Documents, including but not limited to final payment and retained percentage. This Paragraph 9.5.6 shall be specifically included in all Subcontracts and purchase orders entered into by the Contractor. Notwithstanding any other provision of the Contract, nothing in the Contract shall affect the rights of Subcontractors, Sub-subcontractors, Material Suppliers and Vendors from enforcing any lien rights they have against parties other than the Owner.

9.6 PAYMENTS WITHHELD

9.6.1 The Design Consultant may decline to certify payment and may withhold their Certification of Payment in whole or in part, to the extent necessary to reasonably protect the Owner, if in the Design Consultant's opinion it is unable to make representations to the Owner as provided in Paragraph 9.4.3. If the Design Consultant is unable to make representations to the Owner as provided in Paragraph 9.4.3 and to certify payment in the amount of the Application for Payment, it will notify the Contractor as provided in Paragraph 9.4.1. If the Contractor and the Design Consultant cannot agree on a revised amount, the Design Consultant will promptly issue a Certification of Payment for the amount for which it is able to make such representations to the Owner. The Design Consultant may also decline to certify payment because of subsequently discovered evidence or subsequent observations that may nullify the whole or any part of any Certification of Payment previously issued to such extent as may be necessary in its opinion to protect the Owner from loss, because of:

.1 Defective Work not remedied,

.2 Third party claims filed, whether in court, in arbitration or otherwise, or reasonable evidence indicating probable filing of such claims,

.3 Failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment,

.4 Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum,

.5 Damage to the Owner or another contractor,

.6 Reasonable evidence that Contractor will not achieve Substantial Completion and/or Final Completion by the dates specified in the Supplemental Conditions.

.7 Failure or refusal of the Contractor to carry out the Work in accordance with or to otherwise substantially or materially comply with the Contract Documents,

.8 Liens filed or reasonable evidence that a lien may be filed for any portion of the Work,

.9 Failure or refusal of the Contractor to properly schedule and coordinate the Work, to provide progress schedules, reports and updates, or to otherwise fully comply with the Specifications, Construction Schedules and Reports,

.10 Failure or refusal of the Contractor to fully comply with the provisions of Section 6.2 requiring the Contractor to direct certain Claims to Separate Contractors and to defend and indemnify the Owner and/or the Design Consultant in the event Separate Contractors file certain Claims, or

.11 Failure or refusal of the Contractor to submit the required information on MWSBE Businesses.

.12 Failure or refusal of the Contractor to submit a notarized North Carolina State and County Sales Tax Report.

.13 Any other breach of the Contract by Contractor which has or is likely to cause monetary damages or loss to Owner.

.14 Any other reason authorized by the Contract Documents or by law.

9.6.2 When the above grounds in Paragraph 9.6.1 are removed to the Design Consultant's and Owner's satisfaction, payment shall be made for amounts withheld because of them.

9.6.3 In addition to the reasons outlined in section 9.6.1 payment may be withheld for the following reasons: The Contractor shall reimburse the Owner or the Owner will retain from the compensation otherwise to be paid to the Contractor funds sufficient to cover the payment of the following additional services performed by the Architect: (1) services required pursuant to the Owner's dispute resolution policy; (2) expense of overtime work requiring higher than regular rates when such work is required due to the failure of the Contractor to perform in accordance with the Contract Documents; (3) review of the Contractor's submittal or shop drawing out of sequence of the submittal schedule agreed to by the Contractor and Architect; (4) responses to the Contractor's requests for information where such information is available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, other Owner-provided information, Contractor-prepared coordination drawings, or prior project correspondence or documentation; (5) evaluation of an extensive number of substitutions proposed by the Contractor and making subsequent revisions to instruments of service resulting therefrom; (6) design services related to the default of the contractor; (7) contract administration services provided 60 days after the date of substantial completion of the work if required due to the Contractor's failure to complete its punchlist work in a timely fashion; (8) more than two inspections or reviews of the same area or areas for

the purpose of determining substantial completion; (9) more than two inspections or reviews of the same area or areas for the purpose of determining final completion; and (10) multiple reviews of incomplete or deficient submittal or shop drawings from the Contractor.

9.7 FAILURE OF PAYMENT

9.7.1 If the Owner does not make payment to the Contractor within the forty-five (45) calendar days after receipt of the Contractor's approved Application for Payment from the Design Consultant through no fault of the Contractor, and the Owner otherwise not being entitled under the Contract Documents or applicable law to withhold payment, then the Contractor may, upon seven (7) additional days' Notice to the Owner, stop the Work until payment of the amount owed according to the Contract Documents has been received. In such event, the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, which shall be effected by appropriate Change Order as provided herein.

9.8 SUBSTANTIAL COMPLETION

9.8.1 When the Contractor considers that the Work, or a designated portion thereof which is acceptable to the Owner, is substantially complete as defined in Paragraph 8.1.3, the Contractor shall prepare for submission to the Owner a comprehensive list of items which in his opinion are to be completed or corrected and shall request in writing that the Design Consultant and the Owner perform a Substantial Completion inspection. The Design Consultant and the Owner shall review the Contractor's list and shall compile a punch list of items to be corrected and completed. The failure to include any items on such list does not alter the responsibility of the Contractor to complete the Work in accordance with the Contract Documents. When the Design Consultant and the Owner on the basis of an inspection jointly determine that the Work or designated portion thereof is substantially complete, they will then prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion, shall state the responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to the Work, and insurance, and shall fix the time within which the Contractor shall complete the items listed therein. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion. The Certificate of Substantial Completion shall be submitted to the Owner and the Contractor for their written acceptance of the responsibilities assigned to them in such Certificate.

9.8.2 Upon Substantial Completion of the Work or designated portion thereof and upon application by the Contractor and certification by the Design Consultant, the Owner shall make payment, except retainage held pursuant to Paragraph 9.3.2, for such work or portion thereof, as provided in the Contract Documents unless Contractor is in breach of the Contract in which case Owner may withhold an appropriate amount.

9.8.3 The acceptance of Substantial Completion payment shall constitute a waiver of all Claims by the Contractor and its Subcontractors and Sub-subcontractors except those previously made in writing and identified by the Contractor as unsettled at the time the Contractor submits the Application for Payment for Substantial Completion, and except for the retainage sums due at Final Completion. The Contractor shall indemnify and hold the Owner harmless against any Claims by its Subcontractors and Sub-subcontractors that are waived because they were not made in writing and identified by the Contractor as unsettled when the Contractor submitted the Application for Payment for Substantial Completion.

9.8.4 The Owner shall have the option to correct or conclude any and all punch list items not completed by the Contractor to the satisfaction of the Design Consultant and the Owner within thirty (30) days from the actual date of Substantial Completion by utilizing its own forces or by hiring others. The cost of such correction of remaining punch list items by the Owner or others shall be deducted from the final payment to the Contractor. If Contractor does not complete certain punch list items within this time period, specified in Paragraph 9.8.4, all warranties and guarantees for such incomplete punch list items shall become effective upon issuance of final payment for the Project. Paragraph 9.8.4 does not limit the Liquidated Damages provisions related to failure to reach Final Completion by the date stipulated in the

Contract Documents.

9.8.5 The issuance of the Certificate of Substantial Completion does not indicate final acceptance of the Project by the Owner, and the Contractor is not relieved of any responsibility for the Project except as specifically stated in the Certificate of Substantial Completion.

9.8.6 Should the Design Consultant and the Owner determine that the Work or a designated portion thereof is not substantially complete, they shall inform the Contractor in writing stating why the Project or designated portion is not substantially complete. The Contractor shall expeditiously complete the Work and shall re-request in writing that the Design Consultant and the Owner perform a Substantial Completion inspection. Costs (if any), associated with such inspection shall be assessed to the Contractor.

9.8.7 The date of Substantial Completion will not be established until the following is completed by Contractor:

.1 Submit Contractor's punch list of work not yet complete with proposed time for completion signed by Contractor's project superintendent;

.2 Submit Certificate of Occupancy;

.3 Submit maintenance manuals as required by the contract documents;

.4 Complete start-up testing of all systems;

.5 Discontinue and remove temporary facilities from the site;

.6 Compliance with the requirements of Section 8.1.3 and Section 9.8.

9.9 FINAL COMPLETION AND FINAL PAYMENT

9.9.1 Upon receipt of the documentation required by Section 9.8, and of written Notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Design Consultant and the Owner will promptly make such inspection and, when they find the Work acceptable under the Contract Documents and the Contract fully performed, the Design Consultant shall issue a final Certification of Payment stating that to the best of their knowledge, information and belief, and on the basis of their observations and inspections, the Work has been completed in accordance with the terms and conditions of the Contract Documents. The final Certification of Payment will constitute that the conditions precedent to the Contractor's being entitled to final payment as set forth in Section 9.8 have been fulfilled. Payment shall be made in full to the Contractor within forty five (45) calendar days after receipt by the Owner of the final Certification of Payment except for any Work for which the Owner is entitled a credit under the Contract Documents.

9.9.1.1 Final Completion will not be met until the following:

.1 Coordinate and complete changeover of security, telephone, cable and other services;

.2 Instruction of the Owner's personnel;

.3 Coordinate and complete final changeover of permanent locks and transmit keys to Owner;

.4 Deliver tools, spare parts, extra stock and similar items;

.5 Submit warranties, bonds, maintenance agreements and final certifications;

.6 Submit record drawings, final project photos, property surveys;

.7 Complete final cleaning;

9.9.2 Neither the final payment nor the remaining retained percentage shall become due until the Work is free and clear of any and all liens and the Contractor submits to the Owner:

.1 An affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or his property might in any way be responsible, have been paid or otherwise satisfied;

.2 Consent of Surety to final payment;

.3 If required by the Owner, other data establishing payment or satisfaction of all such obligations, such as receipts, releases and waivers of liens arising out of the Contract, to the extent and in such form as may be designated by the Owner; and

.4 A written certification that:

.1 The Contractor has reviewed the requirements of the Contract Documents,

.2 The Work has been inspected by the Contractor for compliance with all requirements of the Contract Documents,

.3 Pursuant to this inspection, the Contractor certifies and represents that the Work complies in all respects with the requirements of the Contract Documents,

.4 The Contractor further certifies and represents that all equipment and systems have been installed in accordance with the Contract Documents and have been tested in accordance with the Specification requirements and are operational, and

.5 The Contractor hereby certifies and represents that the Work is complete in all respects and ready for final inspection.

9.9.3 If any Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify him against any loss. If any such lien or claim remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all moneys that the latter may be compelled to pay in discharging such lien or claims, including all costs and reasonable attorney's fees. The Owner may withhold from the final payment any sum that the Owner has reason to believe may be needed to satisfy any lien, claim or threat of lien arising from the Work. The Owner may deduct from the final payment an amount equal to any costs, expenses and attorney's fees incurred by the Owner in removing or discharging any liens or claim arising from the Work.

9.9.4 If, after Substantial Completion of the Work, Final Completion thereof is materially delayed through no fault of the Contractor or by the issuance of Change Orders affecting Final Completion, and the Owner so confirms, the Owner shall, upon application by the Contractor and certification by the Design Consultant, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for the portion of the Work not fully completed or corrected is less than the retainage stipulated in the Contract Documents, and if bonds have been furnished as provided in Section 7.4, the written consent of the Surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Design Consultant prior to certification of such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

9.9.5 The making of final payment shall constitute a waiver of all Claims by the Owner against the Contractor

except those arising from:

.1 Unsettled liens, and claims against the Owner or the Design Consultant, or their employees, agents, or representatives;

.2 Faulty, defective or non-conforming Work;

.3 Failure of the Work to comply with the requirements of the Contract Documents;

.4 Terms of any warranties contained in or required by the Contract Documents;

.5 Damages incurred by the Owner resulting from lawsuits brought against the Owner, the Design Consultant, or their agents, employees or representatives because of failures or actions on the part of the Contractor, his Subcontractors, Sub-subcontractors, or any of their employees, agents or representatives;

.6 Fraud or bad faith committed by the Contractor or any Subcontractor or supplier during performance of the Work but discovered by Owner after final payment; or

.7 Claims about which Owner did not have actual knowledge or which increase in scope or amount at the time of final payment.

9.9.6 The acceptance of final payment shall constitute a waiver of all Claims by the Contractor except those previously made in writing and identified by the Contractor as unsettled at the time of the final Application for Payment.

9.9.6.1 Notwithstanding any other provision of the Contract, Owner may withhold from Contractor payment otherwise due, as a result of any losses, expenses costs or damages suffered or anticipated to be suffered by Owner as a result of Contractor's breach of any provision of the Contract, including but not limited to Liquidated Damages or backcharges against Contractor.

9.10 OWNER'S RIGHT TO OCCUPY INCOMPLETE WORK

9.10.1 Should the Project, or any portion thereof, be incomplete for Substantial or Final Completion at the scheduled date or dates, the Owner shall have the right to occupy any portion of the Project. In such an event, the Contractor shall not be entitled to any extra compensation on account of said occupancy by the Owner or by the Owner's use of the Project, nor shall the Contractor interfere in any way with said use of the Project. Further, in such an event, the Contractor shall not be entitled to any extra compensation on account of the Owner's occupancy and use of the Project, nor shall the Contractor be relieved of any responsibilities of the Contract including the required times of completion. Such occupancy by the Owner shall not, in itself, constitute Substantial or Final Completion.

9.10.2 If the Owner exercises his rights under the foregoing and occupies the full Project, then there shall be no Liquidated Damages on account of failure on the Contractor's part to reach Substantial Completion from that date forward. This provision does not affect, however, any Liquidated Damages that would be assessed for any period of time between the contractual date of Substantial Completion and the date of any such occupancy. Further, this provision would have no effect on Liquidated Damages assessed on account of late Final Completion.

ARTICLE 10

PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

10.1.1 The Owner, the Design Consultant, or their agents, employees or representatives are not responsible for the means, methods, techniques, sequences or procedures utilized by the Contractor, or for safety precautions and programs in connection with the Work. The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. This requirement applies continuously throughout the Contract performance, until final payment is made and all punch list and warranty work is performed properly, and is not limited to regular working hours.

10.2 SAFETY OF PERSONS AND PROPERTY

10.2.1 The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury or loss to:

.1 All employees on the Work and all other persons who may be affected thereby;

.2 All the Work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of his Subcontractors or Sub-subcontractors, machinery, equipment and all hazards shall be guarded or eliminated in accordance with all applicable safety regulations; and

.3 Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and overhead or underground utilities not designated for removal, relocation or replacement in the course of construction.

10.2.2 The Contractor shall give all notices and comply with all applicable laws, ordinances, permits, rules, regulations and lawful orders of any public authority bearing on the safety or persons or property or their protection from damage, injury or loss.

10.2.2.1 The Contractor shall at all times safely guard the Owner's property from injury or losses in connection with the Contract. He shall at all times safely guard and protect his own work and adjacent property as provided by law and the Contract Documents, from damage. All passageways, guard fences, lights and other facilities required for protection by applicable safety regulations must be provided and maintained.

10.2.3 The Contractor shall erect and maintain, as required by existing conditions and progress of the Work, all reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent utilities.

10.2.4 When the use or storage of explosives or other hazardous materials or equipment is necessary for the execution of the Work, the Contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel.

10.2.5 The Contractor shall promptly remedy at his own cost and expense all damage or loss to any property referred to in Subparagraphs 10.2.1.2 and 10.2.1.3 caused by the Contractor, any Subcontractor, any Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable and for which the Contractor is responsible under Subparagraphs 10.2.1.2 and 10.2.1.3, except damage or loss attributable solely to the acts or omissions of the Owner or Design Consultant or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to his obligations under Section 4.21. The Contractor shall perform such restoration by underpinning, repairing, rebuilding, replanting, or otherwise restoring as may be required or directed by the Owner, or shall make good such damage in a satisfactory and acceptable manner. In case of failure on the part of the Contractor to promptly restore such property or make good such damage, the Owner may, upon two (2) calendar days Notice, proceed to repair, rebuild or otherwise restore such property as may be necessary and the cost thereof, or a sum sufficient in the judgment of the Owner to reimburse the owners of property so damaged, will be deducted from any monies due or to

become due the Contractor under the Contract.

10.2.6 The Contractor is responsible for the proper packing, shipping, handling and storage (including but not limited to shipment or storage at the proper temperature and humidity) of materials to be incorporated in the Work, so as to insure the preservation of the quality and fitness of the material for proper installation and incorporation in the Work, as required by the Contract Documents. For example, but not by way of limitation, Contractor shall, when necessary, place material on wooden platforms or other hard and clean surfaces and not on the ground and/or place such material under cover in any appropriate shelter or facility. Stored materials or equipment shall be located so as to facilitate proper inspection. Material and equipment which is delivered crated shall remain crated until ready for installation. Lawns, grass plots or other private property shall not be used for storage purposes without the written permission of the Owner or lessee unless otherwise within the terms of the easements obtained by the Owner.

10.2.6.1 It shall be the responsibility of the Contractor in his preparation of phasing schedule of work operations after consulting with the other Prime Contractors to designate areas in which each Prime Contractor may store materials. Areas designed shall meet with the approval of the Design Consultant.

10.2.7 The Contractor shall give notice in writing at least forty eight (48) hours before breaking ground, to all persons, public utility companies, owners of property having structures or improvements in proximity to site of the Work, superintendents, inspectors, or those otherwise in charge of property, streets, water pipes, gas pipes, sewer pipes, telephone cables, electric cables, railroads or otherwise, who may be affected by the Contractor's operation, in order that they may remove any obstruction for which they are responsible and have representative on site to see that their property is properly protected. Such notice does not relieve the Contractor of responsibility for all damages, claims, or defense or indemnification of all actions against Owner resulting from performance of such work in connection with or arising out of Contract.

10.2.8 The Contractor shall investigate, locate, mark and protect all utilities encountered or to be encountered while performing the Work, whether indicated on the Drawings or not. The Contractor shall maintain utilities in service until moved or abandoned. The Contractor shall exercise due care when excavating around utilities and shall restore any damaged utilities to the same condition or better as existed prior to starting the Work, at no cost to the Owner. The Contractor shall maintain operating utilities or other services, even if they are shown to be abandoned on the Contract Drawings, in service until new facilities are provided, tested and ready for use.

10.2.9 The Contractor shall return all improvements on or about the site and adjacent property which are not shown to be altered, removed or otherwise changed to conditions which existed prior to starting the Work. The Contractor shall video record all areas or otherwise document the conditions existing at the site and in and around existing buildings prior to starting the Work. Submit documentation to the Design Consultant prior to beginning the Work.

10.2.10 The Contractor shall protect the Work, including but not limited to, the site, stored materials and equipment, excavations, and excavated or stockpiled soil or other material, intended for use in the Work, and shall take all necessary precautions to prevent or minimize damage to same or detrimental effect upon his performance or that of his Subcontractors, caused by or due to rain, snow, ice, run-off, floods, temperature, wind, dust, sand and flying debris; for example, but not by way of limitation, Contractor shall, when necessary, utilize temporary dikes, channels or pumping to carry-off divert or drain water, and shall as necessary tie-down or otherwise secure the Work and employ appropriate covers and screens.

10.2.11 The Contractor shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents and the protection of material, equipment and property. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner.

10.2.12 The Contractor shall not load or permit any part of the Work to be loaded so as to endanger its safety.

10.2.13 Notification to the Contractor by the Owner or the Design Consultant of a safety violation will in no way

relieve the Contractor of sole and complete responsibility for the correctness of said violation or of sole liability for the consequences of said violation.

10.3 EMERGENCIES

10.3.1 In any emergency affecting the safety of persons or property, the Contractor shall act, at his discretion, to prevent threatened damage, injury or loss. The Contractor shall notify the Owner of the situation and all actions taken immediately thereafter. If, in the opinion of the Contractor, immediate action is not required, the Contractor shall notify the Owner of the emergency situation and proceed in accordance with the Owner's instructions. Provided, however, if any loss, damage, injury or death occurs that could have been prevented by the Contractor's prompt and immediate action, the Contractor shall be fully liable for all costs, damages, claims, actions, suits, attorney's fees and all other expenses arising therefrom or relating thereto.

ARTICLE 11

INSURANCE

11.1 CONTRACTOR'S LIABILITY INSURANCE

11.1.1 The Contractor shall purchase and maintain in companies properly licensed by the Insurance Department of the State of North Carolina and acceptable to the Owner such insurance as will protect him, the Owner, and the Owner’s agents, representatives, and employees from claims set forth below which may arise out of or result from the Contractor's operations under the Contract, whether such operations be by himself or by any Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

.1 Claims under workers' or workmen's compensation, disability benefit and other similar employee benefit acts (with Workmen's Compensation and Employer's Liability Insurance in amounts not less than those necessary to meet the statutory requirements of the state(s) having jurisdiction over any portion of the Work);

.2 Claims for damages because of bodily injury, sickness or disease, or death of his employees; the Contractor will require his Subcontractors to similarly provide Workmen's Compensation Insurance for all of the latter's employees;

.3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees;

.4 Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the Contractor, or (2) by any other person;

.5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom; and

.6 Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

11.1.2 The insurance required by Paragraph 11.1.1 shall be primary and non-contributing to any insurance possessed or procured by the Owner, and limits of liability shall be not less than those set forth in these General Conditions of the Contract or required by law, whichever is greater.

11.1.3 The insurance required by the Contract shall include contractual liability insurance applicable to the

Contractor's obligations under the Contract

11.1.4 Without limiting the above during the term of the Contract, the Contractor and each Subcontractor shall, at their own expense, purchase and maintain the following insurance with companies properly licensed by the Insurance Department of the State of North Carolina and satisfactory to the Owner.

.1 Worker's Compensation including Occupational Disease and Employer's Liability Insurance.

.1 Statutory - Amount and coverage as required by State of North Carolina Worker's Compensation laws.

.2 Employer's Liability
$1,000,000 Each Accident
$1,000,000 Policy Limit
$1,000,000 Each Employee

.2 Commercial General Liability (Occurrence Form) - The Contractor shall provide during the life of the Contract such Commercial General Liability (Occurrence Form) Insurance as shall protect him and any Subcontractor performing work under the Contract from claims for damages for Bodily Injury including accidental death, as well as from claims for Property Damage which may arise from operations under the Contract, whether such operations be by himself or by any Subcontractor or by anyone directly or indirectly employed by either of them. This insurance shall be on the Standard Insurance Services Office, Inc. (ISO) Commercial Liability Occurrence Form or other form reasonable acceptable to Owner. The Contractor shall procure insurance coverage for direct operations, sublet work, elevators, contractual liability and completed operations with limits not less than those stated below:

.1 A Combined Single Limit for Bodily Injury, Property Damage and Personal Injury of:
Limits of Insurance
$2,000,000 General Aggregate (except Products – Completed Operations) Limit
$2,000,000 Products – Completed Operations Aggregate Limit
$1,000,000 Personal and Advertising Injury Limit
$1,000,000 Each Occurrence Limit

.3 Property Damages, including Broad Form Property Damage and Explosion, Collapse, Underground property damage coverages, and blasting, where necessary;

.4 Completed Operations Liability: Continuous coverage in force for one year after completion of the Work;

.5 Commercial Automobile Insurance, including coverage for owned, non-owned and hired vehicles - with limits not less than those stated below:

.1 A Combined Single Limit for Bodily Injury
and Property Damage of $1,000,000.

.6 Umbrella Liability Insurance: Policy to "pay on behalf of the Insured"
Limits of Liability:

.1 Contract Amount: $1,000,000-$2,000,000:
Requires Umbrella Liability Insurance Limit of $1,000,000.

.2 Contract Amount: $2,000,000 and above:
Requires Umbrella Liability Insurance Limit of $2,000,000.

11.1.5 The insurance required by Section 11.1 shall be written for not less than any limits of liability specified in the Contract Documents, or required by law, whichever is greater.

11.1.6 Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These Certificates shall contain a provision that coverages afforded under the policies will not be canceled until at least thirty (30) days' prior written Notice has been given to the Owner. Failure to provide such Notice shall not limit the liability of the Insurer, its agents or representatives.

.1 Description of operations/locations/vehicles/special items should contain the following statement along with any items particular to your company:
CHARLOTTE MECKLENBURG BOARD OF EDUCATION IS NAMED AS ADDITIONAL INSURED IN RESPECT TO GENERAL LIABILITY.

2. The certificate holder is:
CHARLOTTE MECKLENBURG BOARD OF EDUCATION
P.O Box 30035
Charlotte, NC 28230

3. The cancellation statement is:
SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANIES WILL MAIL THIRTY (30) DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT.

11.1.7 All insurance policies required in this Article, except Worker's Compensation and Commercial Automobile, shall name the Owner as additional named insured for the insurance.

11.1.8 The Contractor shall not commence the Work under the Contract until he has obtained all the insurance required hereunder and such insurance has been approved by the Owner, nor shall the Contractor allow any Subcontractor to commence work on his subcontract until all similar insurance required of the Subcontractor has been so obtained and approved. Approval of the insurance by the Owner shall not relieve or decrease the liability of the Contractor hereunder.

11.1.9 The Commercial General Liability and Workers Compensation Policies provided by the Contractor shall have endorsements waiving subrogation against the Owner.

11.2 PROPERTY INSURANCE

11.2.1 The Contractor shall purchase and at all times maintain such insurance as will protect the Contractor, the Owner, Subcontractors and Sub-subcontractors from loss or damage to the Work or property in the course of construction, including all machinery, materials and supplies on the premises or in transit thereto and intended to become a part of the finished Work until Final Completion. This insurance shall be in the form of "Builders Risk Covered Cause of Loss Form", or equivalent form, to include but not limited to theft, collapse, earth movement, flood, and portions of the Work stored on site, off site and in transit. Any deductible provision in such insurance shall not exceed ten thousand dollars ($10,000). Notwithstanding any such deductible provision, the Contractor shall remain solely liable for the full amount of any item covered by such insurance. Such insurance shall be in the initial Contract Sum and shall be increased at Contractor's expense in the amount of all additions to the Contract Sum. Such insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

11.2.2 Any loss insured under Paragraph 11.2.1 is to be adjusted with the Owner and made payable to the Owner as trustee for the insureds, as their interests may appear, subject to the requirements of Paragraph 11.2.4. The Contractor shall pay each Subcontractor a just share of any insurance moneys received by the Contractor, and by appropriate agreement, written where legally required for validity, shall require each Subcontractor to make payments to his Sub-subcontractors in similar manner.

11.2.3 The Owner and Contractor waive all rights against each other for damages caused by fire or other perils to the extent their Claims are covered by insurance obtained pursuant to this Section 11.2, or any other property insurance applicable to the Work, except such rights as they may have to the proceeds of such insurance. The Contractor shall require, by appropriate agreement, written where legally required for validity, similar waivers in favor of the Owner and the Contractor by Subcontractors and Sub-subcontractors. With respect to the waiver of rights of recovery, the term Owner shall be deemed to include, to the extent covered by property insurance applicable thereto, his consultants, employees, and agents and representatives. The Contractor waives as against any Separate Contractor described in Article 6, all rights for damages caused by fire or other perils in the same manner as is provided above as against the Owner. The Owner shall require, by appropriate agreement, written where legally required for validity, similar waivers in favor of the Contractor by any Separate Contractor and his subcontractors and sub-subcontractors.

11.2.4 The Owner as trustee shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within five (5) days after the occurrence of loss to the Owner's exercise of this power, and if such objection is made, the matter shall be decided by a court of competent jurisdiction or as the parties in interest otherwise agree. The Owner as trustee shall, in that case, make settlement with the insurers in accordance with the orders of the court or as otherwise agreed by the parties in interest.

11.2.5 If the Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion thereof, such occupancy or use shall not commence prior to a time mutually agreed to by the Owner and Contractor and to which the insurance company or companies providing the property insurance have consented by endorsement to the policy or policies. This insurance shall not be canceled or lapsed on account of such partial occupancy or use. Consent of the Contractor and of the insurance company or companies to such occupancy or use shall not be unreasonably withheld.

11.2.6 The Contractor bears the risk of loss or damage to the Work, the Project, materials stored on site or off site, and Owner’s improvements and property under Contractor’s control, both during construction and prior to Substantial Completion.

11.3 EFFECT OF SUBMISSION OF CERTIFICATES

11.3.1 The Owner shall be under no obligation to review any Certificates of Insurance provided by the Contractor or to check or verify the Contractor's compliance with any and all requirements regarding insurance imposed by the Contract Documents. The Contractor is fully liable for the amounts and types of insurance required herein and is not excused should any policy or certificate of insurance provided by the Contractor not comply with any and all requirements regarding insurance imposed by the Contract Documents.

11.4 FAILURE OF COMPLIANCE

11.4.1 Should the Contractor fail to provide and maintain in force any and all insurance, or insurance coverage required by the Contract Documents or by law, or should a dispute arise between Owner and any insurance company of Contractor over policy coverage or limits of liability as required herein, the Owner shall be entitled to recover from the Contractor all amounts payable, as a matter of law, to Owner or any other parties, had the required insurance or insurance coverage been in force. Said recovery shall include, but is not limited to interest for the loss of use of such amounts of money, plus all attorney's fees, costs and expenses incurred in securing such determination and any other consequential damages arising out of the failure of the Contractor or insurance company to comply with the provisions of the Contract Documents, or any policy required hereby, or any other requirements regarding insurance imposed by law. Nothing herein shall limit any damages for which Contractor is responsible as a matter of law.

11.5 OWNER'S INSURANCE

11.5.1 Property Insurance: The Owner, at his option, may purchase and maintain such insurance as will insure him against loss of use of his property due to fire or other hazards, however caused.

11.5.2 Commercial Public Liability Insurance: The Owner, at his option, may purchase and maintain insurance which will insure and protect him against claims involving bodily injury and property damage to the public. The Owner does not request his insurer to waive any right of subrogation against the Contractor from claims under this coverage.

11.6 LICENSED INSURANCE COMPANIES

11.6.1 All insurance companies providing the above insurance shall be licensed by the Insurance Department of the State of North Carolina and have a minimum AM Best "A" rating or similar rating from another rating agency reasonably acceptable to Owner.

ARTICLE 12

CHANGES IN THE WORK

12.1 GENERAL PROVISIONS RELATED TO CHANGES

12.1.1 A Construction Change Directive is a document issued pursuant to this Paragraph 12.1.1. The Owner may, at any time, without the agreement of the Contractor, by written order signed by the Owner and Design Consultant designated or indicated to be a Construction Change Directive, make any Changes in the Work or add to or subtract from the Work within the general scope of the Contract. A Change in the Work is defined as changes within the general scope of the Contract, including, but not limited to changes:

.1 In the Specifications or Drawings;

.2 In the sequence, method or manner of performance of the Work;

.3 In the Owner-furnished facilities, equipment, materials, services or site; or

.4 Directing acceleration in the performance of the Work.

12.1.2 A Change Order is a document executed pursuant to this Paragraph 12.1.2. The Owner and Contractor may agree to Changes in the Work, the Contract Sum, the Contract Time and any other change in the Contract by written agreement signed by Owner, Contractor and Design Consultant designated or indicated to be a Change Order. If the Contractor, subsequent to the issuance of a Construction Change Directive, agrees to its terms including any applicable adjustment to the Contract Sum and Contract Time, Contractor shall sign it and it shall become a Change Order.

12.1.3 The Contractor shall not be entitled to any amount for indirect costs, damages or expenses of any nature, including, but not limited to, so-called "impact" costs, labor inefficiency, wage, material or other escalations beyond the prices upon which the Proposal is based and to which the parties have agreed pursuant to the provisions of Article 12, and which the Contractor, its Subcontractors or Sub-subcontractors or any other person may incur as a result of delays, interferences, suspensions, changes in sequence or the like, for whatever cause, whether reasonable or unreasonable, foreseeable or unforeseeable, or avoidable or unavoidable, arising from the performance of any and all Changes in the Work performed pursuant to this Article 12, unless the delay is caused solely by the Owner or its agent. It is understood and agreed that the Contractor's sole and exclusive remedy in the event the delay is caused solely by the Owner or its agent shall be recovery of his direct costs as compensable hereunder and an

extension of the Contract Time, but only in accordance with the provisions of the Contract Documents. The phrase "Owner or its agent" as used in the Contract, does not include the Prime Contractors or their Subcontractors.

12.1.4 No Claim by the Contractor shall be allowed if asserted after final payment under this Contract. No Claim relating to or flowing from a particular change shall be allowed after execution of the Change Order relating to that change or commencement of the change by the Contractor except as specifically provided in Paragraph 12.2.4.

12.1.5 If any dispute should arise between the parties with respect to an increase or decrease in the Contract Sum or an expansion or contraction in the Contract Time as a result of a Change in the Work, the Contractor shall not suspend performance of a Change in the Work or the Work itself unless otherwise so ordered by the Owner in writing. The Owner shall, however, pay to the Contractor up to the Owner's reasonable estimated value of the Change in the Work, regardless of the dispute, if said Change in the Work will result in an increase in the Contract Sum; and the Owner shall have the right to withhold payment from the Contractor in an amount up to the Owner's reasonable estimated value of the Change in the Work, regardless of the dispute, if said Change in the Work will result in a decrease in the Contract Sum.

12.1.6 No Change in the Work shall be performed without a fully executed Change Order to the Contract, a fully executed Construction Change Directive or other Modification to the Contract.

12.1.7 If the Contractor intends to assert a Claim under this Article, he must, within ten (10) days after receipt of a Construction Change Directive, Notify the Owner by written statement setting forth the specific nature and cost of such Claim, unless this period is extended by the Owner. The statement of Claim shall include all direct, indirect and impact costs associated with the change, as well as the Contractor's estimate of the schedule impact of the change, if any. The Contractor and its Subcontractors shall not be entitled to reimbursement for any Claims that are not submitted in strict conformance with the Contract. The Contractor shall indemnify and hold the Owner harmless against any Claims by Subcontractors that are waived because they are not submitted in strict conformance with the Contract.

12.2 OWNER DIRECTED CHANGES REQUIRING AN INCREASE IN CONTRACT SUM.
(For decreases in Contract Sum, refer to Section 12.6)

12.2.1 If the Change in the Work will result in an increase in the Contract Sum, the Owner shall have the right to require the performance thereof on a lump sum basis, a unit price basis or a time and material basis, all as hereinafter more particularly described (the right of the Owner as aforesaid shall apply with respect to each such Change in the Work).

If the Owner elects to have the Change in the Work performed on a lump sum basis, its election shall be based on a lump sum Proposal which shall be submitted by the Contractor to the Owner within ten (10) days of the Contractor's receipt of a request therefore (but the Owner's request for a lump sum Proposal shall not be deemed an election by the Owner to have the Change in the Work performed on a lump sum basis). The Contractor's Proposal shall be itemized and segregated by labor and materials for the various components of the Change in the Work (no aggregate labor total will be acceptable) and shall be accompanied by signed Proposals of any Subcontractors who will perform any portion of the Change in the Work and of any persons who will furnish materials or equipment for incorporation therein. The Proposal shall also include the Contractor's estimate of the time required to perform said changes. The Contractor shall provide any documentation that may be requested by the Owner or Architect to support the change proposal, including but not limited to payroll records, insurance rates, material quotes, and rental quotes.

The portion of the Proposal relating to labor, whether by the Contractor's forces or the forces of any of its Subcontractors, may include reasonably anticipated gross wages of job site labor, including foremen, who will be directly involved in the Change in the Work (for such time as they will be so involved), plus payroll costs (including premium costs of overtime time, if overtime is anticipated, Social Security,

Federal or State unemployment insurance taxes and fringe benefits required by collective bargaining agreements entered into by the Contractor or any such Subcontractor in connection with such labor) and up to fifteen percent (15%) of such anticipated gross wages, but not payroll costs, as overhead and profit for the Contractor or any such Subcontractor, as applicable (said overhead and profit to include all supervision except foremen). Payroll costs are limited to 39% of the net pay of the worker.

The portion of the Proposal relating to materials may include the reasonably anticipated direct costs to the Contractor or to any of its Subcontractors of materials to be purchased for incorporation in the Change in the Work, plus transportation and applicable sales and use taxes and up to fifteen percent (15%) of said direct material costs as overhead and profit for the Contractor or any such Subcontractor (said overhead and profit to include all small tools), and may further include the Contractor's and any of its Subcontractor's reasonably anticipated rental costs in connection with the Change in the Work (either actual or discounted local published rates), plus up to seven and 1/2 percent (7.5%) thereof as overhead and profit for the Contractor or any such Subcontractors, as applicable. The Contractor shall provide an itemized breakdown of all transportation and shipping costs, including receipts documenting the expenses. If any of the items included in the lump sum Proposal are covered by unit prices contained in the Contract Documents, the Owner may, if it requires the Change in the Work to be performed on a lump sum basis, elect to use these unit prices in lieu of the similar items included in the lump sum Proposal, in which event an appropriate deduction will be made in the lump sum amount prior to the application of any allowed overhead and profit percentages. No overhead and profit shall be applied to any unit prices.

The lump sum Proposal may include up to seven and 1/2 percent (7.5%) of the amount which the Contractor will pay to any of its Subcontractors for Changes in the Work as overhead and profit for the Contractor. The Contractor shall not be reimbursed for the costs of the Subcontractors' Payment and Performance Bonds, as such bonding is not required by the Owner.

12.2.2 In the event that the Contractor fails to submit his Proposal within the designated period, the Owner may order the Contractor to proceed with the Change to the Work and the Contractor shall so proceed. The Owner shall unilaterally determine the reasonable cost and time to perform the Work in question, which determination shall be final and binding upon the Contractor. The Contractor may dispute such action in accordance with the Article 15.

12.2.3 In the event that the parties are unable to agree as to the reasonable cost and time to perform the Change in the Work based upon the Contractor's Proposal and the Owner does not elect to have the Change in the Work performed on a time and material basis, the Owner may choose to make a determination of the reasonable cost and time to perform the Change in the Work, based upon its own estimates, the Contractor's submission or a combination thereof. A Construction Change Directive shall be issued in this case for the amounts of cost and time determined by the Owner and shall become final and binding upon the Contractor, subject to Contractor's right to dispute such action in accordance with Article 15. Owner has the right to direct by Construction Change Directive a Change in the Work, which is the subject of such Change Order. Failure of the parties to reach agreement regarding the cost and time of the performing the Construction Change Directive, shall not relieve the Contractor from performing the Change in the Work promptly and expeditiously.

12.2.3.1 The Owner reserves the right to reject the Contractor's Proposal for a Change in the Work and to elect to perform said Work using a Separate Contractor. Under such circumstances, all provisions of Article 6 shall be in force.

12.2.4 If the Owner elects to have the Change in the Work performed on a time and material basis, the same shall be performed, whether by the Contractor's forces or the forces of any of its Subcontractors or Sub-subcontractors, at actual cost to the entity performing the Change in the Work (without any charge for administration clerical expense, supervision or superintendence of any nature whatsoever, including foremen, or the cost, use or rental of tools or plant), plus fifteen percent (15%) thereof as the total overhead and profit (except that said fifteen percent (15%) shall not be applied against any payroll costs, as set forth in Paragraph 12.2.1.) The Contractor shall submit to the Owner daily time and material tickets, on a daily

basis to include the identification number assigned to the Change in the Work, the location and description of the Change in the Work, the classification of labor employed, the materials used, the equipment rented (not tools) and such other evidence of cost as the Owner may require. The Owner may require authentication of all time and material tickets and invoices by persons designated by the Owner for such purpose. The failure of the Contractor to secure any required authentication shall, if the Owner elects to treat it as such, constitute a waiver by the Contractor of any Claim for the cost of that portion of the Change in the Work covered by a non-authenticated ticket or invoice; provided, however, that the authentication of any such ticket or invoice by the Owner shall not constitute an acknowledgment by the Owner that the items thereon were reasonably required for the Change in the Work.

12.2.5 No overhead and profit will be paid by the Owner on account of a Change in the Work except as specifically provided in Section 12.2. Overhead and profit, as allowed under Section 12.2, shall be deemed to include all costs and expenses which the Contractor or any of its Subcontractors may incur in the performance of a Change in the Work and which are not otherwise specifically recoverable by them pursuant to Section 12.2.

12.3 CONTRACTOR NOTICE OF CHANGE

12.3.1 If the Contractor or any of its Subcontractors asserts that any event or occurrence has caused a Change in the Work which change causes an increase or decrease in the Contractor's or its Subcontractors cost or the time required for the performance of any part of the Work under the Contract, including Work not affected directly by the change, the Contractor shall, within ten (10) days of such event, give the Owner written Notice as herein required. Said Notice shall include the instructions or circumstances that are the basis of the Claim and the Contractor's best estimate of the cost and time involved.

12.4 MINOR CHANGES IN THE WORK

12.4.1 The Owner shall have authority to order minor Changes in the Work not involving an adjustment in the Contract Sum or an extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order, and shall be binding on the Owner and the Contractor. The Contractor shall carry out such written orders promptly.

12.4.2 The Contractor shall not perform any Changes in the Work unless authorized in writing by the Design Consultant or Owner.

12.5 DIFFERING SITE CONDITIONS

12.5.1 Should the Contractor encounter subsurface and/or latent conditions at the 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 Contract, or different from that shown on surveys or tests provided in the bid materials at the time the Owner solicited bids from the construction of the Project, he shall immediately give Notice to the Owner of such conditions before they are disturbed. The Owner and the Design Consultant 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 of cost resulting from such changes shall be adjusted in the manner provided herein for adjustments as to extra and/or additional work and changes.

12.6 OWNER DIRECTED CHANGES REQUIRING A DECREASE IN CONTRACT SUM.

12.6.1 If the Change in the Work will result in a decrease in the Contract Sum, the Owner may request a quotation by the Contractor of the amount of such decrease. The following provisions shall apply:

The portion of the Proposal relating to labor, whether by the Contractor's forces or the forces of any of

its Subcontractors, shall include reasonably anticipated gross wages of job site labor, including foremen, who would have been directly involved in the Work that has been deleted from the Contract, (for such time as they would have been so involved), plus payroll costs (including premium costs of overtime time, if overtime was anticipated, Social Security, Federal or State unemployment insurance taxes and fringe benefits required by collective bargaining agreements entered into by the Contractor or any such Subcontractor in connection with such labor) and fifteen percent (15%) of such anticipated gross wages, but not payroll costs, as overhead and profit not incurred or earned by the Contractor or any such Subcontractor, as applicable (said overhead and profit to include all supervision except foremen).

The portion of the Proposal relating to materials shall include the reasonably anticipated direct costs which would have been incurred by the Contractor or to any of its Subcontractors of materials which would have been purchased for incorporation in the Work but which has been deleted from the Contract, plus transportation and applicable sales and use taxes which will be avoided and fifteen percent (15%) of said direct material costs as overhead and profit not incurred or earned by the Contractor or any such Subcontractor (said overhead and profit to include all small tools), and shall further include the Contractor's and any of its Subcontractor's reasonably anticipated rental costs which will be avoided (either actual or discounted local published rates). If any of the items included in the lump sum Proposal are covered by unit prices contained in the Contract Documents, the Owner may elect to use these unit prices in determining the amount of reduction to the Contract Sum as a result of a deletion of Work from the Contract. No overhead and profit shall be applied to any unit prices for purposes of calculation such reduction in the Contract Sum.
The lump sum Proposal for Work which would have been performed by any Subcontractors shall include seven and 1/2 percent (7.5%) of that amount as an estimate of the Contractor's overhead and profit that will not be earned by Contractor due to the decrease in the Contract Sum.

The Contractor's quotation shall be forwarded to the Owner within ten (10) days of the Owner's request and, if acceptable to the Owner, shall be incorporated in the Change Order. If not acceptable, the parties shall make every reasonable effort to agree as to the amount of such decrease, which may be based on a lump sum properly itemized, on unit prices stated in the Contract Documents and/or on such other basis as the parties may mutually determine. If the parties are unable to so agree, the amount of such decrease shall be the total of the estimated reduction in actual cost of the Work, as determined by the Owner in its reasonable judgment, plus overhead and profits stated above. This shall become final and binding upon the Contractor, subject to Contractor's right to dispute such action in accordance with the Article 15.

ARTICLE 13

UNCOVERING AND CORRECTION OF WORK

13.1 UNCOVERING OF WORK

13.1.1 If any portion of the Work is covered contrary to the request of the Owner or the Design Consultant or to requirements specifically expressed in the Contract Documents or to requirements of applicable construction permits, it must, if required in writing by the Design Consultant or Owner, be uncovered for his observation and shall be replaced at the Contractor's expense.

13.1.2 If any other portion of the Work has been covered which the Design Consultant or the Owner has not specifically requested to observe prior to being covered, either may request to see such portion of the Work and it shall be uncovered by the Contractor. If such Work be found in accordance with the Contract Documents, the cost of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work be found not in accordance with the Contract Documents, the Contractor shall pay such costs unless it is found that this condition was caused by the Owner, in which event the Owner shall be responsible for the payment of such costs. If such condition was caused by a Separate Contractor, Contractor may proceed against and only against, said Separate Contractor as provided in Article 6. Any

costs to the Owner pursuant to this Paragraph shall be determined in accordance with the provisions of Article 12.

13.2 CORRECTION OF WORK

13.2.1 The Contractor shall promptly reconstruct, replace or correct portions of the Work rejected by the Design Consultant or Owner as defective or as failing to conform to the Contract Documents or as not in accordance with the guarantees and warranties specified in the Contract Documents whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such rejected portions of the Work, including compensation for the Design Consultant's and the Owner's additional construction management services made necessary thereby.

13.2.2 The Contractor, unless removal is waived by the Owner, shall remove from the site all portions of the Work which are defective or non-conforming, or if permitted or required, he shall correct such portions of the Work in place at his own expense promptly after receipt of Notice, and such rejected Work shall not thereafter be tendered for acceptance unless the former rejection or requirement for correction is disclosed.

13.2.3 If the Contractor does not proceed with the correction of such defective or non-conforming portions of the Work within a reasonable time fixed by written Notice from the Owner or Design Consultant, the Owner may either (1) by separate contract or otherwise replace or correct such portions of the Work and charge the Contractor the cost incurred by the Owner thereby and remove and store the materials or equipment at the expense of the Contractor, or (2) terminate this Contract for default as provided in Section 14.3, or both, or take any other measure allowed by law.

13.2.4 The Contractor shall bear the cost of making good all work of the Owner or Separate Contractors destroyed or damaged by such correction or removal.

13.2.5 Nothing contained in this Section 13.2 shall be construed to establish a period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents, including Section 4.6 hereof. The establishment of the time period of one year after the date of Substantial Completion or such longer period of time as may be prescribed by law or by the terms of any warranty required by the Contract Documents relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which his obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to his obligations.

13.3 ACCEPTANCE OF DEFECTIVE OR NON-CONFORMING WORK

13.3.1 If the Owner prefers to accept defective or non-conforming Work, he may do so instead of requiring its removal and correction, in which case a Change Order will be issued to reflect a reduction in the Contract Sum where appropriate and equitable, or the Owner may elect to accept payment in materials or services, in lieu of a reduction in the Contract Sum. If the amount of a reduction is determined after final payment, it shall be paid to the Owner by the Contractor.

ARTICLE 14

TERMINATION OF THE CONTRACT

14.1 TERMINATION BY THE CONTRACTOR

14.1.1 If the Work is stopped for a period of one hundred twenty (120) days by the Owner or under an order of

any court or other public authority having jurisdiction, or as a result of an act of government, such as a declaration of a national emergency making materials unavailable, and through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing any of the Work under a contract with the Contractor, then the Contractor may, upon fourteen (14) additional days' written Notice to the Owner and the Design Consultant, terminate the Contract and recover from the Owner payment on a quantum merit basis, for all Work executed for which Contractor has not previously been paid, less any amounts Contractor may owe Owner under the Contract Documents and less any amounts Owner is entitled to withhold from Contractor or backcharge to the Contractor under the Contract Documents or pursuant to law. The Contractor shall not be entitled to collect and hereby expressly waives any overhead or profit on Work not performed and any damages related to that portion of the Contract which has been terminated.

14.2 TERMINATION FOR CONVENIENCE OF THE OWNER

14.2.1 The Owner may, at any time upon ten (10) days written Notice to the Contractor and to the Contractor's Surety, which Notice shall specify that portion of the Work to be terminated and the date said termination is to take effect, terminate (without prejudice to any right or remedy of the Owner) the whole or any portion of the Work for the convenience of the Owner. The Contractor's sole remedy, in the event of such termination, will be the allowable termination costs permitted by Section 14.4. Contractor shall include termination clauses identical to Article 14 in each of his subcontracts.

14.3 DEFAULT TERMINATION

14.3.1 Ten (10) days after written Notice is mailed to the Contractor and to the Contractor's Surety, the Owner may terminate (without prejudice to any right or remedy of the Owner or any subsequent buyer of any portion of the Work) the employment of the Contractor and his right to proceed either as to the whole or any portion of the Work required by the Contract Documents and may take possession of the Work and complete the Work by contract or otherwise in any one of the following circumstances:

.1 If the Contractor or its Surety refuses or fails to prosecute the Work or any separable part thereof with such diligence as will ensure the Substantial and Final Completion of the Work by the dates specified in the Supplemental Conditions for Substantial and Final Completion or fails to complete the Work or remedy a default within said period;

.2 If the Contractor is in material default in carrying out any provisions of the Contract;

.3 If the Contractor fails to supply a sufficient number of properly skilled workers or proper equipment or materials;

.4 If the Contractor fails to make prompt payment to Subcontractors or for materials or labor, unless he otherwise provides the Owner satisfactory evidence that payment is not legally due;

.5 If the Contractor disregards laws, permits, ordinances, rules, regulations or orders of any public authority having jurisdiction, or fails to follow the instructions of the Owner;

.6 If the Contractor substantially violates any provisions of the Contract Documents; or

.7 If the Contractor refuses or fails to properly schedule, plan, coordinate and execute the Work, as specified herein, so as to perform the Work within the specified Completion Dates, or to provide scheduling or related information, revisions and updates as required by the Contract Documents.

14.3.2 The right of the Contractor to proceed shall not be so terminated under this Section 14.3 if the delays in the completion of the Work are due to unforeseeable causes beyond the control and without the fault or negligence of the Contractor or his Subcontractors as specifically set forth in Section 8.3 hereof.

14.3.3 If, after the Contractor has been terminated for default pursuant to Section 14.3, it is determined that none of the circumstances set forth in Paragraph 14.3.1 exist, then such termination shall be considered a termination for convenience pursuant to Section 14.2. In such case, the Contractor's sole remedy will be the costs permitted by Section 14.4.

14.3.4 If the Owner so terminates the employment of the Contractor due to the Contractor's default, the Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the compensation to be paid to the Contractor hereunder shall exceed the expense of so completing the Work (including compensation for additional managerial, administrative, consultant and inspection services, attorney's fees and any damages for delay) such excess shall be paid to the Contractor.

14.3.5 If such expenses referenced in Paragraph 14.3.1, shall exceed the unpaid balance, the Contractor and his sureties shall be liable to the Owner for such excess. If the right of the Contractor to proceed with the Work is partially or fully terminated, the Owner may take possession of and utilize in completing the Work such materials, appliances, supplies, plant and equipment as may be on the site of the terminated portion of the Work and necessary for the completion of the Work. If the Owner does not fully terminate the right of the Contractor to proceed, the Contractor shall continue to perform the part of the Work that is not terminated.

14.3.6 If the Owner terminates the whole or any part of the Work pursuant to Section 14.3, the Owner may procure, upon such terms and in such manner as the Owner may deem appropriate, supplies or services similar to those so terminated, and the Contractor shall be liable to the Owner for any excess costs for such similar supplies or services. The Contractor shall continue the performance of the Contract to the extent not terminated hereunder.

14.4 ALLOWABLE TERMINATION COSTS

14.4.1 If the Owner terminates the whole or any portion of the Work pursuant to Section 14.2, then the Owner shall only be liable to the Contractor for those costs reimbursable to the Contractor in accordance with Paragraph 14.4.2, plus a markup of ten percent (10%) for profit and overhead on the actual fully accounted costs specified under Paragraph 14.4.2; provided however, that if there is evidence that the Contractor would have sustained a loss on the entire Contract had it been completed, no profit or overhead shall be included or allowed hereunder for the Work performed and an appropriate adjustment shall be made reducing the amount of the settlement to reflect the indicated rate of loss. Under no circumstances shall the Contractor be entitled to any loss profit on the Work terminated pursuant to Section 14.2.

14.4.1.1 After receipt of a Notice of Termination, the Contractor shall submit to the Owner his termination Claim, in the form and with certification prescribed by the Owner. Such Claim shall be submitted promptly but in no event later than three (3) months from the effective date of termination, unless one or more extensions in writing are granted by the Owner upon request of the Contractor made in writing within such three (3) month period or authorized extension thereof. However, if the Owner determines that the facts justify such action, he may receive and evaluate any such termination Claim at any time after such three (3) month period or any extension thereof. Upon failure of the Contractor to submit his termination Claim within the time allowed, the Owner may determine, on the basis of information available to him, the amount, if any, due to the Contractor by reason of the termination and such termination shall be final and binding on the Contractor.

14.4.2 If the Owner terminates the whole or any portion of the Work pursuant to Section 14.2, the Owner shall pay the Contractor an amount for supplies, services, or property accepted by the Owner, and which is in accordance with the Contract Documents, in an amount as if the Contract had not been terminated. In addition, in such event, the Owner shall pay to Contractor an amount representing Contractor's actual cost, excluding any overhead and profit for the items and things specified in Subparagraph 14.5.1.6 and not heretofore paid for, appropriately adjusted for any saving of freight or other charges. Under no circumstances shall the Contractor be entitled to any loss profit on the Work terminated pursuant to Section 14.2.

14.4.2.1 The Contractor agrees that neither the Owner nor the Design Consultant will be liable for payments to Contractors or Subcontractors pursuant to Section 14.4.2 unless each contract and subcontract contains termination provisions identical to those set forth in this Article 14. The Owner and the Design Consultant will not be liable to the Contractor or any of the Subcontractors for any costs associated with termination if the contract or subcontract of the party involved does not include the required termination language.

14.4.3 In arriving at any amount due the Contractor pursuant to Section 14.4, there shall be deducted the following:

.1 All unliquidated advance or other payments on account theretofore made to the Contractor applicable to the terminated portion of the Contract;

.2 Any Claim which the Owner may have against the Contractor;

.3 Such amount as the Owner determines to be necessary to protect the Owner against loss because of outstanding or potential liens or claims; and

.4 The agreed price for, or the proceeds of sale of, any materials, supplies or other things acquired by the Contractor sold, pursuant to the provisions of Subparagraph14.5.1.7, and not otherwise recovered by or credited to the Owner, or returned for a refund by the Contractor.

.5 All other amounts the Owner is entitled to withhold form the Contractor or charge to the Contractor pursuant to the Contract or as allowed by applicable law.

14.4.4 The total sum to be paid to the Contractor under Section 14.4 shall not exceed the Contract Sum as reduced by the amount of payments otherwise made or to be made for Work not terminated and as otherwise permitted by the Contract. Except for normal spoilage, and except to the extent that the Owner shall have otherwise expressly assumed the risk of loss, there shall be excluded from the amounts payable to the Contractor, as provided in Paragraph 14.4.2, the fair value, as determined by the Owner, of property which is destroyed, lost, stolen or damaged so as to become undeliverable to the Owner, or to a buyer pursuant to Subparagraph 14.5.1.7.

14.5 GENERAL TERMINATION PROVISIONS

14.5.1 After receipt of a Notice of termination from the Owner, pursuant to Section 14.2 or 14.3, and except as otherwise directed by the Owner, the Contractor shall:

.1 Stop work under the Contract on the date and to the extent specified in the Notice of termination;

.2 Place no further orders or subcontracts for materials, services or facilities, except as may be necessary for completion of such portion of the Work under the Contract as is not terminated;

.3 Terminate all orders and subcontracts to the extent that they relate to the performance of the Work terminated by the Notice of termination;

.4 At the option of the Owner, and in lieu of terminating such orders and subcontracts, assign to the Owner in the manner, at the times and to the extent directed by the Owner in writing, all of the rights in the such orders and subcontracts,

.5 Settle all outstanding liabilities and all Claims arising out of such termination or orders and subcontracts, with the approval or ratification of the Owner in writing, to the extent he may require, which approval or ratification shall be final for all the purposes of this Article;

.6 Transfer title and deliver to the entity or entities designated by the Owner, in the manner, at the times

and to the extent directed by the Owner to the extent specifically produced or specifically acquired by the Contractor for the performance of such portion of the Work as had been terminated, the following:

(1) The fabricated or unfabricated parts, Work in process, partially completed supplies and equipment, materials, parts, tools, dies, jigs and other fixtures, completed Work, supplies and other material produced as part of, or acquired in connection with the performance of, the Work terminated by the Notice of termination; and

(2) The completed or partially completed plans, drawings, information, releases, manuals and other property related to the Work and which, if the Contract had been completed, would have been required to be furnished to the Owner;

.7 Use his best efforts to return for a refund or sell, in the manner, at the times, to the extent and at the price or prices directed or authorized by the Owner, any property of the types referred to in Subparagraph 14.5.1.6; provided, however, that the Contractor:

(1) Shall not be required to extend credit to any buyer, and

(2) May acquire any such property under the conditions prescribed by and at a price or prices approved by the Owner in writing; and provided further that the proceeds of any such transfer or disposition shall be applied in reduction of any payments to be made by the Owner to the Contractor under the Contract or shall otherwise be credited to the Contract Sum covered by the Contract or paid in such other manner as the Owner may direct;

.8 Complete performance of such part of the Work as shall not have been terminated by the Notice of termination;

.9 Take such action as may be necessary, or as the Owner may direct, for the protection and preservation of the property related to the Contract which is in the possession of the Contractor and in which the Owner has or may acquire an interest; and

.10 Otherwise mitigate any damages Contractor claims to suffer as a result of a termination.

14.5.2 The Contractor shall, from the effective date of termination until the expiration of three (3) years after final settlement under the Contract, preserve and make available to the Owner, at all reasonable times at the office of the Contractor, but without direct charge to the Owner, all his books, records, documents and other evidence bearing on the costs and expenses of the Contractor under the Contract and relating to the Work terminated hereunder, or, to the extent approved by the Owner, photographs, micro-photographs or other authentic reproductions thereof.

14.5.3 If the termination, pursuant to Section 14.2, be partial, the Contractor may file with the Owner a Claim for an equitable adjustment of the price or prices specified in the Contract relating to the continued portion of the Contract (the portion not terminated by the Notice of termination), and such equitable adjustment as may be agreed upon shall be made in such price or prices.
Any Claim by the Contractor for an equitable adjustment under this Paragraph must be asserted within thirty (30) days from the effective date of the Notice of termination.

14.5.4 The Contractor shall refund to the Owner any amounts paid by the Owner to the Contractor in excess of costs reimbursable under Section 14.4.

14.5.5 The Contractor shall be entitled to only those damages and that relief from termination by the Owner as specifically provided in Article 14.

ARTICLE 15

DISPUTE RESOLUTION

15.1 INITIATING CLAIMS

15.1.1 Claims must be initiated by written Notice to the Owner and to the party against whom the Claim is made with a copy to the Design Consultant. The responsibility to substantiate Claims shall rest with the party making the Claim.

15.1.2 Nothing in the Contract shall be construed as meaning that the Owner's assessment of Liquidated Damages is a Claim as defined herein, or that the Owner has the burden of proof to assess Liquidated Damages. Should the Owner assess Liquidated Damages, the burden of proving that such damages should not have been assessed shall rest upon the Contractor.

15.2 RESOLUTION OF CLAIMS AND DISPUTES BETWEEN CONTRACTOR AND OWNER

15.2.1 Claims by Contractor against Owner and by Owner against Contractor, including those alleging an error or omission by the Design Consultant shall be subject to the process set forth in this Section 15.2. Such Claims shall be referred initially to the Design Consultant for a decision. A final decision by the Design Consultant, or the failure of the Design Consultant to issue a final decision shall be required as a condition precedent to mediation or litigation of all such Claims arising prior to the date final payment is due. The Design Consultant will initially decide disputes between Owner and Contractor.

15.2.2 The Design Consultant will review Claims by Contractor and Owner against each other and within twenty (20) days of the receipt of the written Claim and take one or more of the following actions:

.1 Request additional supporting data from the claimant or a response with supporting data from the other party;

.2 Reject the Claim in whole or in part;

.3 Approve the Claim;

.4 Suggest a compromise; or

.5 Advise the parties that the Design Consultant is unable to resolve the Claim if the Design Consultant lacks sufficient information to evaluate the merits of the Claim or if the Design Consultant concludes that it would be inappropriate for the Design Consultant to resolve the Claim.

15.2.3 In evaluating Claims made under this Section 15.2, the Design Consultant may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who assist the Design Consultant in rendering a decision.

15.2.4 If the Design Consultant requests a party to provide a response to a Claim under this Section 15.2, or to furnish additional supporting data, such party shall respond, within ten (10) days after receipt of such request, and shall within such time period, either provide a response to the requested supporting data, advise the Design Consultant when the response or supporting data will be furnished, or advise the Design Consultant that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Design Consultant will either reject or approve the Claim in whole or in part.

15.2.5 The Design Consultant will approve or reject Claims under this Section 15.2 by written decision, which shall state the reason thereof and which shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Design Consultant under this Section

15.2 shall be final and binding on the parties but subject to mediation and litigation.

15.2.6 When a written decision of the Design Consultant under this Section 15.2 states that the decision is final but subject to mediation, then a demand for mediation of a Claim covered by such decision must be made within thirty (30) days after the date on which the party making the demand receives the final written decision. Any failure to demand mediation within said thirty (30) days' period shall result in the Design Consultant's decision becoming final and binding to all parties. Claims not resolved in mediation shall be subject to litigation if in accordance with the applicable statutes of limitation and repose.

15.2.7 Upon receipt of a Claim under Section 15.2 against the Contractor or at any time thereafter, the Design Consultant or the Owner may, but is not obligated to, notify the Surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Design Consultant or the Owner may, but are not obligated to, notify the Surety and request the Surety's assistance in resolving the controversy.

15.2.8 If the Design Consultant deems that a Claim under this Section 15.2 is valid, the Design Consultant shall require all parties to the dispute to share the cost of the Design Consultant's review equitably. If the Design Consultant deems that a Claim under this Section 15.2 is invalid, the Design Consultant shall require the complaining party to bear the cost of the Design Consultant's review. In any event, the Design Consultant may require the complaining party to submit a deposit equivalent to the Design Consultant's hourly rate multiplied by the amount of time the Design Consultant estimates, in the Design Consultant sole discretion, that will be necessary to review the Claim. The Design Consultant shall return any unused portion of this initial deposit to the complaining party following the Design Consultant's completion of the Design Consultant's review of the Claim. Nothing in these procedures shall entitle the Design Consultant to compensation for additional services from the Owner that is not authorized pursuant to the terms and conditions of the Agreement for Design Consultant Services.

15.3 TIME LIMITS ON CLAIMS

15.3.1 Unless a shorter time is provided in the Contract Documents, Claims by Contractor or any party except Owner must be initiated within twenty (20) days after occurrence of the event giving rise to such Claim or within twenty (20) days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. Claims against the Owner shall be initiated in strict conformance with the Contract Documents. Nothing in these procedures shall extend the period within or the manner in which Claims against the Owner must be submitted. Claims must be initiated by written Notice to the Owner and written notice to the other party and to the Design Consultant. Any Claim against the Owner that is not initiated within the applicable time period is waived. Claims by Owner may be made at any time within the applicable statute of limitations and repose.

15.4 CONTINUING CONTRACT PERFORMANCE

15.4.1 Pending final resolution of a Claim, the Contractor shall proceed diligently with the performance of the Contract, unless instructed otherwise in writing by the Owner.

15.5 MEDIATION

15.5.1 As required by N.C.G.S 143-128 (f1), any Claim as defined herein, which exceeds fifteen thousand dollars($15,000.00), and which concerns a party involved in the Project, including the Owner, Contractor, Design Consultant, any construction manager, Separate Contractors, or first and lower tier Subcontractors and which arise out of the Contract or the construction process, except those waived Claims shall, be subject to mediation as a condition precedent to the institution of legal proceedings by any party, except that any party may institute legal proceedings or perfect any mechanic's or materialmen's lien in order to meet any applicable statute of limitations or similar deadline prior to engaging in mediation.

15.5.2 The parties shall endeavor to resolve their Claims under this Section 15.5 by mediation which, unless the

parties mutually agree otherwise, shall be in accordance with the rules established by the Owner.

15.5.3 The parties shall share cost of the mediation equally except that if the Owner is a party to the dispute, the Owner shall pay at least one third of the cost of the mediation.

15.5.4 The mediation shall be held in a place where the Project is located, unless another location is mutually agreed upon.

15.5.5 Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

END OF GENERAL CONDITIONS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all materials, labor, tools, supplies, equipment, transportation, superintendence, temporary construction of every nature, insurance, taxes, contributions and all services and facilities, unless specifically excluded, and install materials, items and equipment required to complete the construction of the Project as set forth in the Contract Documents.

B. Documents:
   1. Drawings are listed on the Cover Sheet of the Drawings.
   2. Specifications are listed in the Table of Contents of this Project Manual, showing Divisions and the related Sections.

C. Contract: The work will be constructed under a Contractor at risk contract. The Contractor shall act as project expeditor and coordinator for the Project.

D. Related Work of Other Contracts: Cooperate and coordinate his work with work provided under other contracts. Separate contracts will include, but not necessarily be limited to the following:
   1. Furniture, Fixtures and Equipment (except as indicated)
   2. N.I.C. (Not In Contract) Work

1.2 SPECIAL SAFETY CONSIDERATIONS (ASBESTOS)

A. Restrictions on Asbestos Use: All Contractors shall certify, and furnish manufacturer's certification, that no new materials used in the construction of this work contains any form of asbestos.

1.3 CONTRACTOR'S SCHEDULING RESPONSIBILITIES

A. Project Expediting: For purposes of expediting the work, construction supervision and administration, the Contractor shall be responsible for publishing, the project schedule and monitoring the schedule progress. Initial approval of the schedule is subject to the Architect and Owner's Representative review. Refer to Section 01 33 00 - Submittal Procedures for additional information.

B. The Contractor shall have the following responsibilities:
   1. Schedule the work of all subcontractors, and any other separate contractors**;**
   2. Maintain a progress schedule for all subcontractors, and any other separate contractors;
   3. Provide adequate notice to all subcontractors, and any other separate contractors**;** to insure efficient continuity of all phases of the work;
   4. Notify the Architect of any changes in the Project Schedule
   5. Cooperate with and obtain from the subcontractors, and any other separate contractors on the job their respective schedules and to integrate them into a Project Progress Schedule that will show graphically, by a CPM logic generated detailed bar chart, CPM or other acceptable and approved methods, the projected progress of the job from start to finish and within the allotted time frame

1.4 CONTRACTOR'S USE OF PREMISES

   1. Complete within the limits indicated on the Drawings.
   2. Upon Notice to Proceed, the Owner will make the areas or the Project site designated to receive the new addition available to the Contractor for the operation under the Contract.
   3. Confine operations at Project Site to areas permitted by law, ordinances, permits, Contract Documents and Owner.

4. Do not unreasonably encumber site with materials and equipment or block the Owner's access.
5. Do not load structure with weight that will endanger structure.
6. Assume full responsibility for protection and safekeeping of products stored on premises.
7. Move stored products, which interfere with operations of Owner and other Contractors.
8. Obtain and pay for use of additional storage, parking and work areas needed for operations.
9. Cooperate and coordinate Contractor's work and subcontractor's work, and any other separate contractors including access to the Work.

A. Partial Owner Occupancy
   1. Owner reserves the right to use and occupy in whole or any part of the improvements which have been completed sufficiently to permit use and occupancy without delaying Contractor's work. Use and occupancy by Owner shall not, however, be construed as acceptance of Work or any part, and any claim, which Owner may have against Contractor shall not be deemed to have been waived by occupancy. If prior use of the work delays the scheduled completion, Contractor shall be entitled to extension of time. Claims shall be in writing and shall be substantiated with supporting data.
   2. Execute Certificate of Substantial Completion for each specific portion of the Work prior to Owner occupancy.
      a. After Owner occupancy Contractor shall allow:
         1) Access for Owner's personnel
         2) Access for the public.
         3) Operation of the HVAC, plumbing and electrical systems for occupied areas.
         4) Owner's security and protection of occupied areas.
         5) Owner's maintenance of occupied areas.
         6) Owner's insurance for occupied areas.

      b. Upon occupancy the Owner will provide:
         1) Operation of HVAC, plumbing and electrical systems for occupied areas.
         2) Security and protection of occupied areas.
         3) Maintenance of occupied areas.
         4) Insurance for occupied areas.

B. Phasing of Work: After receipt of Notice to Proceed, the Contractor shall erect the temporary barricades or fences shown on the drawings.

1.5 CONTRACTOR'S RESPONSIBILITIES

A. Review and check shop drawings, product data and samples. Submit to Architect/Engineer with notification of any discrepancies or problems anticipated in the use of the product.

B. Receive, unload and handle products at the site, including uncrating and storage.

C. Protect products from exposure to the elements and from damage.

D. Assemble, install, connect, adjust and finish products, as stipulated in the respective sections of the Specifications.

E. Repair or replace damaged items.

F. Pay all required sales, consumer and use taxes and report tax paid with each pay application.

G. Secure, as necessary for the execution of the Work and as applicable, all permits and licenses.

H. Give all notices required by the Contract Documents or by governing regulations.

I. Comply with codes ordinances, rules, regulations, orders and other legal requirements of public authorities which pertain to proper performance of the Work, and promptly submit written notice to the Architect of any observed variance of the Contract Documents from legal requirements.

J. Enforce proper discipline and good order among employees at all times. Employees and subcontractors shall not in any manner interfere with or cause any form of nuisance to the Owner's workers or the building occupants.

K. Cover, protect and final clean any of the Owner's furnishings and equipment which remain in those spaces where his work will be performed.

L. Clean work areas after completion of the work and replace or repair any of Owner's furnishings and equipment damaged in the course of the work.

M. Maintain erosion control measures after every rain. Provide all measures necessary to control run-off.

N. Keep site clean and tidy at all times.

O. Contractor is advised that the Owner expects that the time between Notice to Proceed and the release to begin work at the job site to be used productively in preparation for the start of work. Activities which do not require The Contractor's physical presence on the site, such as, subcontractor negotiations, material purchases and deliveries, processing of shop drawings, schedule preparation, and other related functions in support of the field operations should be initiated upon receipt of NTP. No requests for time extensions resulting from The Contractor failure to initiate preparatory work upon Notice to Proceed will be accepted.

P. Comply with CMS Prequalification Policy.

Q. Comply with CMS BIM Standards.

1.6 SITE CONDITIONS

A. Sub-surface Soils Investigations

1. Information concerning a sub-surface soil investigation by an independent testing laboratory is available and may be included in the Project Manual. The data included therein is not a part of the Contract Documents and may be used by the Contractor for his general information only. The Architect and Owner will not be responsible for the accuracy or applicability of the data given therein.
2. Contractor shall make any additional investigations deemed necessary to properly bid or complete any and all work related thereto. No additional amounts will be made available to the Contractor for work arising from failure to examine the Project Site or subsoil conditions unless specifically provided for elsewhere in the Specifications for this project.

B. Survey of Existing Conditions:

1. Contractor acknowledges by executing the Agreement, that he had visited and inspected the Project Site on which the Work is to be performed, that he has satisfied himself as to the nature and location of the Work, including any obstruction, amount of work, actual levels, the equipment and facilities needed preliminary to and during the prosecution of the Work and all other matters which can in any way affect the Work or the cost thereof under this Contract.
2. Contractor shall locate all public and private drainage or sewer lines, water, gas, and other utility and electrical service lines, piping and conduits in the way of new work. He shall see that services which are to be removed have been capped or plugged and made gas and water tight in conformance with applicable requirements of governing authorities and utility firms.

3. Failure by Contractor to have acquainted himself with available information concerning site conditions, including factors affecting costs and liabilities, shall not relieve Contractor of responsibility for performance of work in accordance with requirements of Contract Documents and for amount of consideration named or otherwise determined.
4. Contractor shall maintain all existing services to existing facilities.

C. Concealed Utilities: When concealed utilities or services, which are not on the Drawings, are encountered during construction operations, the Contractor shall trace the services and determine which are active and which are abandoned. Abandoned lines shall be removed and capped or plugged as required. Active lines shall be relocated as required. The Contractor shall submit a sketch indicating the proposed relocations of such active lines. Materials to be used shall be those specified in the applicable Sections, where possible and shall match the existing installations where suitable materials are not specified.

1.7 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. This Project Manual utilizes industry standard conventions as follows in the use of language and the intended meaning of certain terms, words, and phrases:
1. Abbreviated language: Language used in Specifications and other Contract Documents is the abbreviated type. Implied words and meanings will be appropriately interpreted. Singular words will be interpreted as plural and plural works interpreted as singular where applicable and the full context of the Contract Documents so indicates.
2. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.
a. The words “shall be” shall be included by inference wherever a colon (:) is used within a sentence or phrase.

END OF SECTION

SECTION 011400 – WORK RESTRICTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contractor's use of site and premises.
2. Coordination with occupants.
3. Work restrictions.

1.2 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, Lessee, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.3 COORDINATION WITH OCCUPANTS

A. Partial Occupancy: Lessee (Department of Motor Vehicles) will occupy a portion of the premises at the 6635 Executive Circle building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with and outside of the DMV’s hours of operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.4 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Normal business working hours are 7:00 a.m. to 6:30 p.m., Monday through Friday, and 10:00 a.m. to 6:30 p.m. on Saturdays, Sundays, and holidays. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction

1. “Holidays” are defined as New Year’s Day, Martin Luther King Day, Presidents’ Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans’ Day, Thanksgiving, and Christmas.
2. Indoor construction activity, defined as activity occurring entirely within a structure fully enclosed on all sides by installed exterior walls, windows, and/or doors, shall end at midnight each day, and any such activity that occurs after 6:30 p.m. shall not annoy or disturb reasonable persons of normal sensitivities.
3. Provide a minimum of one sign per street front indicating the permissible hours of construction around the construction site. Place one additional sign within the construction trailer containing the same information. Provide a written copy of the permissible hours of construction to all subcontractors.

C. On-Site Work Hours, Lessee-Occupied Building: Limit working hours to work outside of 8:00 a.m. to 5:00 p.m., Monday through Friday, and weekends. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction

1. Lessee-Occupied Space: Following any work in DMV, space must be returned to fully occupiable condition for the next business day.

D. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

E. Controlled Substance Restrictions: Use of controlled substances on Owner's property is not permitted.

F. Additional Work Restrictions: Comply with the following requirements:

1. Use of improper language and fraternization by Contractor's employees with occupants and Owner staff are prohibited.
2. Contractor is responsible for protection and safekeeping of Products under this Contract stored at Project site or remotely.
3. Contractor shall, at his option, obtain and pay for the use of additional storage or work areas needed for operations.
4. Repair damage to existing structures, equipment of furnishings resulting from Contractor's use of premises.
5. No hoisting shall be allowed over the occupied portion of buildings when the building is occupied.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012100
ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Lump-sum allowances.

C. The Contract Sum and Contract Time includes those allowances listed in this Section. Secure proposals and provide submittal data for allowance items required by the Contract allowing adequate time for the Owner’s selection to be made without delays to the Work.

1. References to allowances within Specification Sections that are not indicated in this Section are not part of the Contract Documents.

D. Whenever actual costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect the difference between the amount of the allowances and Contractor's actual costs.

E. Related Requirements:

1. Section 012200 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.

1.2 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

D. Prior to beginning Work on any of the scheduled allowances, submit product data, shop drawings, samples, and other submittals indicated in Section 01 33 00 "Submittal Procedures" and the corresponding individual specification sections.

1.4 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance upon Owner request.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance upon Owner request.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 LUMP-SUM ALLOWANCES

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

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.7 QUANTITY ALLOWANCES

A. Not applicable.

1.8 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare an explanation and documentation to substantiate distribution of overhead costs and other markups.
3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF QUANTITY ALLOWANCES

A. Not applicable.

3.4 SCHEDULE OF LUMP SUM ALLOWANCES

A. The following lump sum allowances are to be included in the Contract Sum and include all costs as indicated in General Conditions.

B. Door Hardware Attic Stock: The Owner will identify which door hardware products will be provided by the Contractor for attic stock use with these funds

1. Allowance Amount: $5,000.00

C. Loading Dock Ramp: The Contractor will use this allowance for preventive maintenance to the loading dock ramp system prior to Commissioning of the project to ensure the system operates per the manufacturers specifications

1. Allowance Amount: $2,000.00

D. Unallocated Owner’s Allowance: The Contractor will include this allowance for the Owners sole use regarding additional scope required to be completed prior to substantial completion of the project.

1. Allowance Amount: $100,000.00

END OF SECTION 012100

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SECTION 012200
UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

1.2 DEFINITIONS

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

1.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. The Owner reserves the right to reject Contractor's Bid unit price that is considered to be inequitable to the Owner and establish a new unit price for payment of the work or utilize one of the other methods of compensation listed under Changes in the Work to establish a price for changes in the Work.

E. Schedule of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

1. References to Unit Prices within Specification Sections that are not indicated in this Section are not part of the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF GENERAL BUILDING UNIT PRICES

A. UP-1 Provide price to furnish and install #57 stone structural backfill.

B. UP-2 Provide price to remove and replace 4” floor slab.

C. UP-3 Provide an additional standard 15-amp duplex receptacle, 50’ of MC cabling, and new circuit breaker.

D. UP-4 Provide price to install a new exit sign and 100’ of emergency circuit wiring.

E. UP-5 Provide price for an additional horn strobe device including 100’ of protected wiring and FACP programming.

F. UP-6 Provide price for voice/data drop from 0 to 150’, include cable, wall plate outlet, wall jack, & hangers.

G. UP-7 Provide price for voice/data drop from 150’ to 295’, include cable, wall plate outlet, wall jack, & hangers.

H. UP-8 Provide price for an additional fire extinguisher and cabinet.

I. UP-9 Provide price to install, finish, and paint 10 foot tall double sided 4 inch gypsum board wall.

J. UP-10 Provide price to repaint wall to match existing paint color.

K. UP-11 Provide price to replace exterior plaster found to be unsuitable in addition to that indicated on Drawings.

L. UP-12 Provide price to replace joint sealant at Building 6600 in addition to that indicated on Drawings.

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate. Include costs of related coordination, revision, or adjustment.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

D. References to Alternates within Specification Sections that are not indicated in this Section are not part of the Contract Documents.

1.4 OWNER ACCEPTANCE OF ALTERNATES

A. The Owner reserves the right to accept alternates and to amend the Contract accordingly during the period of the Contract. The price for each alternate indicated on the Bid Form shall remain valid for a period of 90 days from the receipt of Bids.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF BUILDING ALTERNATES

A. **Modifications below indicate Owner accepted alternates**.

~~B. Alternate No. A: Wood and Plastic Laminate Cabinet Quality Certification.~~

~~1. Base Bid: Provide cabinet work as specified in Section 064113 "Wood-Veneer-Faced Architectural Cabinets," Section 064116 "Plastic-Laminate-Faced Architectural Cabinets" and Section 123623 "Plastic Laminate-clad Countertops" to include AWI QCP certification specified.~~

2. ~~Alternate: Provide cabinet work as specified in Section 064113 "Wood-Veneer-Faced Architectural Cabinets," Section 064116 "Plastic-Laminate-Faced Architectural Cabinets" and Section 123623 "Plastic Laminate-clad Countertops" without AWI QCP certification~~.

C. Alternate No. B: Owner-Preferred Alternate – Restricted Keyway Cylinder.

1. Base Bid: Provide restricted keyway cylinder from one of the following: Schlage (C145), Sargent (XC), Corbin Russwin (Access3).
2. Alternate: Provide Schlage C145 restricted keyway cylinder in lieu of keyway cylinders of other listed manufacturers

D. Alternate No. C: Provide solid surface countertops at all locations where plastic laminate countertops are indicated.

1. Base Bid: Provide plastic laminate countertops where indicated.
2. Alternate: Provide solid surface countertops at all locations where plastic laminate countertops are indicated. Refer to construction drawings for product specifications to be provided.

3.2 SCHEDULE OF MEP ALTERNATES

A. Alternate No. D: Enameled cast iron lavatories.

1. Base bid: Equal to the manufacturers listed in specification section 224216.13 "Commercial Lavatories".
2. Alternate: Provide lavatory as manufactured by American Standard.

B. Alternate No. E: Controls System Extended Warranty.

1. Base Bid: Provide two-year warranty for Controls as specified in Section 230900 "Instrumentation and Control For HVAC."
2. Alternate: Provide five-year warranty for Controls in lieu of two-year warranty as specified in Section 230900 "Instrumentation and Control For HVAC."

~~C. Alternate No. F: Access control card readers and electronic hardware at IDF and MDF rooms.~~

~~1. Base Bid: Mechanically latching door hardware for IDF and MDF rooms as specified in Section 087100 "Door Hardware."~~

2. ~~Alternate: Provide access control card reader and electronically activated door hardware for IDF and MDF rooms as indicated as an Alternate in Section 087100 "Door Hardware~~."

3.3 SCHEDULE OF SITEWORK ALTERNATES

A. Alternate No. G: Precast concrete bollards at front entrance.

1. Base Bid: Steel pipe bollards at front entrance / car drop off area.
2. Alternate: Provide precast concrete bollards in lieu of steel bollards as indicated on Sheet C3.01 and as specified in Section 034800 "Precast Architectural Concrete Specialties."

END OF SECTION 012300

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SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. During bidding period, the Bidders shall comply with the substitution request procedures specified in Section 00 26 00 - Procurement Substitution Procedures.

B. This Section specifies administrative and procedural requirements for handling requests for substitutions proposed by the Contractor after the award of the Contract.

C. The substitution process is available as a means to promote fair and open procurement by the Charlotte Mecklenburg Board of Education, and not to provide the Contractor the opportunity to substitute products of an inferior quality. To that end, the Owner reserves the right to reject a product not deemed an equal to the product specified; charge the Contractor for the Additional Services, if required, of the Architect; or require an equitable credit for the substituted product.

D. This section specifies administrative and procedural requirements for handling requests for substitutions made after award of the Contract.

E. Procedural requirements governing the Contractors selection of products and product options are included in Section 01 60 00 Product Requirements.

1.2 DEFINITIONS

A. Definitions used in the Article are not intended to change or modify the meaning of other terms used in the Contract Documents.

B. Substitutions: Requests for changes in products, materials, equipment and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions". The following are not considered substitutions:

1. Revisions to Contract Documents requested by the Owner or Architect.
2. Specified options of products and construction methods included in Contract Document.
3. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.3 SUBMITTALS

A. Substitution Request Submittal: Requests for substitution will be considered if received within thirty (30) days after the Notice to Proceed, or Letter of Intent, whichever comes first. Requests received more than thirty (30) days after the commencement of the work may be considered or rejected at the discretion of the Architect. Substitution items submitted without requests will be rejected.

1. Submit three (3) copies of each request for substitution for consideration. Submit requests in the form and in accordance with the procedures required for change order proposals.
2. Clearly indicate on the transmittal that the product being submitted is a substitution. Do not include on the same transmittal, any product that is not a substitution.
3. Provide a credit change order proposal if the substitution is intended to provide the Owner a product of a lesser value than the value of the specified product.

4. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions and the following information as appropriate:
   a. Product Data, including Drawings and descriptions of products, fabrications and installation procedures.
   b. Samples, where applicable or requested.
   c. A detailed comparison of significant qualities of the proposed substitution with those for the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
   d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors, which will become necessary to accommodate the proposed substitution.
   e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
   f. Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents and that it will perform adequately in the application intended. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
   g. Cost information, including a proposal of the net change, if any in the contract sum.

5. Architect's Action: The Architect may request additional information or documentation necessary for evaluation of the request. The Architect will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made, use the product specified by name.

1.4 PROCEDURES

A. Reference in the project manual or on the drawings to an article device, product, material, fixture, form or type of construction by name, make or catalog number (product or method) whether or not followed by "or equal" establishes a standard of quality, and does not eliminate from competition other products or methods of equal or better quality by other manufacturers, where fully suitable, as approved by the Architect. Applications for approval of substitutions for the specified products or methods will be considered only upon request of the Contractor, not of Subcontractors individual trades or suppliers, and only for a specific purpose; no blanket approvals will be granted. No approval of a substitution will be valid unless it is in written form.

B. If a proposed substitution affects a correlated function, adjacent construction, or the Work of other Contractors, then the necessary changes and modifications to the affected Work are considered an essential part of the proposed substitution, to be accomplished by the Contractor as a part of the Work, if and when approved. Submit detailed drawings and other information necessary to show and explain the proposed modifications with the request for approval of the substitution. The Contractor agrees to include data to substantiate that the proposed substitution is in compliance with the Contract Documents and that the operation and maintenance costs are equal to or less than those for the named products.

C. No substitutions will be allowed when the phrase "no substitutions" or "no substitutions will be allowed" or words or similar effect, is specified or indicated with products or methods or when three or more manufacturers, suppliers, or products are specified, without the words "or equal."

D. The following information is required if, the Contractor desires to submit a substitute product or method in lieu of what has been specified or shown in the Contract Documents:

1. Full explanation of the proposed substitution and submittal of all supporting data including technical information, catalog cuts, warranties, performance and test results, installation instruction, operating procedures, samples where applicable and other like information necessary for a complete evaluation of the substitution and an itemized comparison of the proposal substitution with the product specified relating to such thing as capacities, operation, functions, dimensions, construction details, methods of assembly connections installation, design and artistic effect where applicable and relationship to other Prime separate contracts.
2. Reasons the substitution is advantageous and necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable.
3. The adjustment, if any, the Contract Sum, in the event the substitution is acceptable. Each substitution must be accompanied by accurate cost data on proposed substitution in comparison with specified product whether or not a Contract sum modification is to be a consideration.
4. The adjustment, if any, in the time of completion of the Contract and the Construction Schedule in the event the substitution is acceptable. Any delays to other Primes must be taken into consideration with any substitution request. Delay damages will be paid by for by the Party requesting a substitution who will hold the Owner and Architect harmless for any delay damages arising out of approval of a substitution.

E. An affidavit stating that (1) the proposed substitution conforms and meets all the requirements of the pertinent Specifications and the requirements shown on the Drawings and (2) the Contractor accepts the warranty and correction obligations in connection with the proposed substitution as if originally specified by the Architect, (3) represents that he or she personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that which is specified; and will provide the same guarantee for the substitution that would otherwise be provided for the product which is specified: (4) Certifies that the cost data presented is complete and includes all related costs under this Contract, but excludes costs under separate contracts and the Architect's re-design costs, and that he or she waives all claims for additional costs related to the substitution which subsequently became apparent: (5) will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

F. Proposals for substitutions shall be submitted in triplicate to the Architect in sufficient time to allow the Architect no less than ten (10) working days for review before a product will be ordered to allow delivery on the date required by the schedule but in no case less than fifteen (15) days after the date of the date of execution of the Contract. No substitutions will be considered or allowed without the Contractor's submittal of complete substantiating data and information as stated hereinbefore.

G. Substitutions will not be considered without the formal request as required in accordance with the contract terms.

H. Substitutions and alternates may be considered only if:
1. Required for compliance with building code requirements or insurance regulations then existing.
2. Specified products are unavailable, through no fault of the Contractor.
3. Subsequent information discloses that specified products will not perform properly or fit in designated space.
4. A manufacturer/fabricator refuses to certify or guarantee performance of a specified product as required or;
5. In the judgment of the Owner or the Architect, a substitution would be substantially in the Owner's best interests, in terms of cost, time, or other considerations.

I. In the case of Contractor-proposed substitutions which fail to meet the requirements of Contract Documents, the Contractor shall, at the sole election of the Owner, reimburse the Owner for any fees charged by the Architect or other consultants for evaluating each such proposed substitute.

J. No change in brand or make will be permitted unless (i) satisfactory written evidence is presented to demonstrate that the manufacturer cannot make scheduled delivery of an approved item and that such delivery failure will adversely affect the project's critical path, (ii) the item delivered has been rejected and the substitution of suitable item is required to maintain the project's critical path, or (iii) other conditions have become apparent which indicate that approval of such other material is, in the sole opinion of the Architect, in the best interest of the Owner.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Conditions: The Contractor's substitution request will be received and considered by the Architect when all of the following conditions are satisfied, as determined by the Architect; otherwise, requests will be returned without action except to record noncompliance with these requirements.
1. Extensive revisions to Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of Contract Documents.
3. The request is timely, fully documented and properly submitted.
4. The request is directly related to an "or-equal" clause or similar language in the Contract Documents.
5. Where a proposed substitution involves more than one (1) prime Contractor, each Contractor shall cooperate with the other Contractors involved to coordinate the Work, provide uniformity and consistency and to assure compatibility of products.
6. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
7. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Architect for re-design

and evaluation services, increased cost of other construction by the Owner or separate Contractors and similar considerations.

B. The Contractor's submittal and Architect's acceptance of Shop Drawings, product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an approval or valid request for substitution.

PART 3 - EXECUTION
(Not Used)

END OF SECTION

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SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

1. Provisions of this Section apply to the Work of each Contractor.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Section 01 22 00 - Unit Prices: for administrative requirements governing use of unit prices.
2. Section 01 25 00 - Substitution Procedures: for administrative procedures for handling requests for substitutions made after award of the Contract.
3. Section 01 29 00 - Payment Procedures: for administrative procedures governing applications for payment.
4. Section 01 33 00 - Submittal Procedures: for requirements for the Contractor's Construction Schedule.

1.2 MINOR CHANGES IN THE WORK

A. Supplemental instructions authorizing minor changes in the Work, not involving an adjustment to the Contract Sum or Contract Time, will be issued by the Architect on AIA form G-710, Architect's Supplemental Instructions.

1. Proposal requests issued by the Architect are for information only. Do not consider them an instruction either to stop work in progress, or to execute the proposed change.
2. Unless otherwise indicated in the proposal request, within ten (10) days of receipt of the proposal request, submit to the Architect for the Owner's review an itemized estimate of the cost necessary to execute the proposed change.
    a. Itemize materials and labor separately. Include a list of quantities of products to be purchased and unit costs, along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental and amounts of trade discounts and/or mark-ups.
    c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time; including a detailed of time necessary to procure and perform the work and which activities on the schedule are effected.
3. The proposal (quotation) if accepted will be binding on the Contractor and shall be the only compensation to the Contractor for the change. A Contractors delay in submitting the proposal by the Contractor will not entitle the Contractor to an extension of time or damages for delay.

B. Contractor-Initiated Change Order Proposal Requests: When latent or other unforeseen conditions require modifications to the contract, the Contractor may propose changes by submitting a request for a change to the Architect within seven (7) days of the occurrence of the event or item of latent or unforeseen work giving rise to the assumed change.

1. Include a statement outlining the reasons for the change and the affect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time. Including a detailed schedule of time necessary to proceed and perform the work and which actions on the schedule are effected.
2. Include a list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Where requested, furnish survey date to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. Comply with requirements in Section "Product Substitutions: if the proposed change in the work requires the substitution of one product or system for a product or system specified.

C. Proposal Request Form: Use AIA Document G-709 for Change Order Proposal Requests.

D. Cost of change Format shall follow that outlined in Document 00 63 63 - Change Order Form

E. The proposal (quotation) if accepted will be binding on the Contractor and shall be the only compensation to the Contractor for the change. A delay in submitting the proposal by the Contractor will not entitle the Contractor to an extension of time or damages for delay. The Architect will have fourteen (14) days to review the proposal during which time he may request additional information to backup the claim. No delay to the project will be considered until at least twenty-one (21) days after the proposal is submitted and will then only be considered if the net effect on the schedule can be clearly shown.

1.3 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: When the Owner and Contractor are not in total agreement on the terms of a Change Order Proposal Request; the Architect may issue a Construction Change Directive on AIA Form G-714, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. The Construction Change Directive will contain a complete description of the change in the Work and designate the method to be followed to determine change in the Contract Sum or Contract Time.
   2. The Contractor will be required to submit unit costs, equipment rates and labor rates as requested by the Architect which shall be agreed upon before the work progresses unless the Contractor is directed to proceed in the absences of an agreement or in an emergency.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive. Provide a copy of those records by daily fax or weekly mail to the Owner and the architect.
   1. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.4 CHANGE ORDER PROCEDURES

A. Upon the Owner's approval of a Change Order Proposal Request, the Architect will issue a Change Order for signatures of the Owner and Contractor on AIA Form G-701, as provided in the Conditions of the Contract.

B. A fully executed Change Order is the only legal document which can change the Contract Sum or Time.

PART 2 - PRODUCTS
(Not Used)

PART 3 - EXECUTION
(Not Used)

END OF SECTION

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements governing Contractor's Applications for Payment.

1. Coordinate the Schedule of Values and Applications for payment with the Contractor's Construction Schedule, list of Subcontracts and Submittal Schedule.

B. The Contractor's construction Schedule and Submittal Schedule are included in Section 01 33 00 - Submittal Procedures.

1.2 SCHEDULE OF VALUES

A. Coordinate preparation of the Schedule of Values with preparation of the Contractor's Construction Schedule.

B. Submit the Schedule of Values (including quantities if required by the owner) to the Architect in accordance with the contract. The schedule of values must be received and approved before the first pay application will be processed.

C. Format and Content: The Schedule of Values will be subdivided on a building-by-building, phase-by-phase or area-by-area basis dependent upon the phasing permitting and/or completion sequence of the project.

Provision of quantity information requested on the schedule of values in no way alters the Contractors responsibility to provide all material and labor necessary to complete the project.

1. Identification: Include the following Project identification on the Schedule of Values:
   a. Project name and location.
   b. Name of the Architect.
   c. Project number (as assigned by Owner).
   d. Contractor's name and address.
   e. Date of submittal.

2. Arrange the Schedule of Values in a tabular form utilizing AIA Document G-703 continuation sheets of the Application for Payment or another format acceptable to the Owner and indicate the following:

   a. General name of Product/Work.
   b. Related Specification Section.
   c. Name of subcontractor.
   d. Name of manufacturer, fabricator or supplier.
   e. Change Orders (numbers) that have affected value.
   f. Separate Dollar values for Material and Labor.
   g. Percentage of Contract Sum to the nearest percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principle subcontract amounts down into several line items.

4. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.

5. The Schedule of Values results in a change in the Contract Sum.

1.3 APPLICATIONS FOR PAYMENT:

A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by the Owner

B. Use AIA Document G-702 and Continuation Sheets as the form for Application for Payment.

C. At the project close-out and prior to final payment the Contractor shall submit a final summary report certifying actual M/WBE firms on the project and contract amounts paid.

D. Transmittal: Submit five (5) executed copies of each Application for Payment to the Architect at the monthly meeting.

E. Prior to the initial Application for Payment the following must be submitted:
1. List of subcontractors.
2. List of principal suppliers and fabricators.
3. Schedule of Values.
4. Contractor's Construction Schedule (preliminary if not final. Final with 2nd application).
5. Submittal Schedule (preliminary if not final. Final with 2nd application).
6. List of Contractor's staff assignments.
7. Copies of building permits.

F. Monthly Applications for payment should be accompanied by the following documents.
1. Sales and Use Tax form.
2. Surety Statement (On form as agreed to by the Owner)
3. MWSBE participation form
4. Updated Project Progress Schedule (hard copy and electronic format)
5. Supporting backup in the form of prime (plumbing, HVAC, electrical) subcontractor pay applications.
6. Construction Waste Report
7. Stored material forms
8. NPDES Storm water Discharge Reports

G. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work. Administrative actions and submittals that shall proceed or coincide with this application include:

1. Occupancy permits and similar approvals.
2. Warranties (guarantees) and maintenance agreements.
3. Test/adjust/balance records.
4. Maintenance instructions.
5. Meter readings.
6. Change-over information related to Owner's occupancy, use, operation and maintenance.
7. Final cleaning.
8. Application for reduction of retainage and consent of surety.
9. Advise on shifting insurance coverage.
10. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.
11. Architect's Certificate of Compliance required by NCGS #133-1.1
12. Change of door locks to owner's access and furnish keys to owner's representative.

H. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:
1. Completion of Project close-out requirements.
2. Completion of items specified for completion after Substantial Completion.
3. Affidavit of Prime Contractor (AIA Document G-706).
4. Affidavit of Release and Waiver of Claims (AIA Document G-706-A).
5. Consent of Surety to Final Payment.
6. Transmittal of required Project construction records to Owner.
7. Certified property survey.

8. Proof that taxes, fees and similar obligations have been paid.
9. Removal of temporary facilities and services.
10. Removal of surplus materials, rubbish and similar elements.
11. As-built drawings.
12. Certificate of Occupancy.
13. All warranties properly executed.
14. Documentation that all utility turnovers have been made.

I. Payments shall be made on account of materials delivered and suitably stored at the Project for subsequent incorporation into the Work. Applications for payment which include stored materials must include an itemized list of materials stored, place of storage, location and phone number, itemized attached invoices, receipts, vouchers or other documentation substantiating the value that shall not in an aggregate amount exceed the Schedule of Values amount. Rental equipment such as, but not limited to, mobile equipment, pans, forms, scaffolding, compressors, etc., shall not be considered material stored. With the Owner's prior written permission, the Contractor may be paid for material stored off the Project site if stored in a licensed, bonded, warehouse, available for inspection by the Owner's Representative and Architect. The Application for Payment for any materials approved to be stored offsite shall accompanied by Insurance Certificate naming the Owner as additional insured and a copy of Owner's written consent to storage offsite. All insurance policies shall be endorsed to include the company's obligation to notify the Owner in writing in the event of cancellation nonrenewable for a period at least 30 days prior to termination. Payment for materials stored on or off site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site. Materials stored off-site shall be marked "Property of Charlotte-Mecklenburg Board of Education".

1. Costs incurred by the Owner and/or Architect to inspect material in off-site storage shall be paid by the Contractor. The Owner and/or Architect's Cost for inspections of off-site stored materials will include his Time (Travel, Site Observation, and Office related duties), the cost of Engineering Consultants if their services are needed, and will also include his/their travel expenses.
2. Subsequent pay requests shall itemize the materials and their cost which were approved on previous pay requests and remain in offsite storage.

PART 2 - PRODUCTS
(Not Used)

PART 3 - EXECUTION
(Not Used)

END OF SECTION

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SECTION 01 31 13
PROJECT COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and supervisory requirements for Project coordination including, but not limited to:
   1. Coordination
   2. Administrative and supervisory personnel
   3. General installation provisions
   4. Cleaning and protection

B. The Contract Documents include, but are not limited to, the Drawings and Project Manual (including the Technical Specifications); each Contractor is expected to review and coordinate the Work of their Contract with that of the other Contractors resulting in the timely construction of the Project, and meeting the quality standards developed by the Contract Documents.

C. Progress meetings, coordination meetings, and pre-installation meetings are included in Section 01 31 19 - Project Meetings.

D. Requirements for the Contractor's Construction Schedule are included in Section 01 33 00 - Submittal Procedures.

1.2 COORDINATION

A. Coordination: Coordinate construction activities included under various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation, connection and operation.
   1. Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.
   2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.
   4. Prior to installation, verify that utility requirements and characteristics of equipment are compatible with building utilities. Coordinate Work of various sections having interdependent responsibilities for installing, connecting to and placing in service of such equipment.

B. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports and meeting attendance.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to the following:
   1. Preparation of schedules
   2. Installation and removal of temporary facilities
   3. Delivery and processing of submittals
   4. Representation at Project Meetings
   5. Project Closeout activities

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water and materials.

E. The Contractor and affected subcontractors will coordinate their efforts with the Owner's Commissioning Agent. It is the responsibility of the Contractor and the subcontractors to provide all required labor and/or materials to comply with the commissioning plan provided by the Commissioning Agent. A copy of the Commissioning Plan is included in the Project Manual.

F. The Contractor and affected subcontractors will coordinate their efforts with the Owner's Playground Contractor.

G. The Contractor and affected subcontractors will coordinate their efforts with the Owner's building and roofing consultant. Selected submittals will be issued to them for review and comment.

H. RFI's shall be utilized to request design clarifications in accordance with the contract.

1.3 SUBMITTALS

A. Coordination Drawings: Prepare and submit coordination documents as required by the BIM standard and/or drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.

1. Show the interrelationship of components shown on separate Shop Drawings
2. Indicate required installation sequences
3. Comply with requirements contained in Section 01 33 00 - Submittal Procedures

B. Staff Names: Within ten (10) days of Notice to Proceed, submit a list of the Contractor's principal staff assignments, including the Superintendent and other personnel, with contact information, in attendance at the site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers and if requested separately provide a list of their past experience on similar work.

1. Post copies of the list in the Project meeting room, the temporary field office and each temporary telephone.

1.4 WORK WEEK AND HOURS

A. The Owner's standard work week for the Project will be Monday through Friday, 8 hours per day. The project's starting and quitting times will be established at the first job site meeting. If The Contractor is working extended additional hours in a particular week due to his Work being behind schedule, the contractor will be responsible for any overtime costs incurred by the Owner (on occupied campuses) or the Architect, who must also work extended hours to support his Work. If The Contractor is working additional hours on weekends or on holidays he must schedule these with the Owner in writing at least two working days (48 hours) in advance of the work taking place.

PART 2 - PRODUCTS
(Not Used)

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS

A. Inspection of Conditions: Require the installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner. Provide notice to the Architect of any condition that will not allow work to proceed.

B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

C. Inspect materials or equipment immediately upon delivery, and again prior to installation. Reject damaged and defective items.

D. Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.

E. Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.

F. Re-check measurements and dimensions before starting each installation.

G. Install each component in a sequence that will ensure the best possible results. Provide adequate weather protection. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

H. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

J. Coordinate space requirements and installation of mechanical and electrical work that is indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, maintenance and repairs.

K. In finished areas, conceal pipes, ducts and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements. If items cannot be concealed the contractor will refer to the Architect for direction.

L. On any equipment provided, The Contractor, and his subcontractors are responsible for providing equipment with electrical characteristics compatible with electrical services provided for this equipment in the Electrical Drawings and Specifications.

M. All penetrations made by The Contractor or any subcontractor through walls, ceilings and/or floors shall be sealed by that Contractor to meet the requirements of all City, County, and State building codes, fire codes, etc., applicable to the Project.

N. All sleeves set in concrete, masonry or other work will be set in a timely manner so as not to delay the concrete, masonry or other Work. The responsibility for the exact location of such items belongs to the individual providing the sleeves.

O. The Contractor shall provide and maintain primary building layout lines, batter boards and permanent reference points for himself and his subcontractors.

END OF SECTION

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SECTION 01 31 19
PROJECT MEETINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for project meetings including but not limited to:
   1. Pre-Construction Conference.
   2. Pre-Installation and Coordination Meetings.
   3. Progress Meetings.

1.2 PRE-CONSTRUCTION CONFERENCE

A. The Owner's Representative will schedule a pre-construction conference and organizational meeting at the Project site or other convenient location after execution of the Agreement and prior to commencement of construction activities. The Architect or Engineer will conduct the meeting to review responsibilities and personnel assignments.

B. Attendees: The Owner, the Owner's Representative, the Architect and their consultants, the Contractor and his superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

C. Agenda: Discuss items of significance that could affect progress including such topics as:
   1. Introduction of Key Personnel
      a. Distribution and Discussion of:
         1) Project Reference List.
         2) List of Major Subcontractors and Suppliers.
         3) Roles and responsibilities and coordination methods.
   2. Schedules
      a. Notice to Proceed Date/Completion Date.
      b. Construction Schedule.
      c. Critical Work Sequencing.
      d. Submittal Schedule.
      e. Recovery Plans.
   3. Procedures and Processing
      a. Modifications/Architects Supplemental Instructions.
      b. Proposal Request.
      c. Change Orders.
      d. Field Reports.
      e. Applications for Payment.
      f. Submittals.
      g. Permits.
   4. Contract Close-out Procedures
      a. Maintaining "Control Sets".
      b. Record Documents.
      c. Operational and Maintenance Data.
      d. Certifications and Warranties.
      e. Substantial and Final Completion.
   5. Miscellaneous
      a. Use of Premises.
         1) Field Office(s).
         2) Storage Area(s).
         3) Phasing Plan and Fencing Plan.
      b. Temporary Utilities.
      c. Safety and First-aid Procedures.
      d. Security.

e. Housekeeping.
f. How to coordinate work with school (i.e., Principal, staff, Custodian, Temporary Relocations).
g. Hours of Operation.
h. Clean-up.
i. Signage.

D. The Architect will record minutes and distribute copies within five (5) days after meeting to all participants.

1.3 PRE-INSTALLATION AND COORDINATION MEETINGS

A. Conduct a pre-installation conference/meetings at the site before each critical construction activity that requires coordination with other construction. The Installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the Architect of scheduled meeting dates.

1. Required meetings which need to be scheduled include but not limited to:
   a. Site Clearing and Earthwork.
   b. Roofing.
   c. Grassing Installation & Maintenance
2. Suggested meetings which may be scheduled, but are not limited to:
   a. Landscaping.
   b. Masonry.
   c. Hardware.
   d. Finishes.
   e. Kitchen Equipment.
   f. Above Ceiling – HVAC, Plumbing, Electrical, Low Voltage coordination.
3. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:
   a. Contract Document requirements, governing regulations and inspection and testing requirements and warranties.
   b. Time Schedules.
   c. Submittals, purchases, deliveries and manufacturers recommendations.
   d. Possible conflicts, compatibility problems and acceptability of substrates.
   e. Related Change Orders.
   f. Safety.
   g. Weather limitations, protection.
4. The Contractor will record significant discussions and agreements and disagreements of each conference, along with the approved schedule. Distribute the record of the meeting to everyone concerned, promptly, including the Owner, Program Manager, Architect and Engineer Consultant if required.
5. Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.4 PROGRESS MEETINGS

A. The Architect will schedule and shall conduct in coordination with the Owner's Representative progress meetings at the Project site at bi-weekly intervals and as deemed necessary. The Owner and Architect will coordinate dates of meetings with preparation of the payment request.

B. Attendees: In addition to representatives of the Owner, the Program Manager, the Architect, the Contractor's Project Superintendent and Project Manager, as well as the superintendents and project managers of the plumbing, mechanical, and electrical subcontractors are mandatory along with suppliers or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the Project and authorized to conclude matters relating to progress.

C. Agenda:
1. Review and correct or approve minutes of the previous progress meeting.
2. Review items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project.
3. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
4. Submittals: Review overall schedule and anticipated near term needs.
5. Field Observations, Deficiency Lists, Problems and Conflicts.
6. Change Orders.
7. Off-site fabrication, deliveries and sequences.
8. Documentation of information for record documents.
9. Safety, hazards and risks.
10. Other Business:
    a. Access.
    b. Site utilization and security.
    c. Quality and Work Standards.
    d. Housekeeping.

D. Reporting: After each progress meeting date, the Architect shall prepare and distribute copies of minutes of the meeting to each party present and to other parties who should have been present.

E. Schedule Updating: The Contractor shall revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting. No logic or original durations shall be changed without the Architect and Owner Representative's approval.

F. Job Coordination Meetings shall be held each week on a day designated by the Contractor and shall be attended by the representative of the Contractor, the Owner Representative, the subcontractor and other parties involved with the phase of work that is in progress or scheduled for the upcoming weeks.
1. Agenda shall include but not be limited to discussion of the previous week's completed activities and dates of completion, discussion of ongoing incomplete activities and their estimated remaining duration. Discussion of other activities upcoming in the next 2 weeks, detailed coordination problems and changes in work sequence.
2. The weekly job meeting minutes to be published by the Contractor format shall include:
    a. Name of project and date.
    b. Names of persons and firms represented.
    c. Contractor work scheduled for the week.
    d. Work to be accomplished by each subcontractor.
    e. Commitment of each party to their aspect of the work.
    f. General agreement between parties on coordination.
    g. Lack of any materials or equipment that might affect the progress.
    h. Any questions or coordination that could hold up the project.

At the end of the minutes to be distributed by the Contractor, the following statement should be included:

"If anyone in attendance finds that they do not agree with the minutes as written, they should contact the writer prior to the next meeting. Otherwise, all commitments shall be carried out."

PART 2 - PRODUCTS

(Not Used)

PART 2 - EXECUTION

(Not Used)

END OF SECTION

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including but not limited to:
   1. Contractor's construction schedule.
   2. Submittal schedule.
   3. Construction reports.
   4. Shop Drawings.
   5. Product Data.
   6. Samples.

B. Administrative Submittals: Submittals include, but are not limited to:
   1. Performance and payment bonds.
   2. Insurance certificates.
   3. List of Subcontractors.
   4. Permits.
   5. Applications for Payment.

C. The Schedule of Values submittal is included in Sections 012900 Payment Procedures and 012973 Schedule of Values.

D. Inspection and test reports are included in Section 01 45 00 Quality Control.

E. Close-out documents submittal requirements are included in Section 017700.

1.2 SUBMITTAL PROCEDURES

A. Coordination: Within fifteen (15) days of Notice to Proceed to the Contractor, a submittal schedule including all shop drawings, samples, and submittal information as outlined in the Specifications must be submitted to the Architect with a copy to the Owner's Representative. Within thirty (30) days of Notice to Proceed, procurement, delivery and installation schedules must be submitted. Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay but not later than sixty (60) days from Notice to Proceed.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
   3. Where an item is part of an assembly and must be fully coordinated with that assembly, submit the entire assembly together in order that proper evaluation of the submittals may be made. Indication that the items have not been coordinated shall show cause for disapproval of the entire group until such coordination has been made. The Architect's approval of a separate item shall not indicate approval of an assembly in which the item functions. Submit each of the following groups of items together after the Contractor has coordinated the work within the assembly:
      a. Architectural hardware, doors and door frames.
      b. Roofing system including roof deck, insulation, flashing and sheet metal work, and roofing membrane.

c. Noise and vibration control equipment and associated mechanical equipment.
d. Exterior window systems and glazing.
e. Toilet partitions and toilet accessories.
f. Reinforcing
g. Concrete design mixes

4. The Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
5. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for re-submittals. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.
   a. Contractor shall allow for a two (2) week submittal turnaround time for the Architect's and Owner's review, typically. The dates for turnaround shall be included in the Contractor's schedule. Time for resubmittal shall be considered when providing time frame for shop drawings. Shop drawings may require review by more than one contractor to coordinate the work, such review shall be coordinated by the Prime Contractor as required to ensure orderly progress of the work. The Architect's review of shop drawings in no way relinquishes the Contractor's responsibility for coordination. All shop drawings, product data, samples, and similar submittals shall be submitted to the Architect, through the Contractor so as not to delay working but no later than 60 calendar days after the Notice to Proceed. Samples and product data required for substitutions shall be submitted with the request for substitution. Shop drawings will not be considered for review unless they first have been completely checked, approved, and stamped by the Contractor, subcontractor, and fabricator and in addition, shop drawings will not be considered on substituted products unless they have been submitted in accordance with Section 012500 Substitution Procedures**.**

B. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software. Upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
   1. Submit all submittals, including RFIs, using Architect's Newforma project management software.

B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
   1. Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.
   2. Include the following information on the label for processing and recording action taken.
      a. Project name.
      b. Date.
      c. Name and address of Architect.
      d. Name and address of Contractor.
      e. Name and address of subcontractor.
      f. Name and address of supplier.
      g. Name of manufacturer.
      h. Number and title of appropriate Specification Section.

i. Drawing number and detail references, as appropriate.

C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.
1. Submit letter of transmittal in duplicate.
2. On the transmittal Record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

D. Submit an electronic Adobe PDF that is searchable and bookmarked. (Or method agreed upon by CMS)

E. Contractor's submittals shall include the following statement: "I hereby certify that the material(s), equipment, and/or material(s) shown and marked in this submittal and proposed to be incorporated into the Work is (are) in strict conformance with the Contract Documents, can be installed in the allocated spaces, and comprise(s) no variation thereto, unless specifically noted otherwise."

F. Before submitting a shop drawing or related material to the Architect, the Contractor shall:
1. Review each such submission for conformance with the Contractor's means, methods, techniques, sequences and operations of construction, and safety precautions, and programs incidental thereto, all of which are the sole responsibility of the Contractor:
2. Review and coordinate each such submission with other related or affected work:
3. Approve each such submission before submitting same: and
4. Provide the required Contractor's certification as specified.

By approving a submittal, the Contractor thereby warrants and represents that he has determined and verified applicable field measurements, field construction criteria, materials, catalog numbers and similar data, and has checked and coordinated the submittal with the requirements of the Work and for conformance with the Contract Documents. Submittals submitted without the required certification and coordination will be returned to the Contractor without review. Delays in construction because of late submission or resubmission of required submittals shall be the sole responsibility of the Contractor.

G. If a submittal deviates from the drawings and project manual because of standard shop practice, substitutions (approved in accordance with contract requirements), or any other reason, the Architect shall be advised in an attached separate written instrument. Deviations shall be acknowledged by Architect in writing. Unless acknowledged by the architect in writing the Contractor will not be relieved of the responsibility for executing the Work in accordance with the Contract Documents even though such submittals may have been approved.

H. Submit only submittals required by the Contract Documents. The Architect reserves the right to refrain from reviewing other submittals.
1. Do not include items from more than one Specification Section per submittal.
2. Contractor may require additional documentation from subcontractors or suppliers for his own use and at no additional cost to the Owner. Such documentation shall not be submitted for review without prior written consent from the Owner's Representative.

I. Color and material chips will be used to select the project's color scheme and, in general, selection will not be completed until necessary chips have been submitted.

J. The Contractor shall make any corrections required by the Architect, file with the Architect three (3) corrected copies and furnish additional copies as may be required to expedite the Work. The Architect's acceptance of such drawings or schedules shall not relieve the Contractor form responsibility for deviations from the Drawings and Specifications, unless he or she has notified the Architect in writing concerning such deviations at the time of submission. Nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules.

K. 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 is the Contractor's responsibility to (i) review and coordinate each submittal with other related or affected work and (ii) approve each such submittal before submitting same to the Architect for approval. If the Architect is required to (i) review a third or later submission of any submittal due to no fault of the Architect, (ii) review more than the number of copies of each submittal specified in the Construction Documents, (iii) review submittals in addition to those required by the Construction for the benefit of the Contractor or any Subcontractor or Supplier, or (iv) review submittals for Contractor proposed substitutions for previously approved items, the Contractor shall be liable to the Owner for any Architect's fees incurred as a result of any such Additional Services of the Architect. Any funds due under this paragraph shall be deducted by the Owner from the amounts due to the Contractor.

1.3 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Submit, within thirty (30) days after the Notice to Proceed, the Contractor's Construction Schedule.

B. Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by requirements for phased completion to permit Work by separate Contractors.

C. Distribution: Following response to the initial submittal by the Architect and Owner's Representative print and distribute copies to the Architect, Owner, subcontractors and other parties required to comply with scheduled dates. Post copies in the Project meeting room and temporary field office.

1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

1.4 PROJECT SCHEDULES

A. The Contractor will retain and pay for the services of a scheduling consultant acceptable to the Owner to develop and maintain the construction schedule as required by the Contract Documents. The Contractor will maintain full responsibility for the content of schedule and will work with his scheduling consultant to insure the schedule accurately reflects the methodology to be used. Use of an independent scheduling consultant does not change the Contractor's responsibility to the Owner related to the contracted delivery date and interim milestones required to meet that date. The independent scheduling consultant will be required to provide all scheduling information using P6. No other scheduling software is acceptable to the Owner. The cost of the independent scheduling consultant will be included as a line item on the Contractor's Schedule of Values.

1. The Scheduling Consultant's qualifications shall be submitted to the Owner prior to acceptance for use on the project.

B. The Contractor's scheduling consultant is responsible to provide an initial and current monthly construction schedule for the purpose of keeping the Owner fully informed as to Work progress, including immediate notification of any changes in the progress of the Work together with a plan of such remedial action as may be required to coordinate with and maintain the pace the work established.
   1. In addition to the required monthly scheduled updates the Scheduling Consultant shall be required to provide a hard copy two week look ahead to be reviewed at each bi-weekly Owner – Architect – Contractor meeting.

C. The Contractor's scheduling consultant shall be responsible for the developmental preparation of the Detailed Construction Schedule and, to notify the Architect and Owner of any changes in the Detailed Construction Schedule and, to maintain a current and updated schedule. Detailed Construction Schedule shall include at a minimum the following items:
   1. Detailed activities representative of the work flow, including all major submittal, procurement and delivery activities with potential impact on the work;
   2. Duration in work days;
   3. Manpower requirements per activity (if requested by the Owner);
   4. Early and late start and finish dates, and total float, based on CPM calculations;
   5. Predecessor/successor report sorted by early start;
   6. In addition, the schedule shall be drawn or plotted with activities grouped (or zoned) by work area or subcontract, as opposed to a random (or scattered) format.
   7. Manpower resource loading (if requested by the Owner).

D. The final Detailed Construction Schedule must be satisfactory to the Owner's Representative. Detailed Construction Schedule shall provide the Owner's Representative with a tool to monitor and follow progress of phases of the work. Detailed Construction Schedule submitted to the Owner's Representative shall comply with (i) limits imposed by scope of work, (ii) contractually specified intermediate milestones and completion dates as requested by the contract documents, and (iii) constraints, restraints or sequences included in the Contract. The degree of detail shall include factors to satisfaction of the Owner's Representative, including but not limited to:
   1. Physical breakdown of the project;
   2. Type of work to be performed and sequences of construction;
   3. Contract milestones and completion date, substantial completion date(s), constraints, restraints, sequences of work shown in the Contract, planned substantial completion date, and the final completion date;
   4. Access to and availability of work areas;
   5. Coordination with other contractors or the Owner's own forces;
   6. Coordination with utilities and regulatory agencies or other third parties;
   7. Preparation, submittal and approval of shop drawings and material samples which constrain any work activity;
   8. Material and Equipment procurement;
   9. Commissioning activities in accordance with commissioning plan;
   10. Testing, balancing, submission of test reports and approval of test results;
   11. All training and assistance required under the Contract;
   12. Substantial Completion;
   13. Punch list work and final cleaning; and
   14. Final Completion.
   15. Manpower loading
   16. Actual and planned cash flow.

E. The Detailed Construction Schedule must be produced utilizing P6 scheduling software. The Contractor must furnish an electronic version of the Detailed Construction Schedule in P6 format or other as acceptable to the Owner.

F. In conjunction with the Detailed Schedule, the Contractor upon request of the Owner shall submit manpower loaded and equipment schedules. The manpower schedule shall show the projected average number of workers per week for the project by contractor and by trade. For example:

Contractor	Trade	Week 1	Week 2	Week 3 …
General	Supervisory	2	2	2
General	Carpenters	4	6	8
General	Masons	0	0	1

This manpower loading schedule may be produced using the scheduling software or manually. The equipment schedule should list all major plant and equipment expected to be utilized during the course of the Work. The manpower and equipment schedules must be satisfactory to the Owner's Representative. Upon approval of the Detailed Construction Schedule, the Owner's Representative will incorporate that schedule as the initial baseline.

G. The Contractor's independent scheduling consultant will furnish monthly updates of the Detailed Construction Schedule to the Owner's Representative for updating the Master Schedule. The data for these updates should come from and agree with the data gathered during the weekly site progress meetings. Updated schedules must be submitted monthly, in printed and electronic format, with The Contractors monthly payment application.

H. The Contractor will be responsible for performing to the latest updated and approved Construction Progress Schedule through whatever means necessary (overtime, additional forces, etc.). To accomplish Substantial Completion of the work within the Contract time designated or as amended by change order.

I. The Contractor will furnish the following printed schedules and electronic reports:
1. Current detailed construction schedule against baseline
2. Critical path schedule
3. An activity listing sorted by early start, early finish, and total float;
4. A listing of all activities started, finished or ongoing during the current month;
5. A listing of all logic or duration changes;
6. A listing of the progress updates for the month;
7. A comparison of actual to planned progress, ("Actual to Target");
8. A recovery plan when actual completion is projected later than the contract completion date.

J. The Contractor's independent scheduling consultant will prepare and update monthly a "Detailed Construction Schedule". This Detailed Schedule will become the Contract Schedule used by all Contractors to build the project. A full size (minimum 24" x 36") copy of the project schedule will be displayed in the Contractor's job trailer at all times during the construction project. Project schedule will show contractual start and finish dates as well as latest schedule update. Major milestones and contractual completion dates must be maintained. Architect and Owner's Representative must approve major milestones and contractual completion date changes.

K. The Contractor shall utilize the Detailed Construction Schedule in planning, scheduling, coordinating, and performing the work required under the Contract (including all activities of Subcontractors, equipment Vendors and Suppliers.) The Contractor shall provide the

Owner's Representative with written confirmation of the concurrence of each major trade Subcontractor with Detailed Construction Schedule and all revisions and updates.

1.4 SUBMITTAL SCHEDULE

A. During development and acceptance of the Contractor's construction schedule, prepare a complete schedule of submittals (submittal register). Note: Do not delay making submittals during schedule development if the anticipated result will be a delay to the project.
   1. Include description of submittal, type of submittal, detailed specification and drawing references, transmittal numbers, and approximate dates scheduled for submission.
   2. Clearly label register with the names of the project and the Contractor, and any other necessary information.
   3. Coordinate submittal schedule with the list of subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.
   4. Prepare the schedule in chronological order. Provide the following information:

B. Distribution: Following response to the initial submittal by the Architect and Owner's Representative print and distribute copies to the Architect, Owner, subcontractors and other parties required to comply with scheduled dates. Post copies in the Project meeting room and temporary field office.
   1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

C. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting. Show original, actual, and planned timelines on each update.

D. Within 30 days of the Notice to Proceed each Contractor must submit a procurement, delivery and installation schedule.

1.5 CONSTRUCTION REPORTS

A. Prepare a periodic construction report, recording the following information concerning events at the site; and submit copies to the Owner's Representative and Architect at weekly intervals:
   1. High and low temperatures, general weather conditions (daily).
   2. Accidents and unusual events (immediately after they occur).
   3. Orders and requests of governing authorities (after they occur).
   4. Stoppages, delays, shortages, losses (as they occur).
   5. List of personnel and subcontractors at the site (monthly).
   6. Services connected, disconnected (as they occur).
   7. Equipment or system tests and start-ups (as they occur).
   8. List of equipment at site and use.
   9. Inspections and tests, including inspector(as they occur)

1.6 SHOP DRAWINGS

A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

B. Shop Drawings include fabrication and installation drawings, setting diagrams, connections, schedules, patterns, templates and similar drawings, layouts or particular elements. Include the following information:
   1. Dimensions.
   2. Identification of products and materials included.
   3. Compliance with specified standards.
   4. Notation of coordination requirements.
   5. Notation of dimensions established by field measurement.
   6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on
      sheets at least 8½" x 11" but no larger the 30" x 42".
   7. Submittal: Submit one correctable translucent reproducible print and four (4) blue or black-line print for the Owner's Representative / Architect / Owner / Engineer review; the reproducible print will be returned.
   8. Do not use Shop Drawings without an appropriate final stamp from the Architect indicating action taken in connection with construction.

C. Coordination drawings are a special type of Shop Drawing that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.
   1. Preparation of coordination Drawings is specified in Section 01 31 13 - Project Coordination and may include components previously shown in detail on Shop Drawings or Product Data.
   2. Submit coordination Drawings for integration of different construction elements. Show sequences and relationships of separate components to avoid conflicts in use of space.

1.7 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, calculations, color charts, mix designs, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings".
   1. Mark each copy to show applicable choices and options. If Product Data includes information on several products, mark copies to indicate the applicable information. Include the following information:
      a. Manufacturer's printed recommendations.
      b. Compliance with recognized trade association standards.
      c. Compliance with recognized testing agency standards.
      d. Application of testing agency labels and seals.
      e. Notation of dimensions verified by field measurement.
      f. Notation of coordination requirements.
   2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
   3. Submittals: Submit four (4) copies of each required submittal; one (1) for the Owner's Representative, the Architect/Owner will retain one (1) and will return the others marked with action taken and corrections or modifications required.
   4. Distribution: Furnish copies of final submittal (i.e., copies with stamp and/or comments) to installers, subcontractors, suppliers, manufacturers, fabricators and others required for performance of construction activities. Show distribution on transmittal forms.
      a. Do not proceed with installation until an applicable copy of Product Data is in the installer's possession.

b. Do not permit use of unmarked copies of Product Data in connection with construction.

5. Standard color charts are to be collected and submitted in packages as outlined below.

1.8 SAMPLES

A. Submit full-size, fully fabricated samples, cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets and swatches showing color, texture and pattern.

1. Mount, display or package Samples in the manner specified to facilitate review of qualities indicated. Prepare Samples to match the Architect's Sample. Include the following:
   a. Generic description of the Sample.
   b. Sample source.
   c. Product name or name of manufacturer.
   d. Compliance with recognized standards.
   e. Availability and delivery time.
2. Submit Samples for review of kind, color, pattern and texture for a final check of test characteristics with the other elements and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
   a. Where variation in color, pattern, texture or other characteristics are inherent in the material or product represented, submit multiple units (not less than three (3)), that show approximate limits of the variations.
   b. Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, detail of assembly, connections, operation and similar construction characteristics.
3. Preliminary submittals: Where Samples are for selection of color, pattern, texture or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.
   a. Preliminary submittals will be reviewed and returned with the Architect's mark indicating selection and other action.
4. Submittals: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit two (2) sets; one will be returned marked with the action taken.
5. Maintain sets of Samples, as returned, at the Project site, for quality comparisons throughout the course of construction.
6. Color samples will be submitted in two complete packages:
   a. Exterior materials
   b. Interior materials

Submit color chips and material samples duplicating the color, texture and finish to be provided for the installed product. Submit manufacturer's complete range as required by the technical specifications. Submit one set of chips for each product specified. Unused chips will not be returned to the Contractor unless specifically requested. In certain cases, the Owner's Architect may have a complete set of color chips in his office. At the request of the Contractor, the Owner's Architect may waive the requirement for specific color samples.

B. Field Samples specified in individual Sections are special types of Samples. Field Samples are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the Work will be judged.

1. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

C. Sample panels: One assembly constructed at the project sites in a location acceptable to the Owner's Representative and using materials and methods to be employed in the work; completely finished: maintained during construction: and removed at the conclusion of the work or when authorized by the Owner's Representative.

1.9 ARCHITECT'S ACTION

A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Architect will review each submittal, mark to indicate action taken, and return promptly.
   1. Compliance with specified characteristics is the Contractor's responsibility
   2. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
   3. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.

B. Action Stamp: The Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:
   1. Final Unrestricted Release: Where submittals are marked "Approved" "No Exceptions Taken", that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
   2. Final-But-Restricted Release: When submittals are marked "Approved as Noted" "Exceptions Indicated", that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
   3. Returned for Re-submittal: When submittal is marked "Correct and Resubmit" "Not Approved: "Revise and Resubmit", do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
      a. Do not permit submittals marked "Not Approved, Revise and Resubmit" to be used at the Project site, or elsewhere where Work is in progress.
   4. "No Action Taken" indicates one of the following:
      a. Submittal incomplete and a proper review cannot be performed
      b. Insufficient copies submitted
      c. Transmittal form incomplete
      d. Contractor's certificate approving submittal not signed or missing
      e. Submittal not required and the Contract Documents do not require the Owner's Representative to take action on this item
      f. Other causes or reason as noted

1.10 RESUBMISSION

Change or correct submittals as required by the Architect and resubmit until approved. Indicate any changes which have been made other than those requested by the Architect.

PART 2 - PRODUCTS
(Not Used)

PART 3 - EXECUTION

(Not Used)
END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROL

PART 1 – GENERAL

1.1 SUMMARY

A. This section specifies requirements for Temporary Utilities, Temporary Construction and Support Facilities and other facilities and controls required to construct the project.

The Contractor agrees that protection of the public and prevention of accidents to workers/others engaged upon or in the vicinity of the Work is their responsibility. The Contractor shall establish and implement safety measures, policies and standards conforming to those required or recommended by governmental or quasi-governmental authorities having jurisdiction and by the Owner, including, but not limited to, any requirements imposed by the Contract documents.

Requirements include, but are not limited to the following:

1. Project Planning
2. Protection of the Public
3. Skills, Competency and Training
4. EHS Performance Monitoring
5. Fall Prevention
6. Project Site Logistics
7. Civil / Ground works
8. Use of Cranes, Hoists, Lifting, and Slinging
9. Electrical Safety
10. Personal Protective Equipment and Worker Welfare
11. Fire and Emergency Preparedness Planning
12. Protection of the Environment
13. Temporary Construction and Support Facilities
14. Temporary and permanent Utilities

In cases where the contract documents and applicable laws or codes conflict the most stringent means shall apply.

Charlotte-Mecklenburg Schools Capital Program Services (CPS) has coordinated a mentoring program with the North Carolina Department of Labor to promote the importance of safety to the public and workers. The intent of the program is for the contractor to have an open door policy with NCDOL, to actively participate in the mentoring program and comply with NCDOL's recommendations. CPS expects the Contractor to pursue their own partnership as well or work towards becoming an NCDOL Carolina Building STAR company.

1.2 SUBMITTALS

(not used)

1.3 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including but not limited to:

1. Building code requirements
2. Health and safety regulations, OSHA, ANSI, NFPA, etc.
3. Utility company regulations
4. Police, fire department and rescue squad requirements
5. Environmental protection regulations
6. Mecklenburg County Health Department

B. Standards: Comply with NFPA Code 241 – "Building Construction and Demolition Operations: ANSI-A10 Series standards for Safety Requirements for Construction and Demolition" and NECA Electrical Design Library "Temporary Electrical Facilities".

1. Refer to “Guidelines for Bid Conditions for Temporary Job Utilities and Services”, prepared jointly by AGC and ASC for industry recommendations.
2. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electrical service. Install services in compliance with National Electric Code and NFPA 70.

C. Inspections: The Contractor will arrange for authorities having jurisdiction to inspect and test each temporary utility as required prior to use and obtain required certifications and permits.

1.4 PROJECT CONDITIONS

A. Temporary Utilities: At the earliest feasible time, and when acceptable to the Owner, convert from use of temporary service to use of permanent service.

B. Conditions of Use: Temporary services and facilities shall be clean and neat at all times and will be operated in a safe and efficient manner. Reference Specification Section 01 74 13 Part 3 Execution for detailed housekeeping requirements.

C. All contractors are discouraged from accessing the project or having materials and equipment delivered to the project site through residential areas unless no other route is available. Should they be required to travel through residential areas, it should be done between 7am and 7pm only or in compliance with local rules and regulations, whichever is more stringent.

D. The Contractor shall stop any part of the work deemed unsafe until corrective measures have been taken.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General: Provide materials suitable for the use intended; undamaged previously used materials in serviceable condition may be used for temporary conditions.

2.2 EQUIPMENT

A. General: Provide equipment suitable for the use intended; undamaged previously used equipment in serviceable condition may be used for temporary conditions.

B. Electrical Systems and Outlets: Provide properly configured NEMA polarized outlets that prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters and reset buttons for connection of power tools and equipment within 100 feet of all work areas. All temporary electrical systems should be inspected and tested on a weekly basis. Contractor shall document these inspections.

C. Electrical Power Cords: All Contractors shall provide UL tested and labeled, grounded “hard service” cords of an appropriate gauge for the intended application. Provide waterproof connectors as needed to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. All electrical cords shall be inspected on a regular basis (Quarterly at a Minimum) and identification of inspection must be visible, i.e. mark with colored tape or tag.

D. Temporary Lamps and Light Fixtures: Provide GFCI protected general service lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture. Provide emergency back-up, i.e. 90-minute battery powered for lighting in areas where access/egress lighting is required.

E. Temporary Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association for the type of fuel being consumed. Provide

Carbon Monoxide detectors.

F. Temporary Owner and Contractor Offices: Provide heated and air conditioned pre-fabricated or mobile units with adequate entrance facilities, lockable doors, operable windows and serviceable finishes. The facilities shall be sufficiently sized to accommodate required office personnel and progress meetings of up to twelve (12) people. Keep the office clean and orderly. The office shall contain at all times the most current set of plans and specs which shall serve as the "control set". Computers, copiers, printers, etc. should be shut down during non-working hours. Provide the Owner and Architect internet connectivity either by wireless or hard wire. Owner reserves the right to set up in the contractor's office if they should have to maintain full time residency on site.

G. Worker Welfare Area: Provide or identify a break facility/area, in a location separate from the work area(s) containing tables and chairs as necessary. It should be located in close proximity to washing and toilet facilities and be constructed in such a way to shelter workers from the rain or sun. Workers should not be allowed to consume food or drinks other than water inside the building

H. Storage and Fabrication Sheds: Install storage and fabrication sheds (if needed) sized, furnished and equipped to accommodate materials and equipment involved including temporary utility service. Shed may be open shelters or fully enclosed spaces within the building or elsewhere on the site.

I. Temporary Toilet Units: Provide self-contained, single-occupant toilet units properly vented and fully enclosed. Comply with regulations and health codes for the type, number and location. Install where facilities will best serve the Project's needs. Toilets are to be properly maintained and cleaned. If piped hand washing facilities or a self-contained hand washing system is not readily available then hand sanitizer shall be available in each unit.

J. First Aid Supplies: Comply with all governing regulations for type and size. Provide an AED in a readily available location known to trained users.

K. Ladders:
1. Contractors on site shall develop a ladder reduction program. This program should identify tasks that are repetitious and/or tasks that are longer than 15 minutes and can be done from a work platform, scaffold or mechanical man-lift.
2. Step ladders that are used on the project shall be platform or podium type. All scaffolds, ladders, working platforms, etc. shall be regularly inspected. Proof of inspection should be conspicuous and documented. All ladder users shall be properly trained. All ladders must be made safe, removed or protected from use, prior to completion of daily work activities.
3. The use of Aluminum ladders are prohibited onsite.

L. Scaffolds: Scaffolds should be built in their entirety and not left unfinished or in an unsafe condition. All scaffolds must be tagged to indicate the latest inspection by the identified competent person. Scaffolds should be tied into the structure as close to a 3:1 ratio as possible and repeated tie-ins shall follow OSHA guidelines. All scaffolds shall have safe access with stairs being the first choice over a ladder. Scaffolds should include netting on upper levels if there is any possibility for materials to fall over the toe boards, per OSHA guidelines.

M. Fire Extinguishers: Provide hand-carried, portable UL-rated, 10lb, class "ABC" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers or a combination of extinguishers of NFPA recommended classes suited for the exposures.
1. Comply with NFPA 10 and 241 for classification of extinguishing agent and size required by location and class of fire exposure.
2. Provide an appropriate number of designated fire watch individuals with fully charged fire extinguishers, welding blankets and welding screens as required to limit risks associated with welding, cutting and burning or any other activity which has the potential to cause a fire. All Hot work shall be done under a permit system

N. Enclosure Fence/Gates: Provide 6'-0" high chain link type fence to limit access to construction activities and as otherwise indicated on the Phasing plans. Where feasible, permanent fencing may be utilized as part of this enclosure. "Rent a fence" will be acceptable if installed in a manner sufficient to prevent tampering or tipping. Provide two (2)-14 ft. wide gates and two (2) 3-ft wide gates or as indicated on the drawings. This will be used by all Contractors for a secure compound. Screening shall be installed where fencing is adjacent to public areas. Fencing layout to be reviewed and approved on the logistics plan and prior to installation

O. Project Sign: Provide construction project sign as described in specification 015000 - Figure 1.

P. Drinking water: Provide adequate supplies of drinking water, containers and ice. Container shall be sanitized per OSHA guidelines. Cups and trash receptacle shall be readily available.

Q. Provide all required site signs, safety signs, temporary exit signs and warning signs as needed on the site. Maintain existing or provide temporary illuminated exit signs and fire alarm equipment needed to accommodate renovation work in areas of occupied buildings and comply with building code officials. Provide lighting in any temporary enclosed exit ways, including emergency egress lighting.

R. Carbon Monoxide Detectors: When utilizing gas powered equipment after building enclosure a temporary carbon monoxide detector shall be provided in space where work is being performed. In addition to proper ventilation of space.

PART 3 – EXECUTION

3.1 PROJECT PLANNING

A. The Contractor shall develop and maintain on a monthly basis (minimum) a project specific Environment, Health and Safety (EHS) plan. Upon completion and whenever modified the EHS plan shall be communicated to all relevant parties involved on the project. The plan shall also be made available on the jobsite upon request.

The plan shall be developed in its entirety and be available on site before any work commences. The plan shall be tailored to the project's site specific safety aspects and not just the overall company safety policy

The EHS plan should, at a minimum, include or address the following items:

1. Project name, location, etc.
2. Scope of work statement
3. Designated safety representative(s)
4. Identification of, and plans to handle, all hazardous work (complete site wide Job Hazard Analysis - JHA)
5. Fall protection plans
6. Trenching and excavation plans and precautions
7. Detailed procedures on locating underground utilities (One-call, potholing, ground penetrating radar, etc.)
8. Confined space entry process
9. Steel erection procedures
10. Lockout/Tag-out procedures
11. Temporary electric and lighting plan
12. Tool and equipment maintenance inspection process
13. Ladder reduction and inspection policy
14. Hot work policy
15. Personnel certifications
16. Hazard communication policy
17. Inspection policies
18. Disciplinary policy

19. PPE requirements
20. Housekeeping procedures
21. Hazardous material information
22. Background check procedure
23. Gate closure procedures
24. Emergency egress procedures site workers/public
25. Falls of materials

B. The Contractor must communicate their EHS plans and expectations to all subcontractors, suppliers, etc. The Contractor shall assess the ability of all parties to perform their intended responsibilities and shall not employ an entity that cannot perform all obligations communicated. Contractor should hold monthly (at a minimum) site wide meetings with all workers to update them on pertinent information and upcoming activities.

C. Meeting minutes, communications and other evidence of the Project Planning shall be made available upon request.

D. The Contractor shall ensure that an adequate number of competent supervisors are employed for execution of the project in accordance with the EHS plan. Evidence of competent person shall be made upon request.

E. The Contractor shall hold a kick-off meeting with each subcontractor, supplier, etc. to discuss the EHS plan requirements. This meeting may be held in conjunction with other project meeting(s).

F. The Contractor shall hold daily coordination meetings with pertinent contractors to communicate key high risk activities. The Contractor shall discuss EHS topics and address any concerns or changes in the project at each weekly project meeting.

G. The Contractor shall develop and utilize a method to identify and inform all site personnel of high risk activities to be performed on a daily basis.

H. Contractor shall designate key project personnel to gather as a team bi-weekly at a minimum to review site safety progress, challenges, and training needs, review incidents and develop solutions for any non-compliance issues. Meeting minutes shall be documented.

I. All equipment utilized on the project shall meet the operational and inspection criteria established by the manufacturer, be well maintained, and used only for the activities intended by the manufacturer. The Contractor shall ensure that all vehicle and equipment operators are certified to operate the assigned vehicle. Inspection information and certifications shall be made available upon request.

J. The Contractor shall plan, communicate and control all activities to be performed in a manner that can eliminate or reduce risks to those performing the task. A focus on each task, especially fall protection, should be performed following the hierarchy of risk control. The steps include but are not limited to the following:
1. Elimination
2. Substitution
3. Engineering control
4. Administrative controls
5. Personal protective equipment

EXAMPLES OF EACH STEP IN THE HIERARCHY OF HAZARD CONTROLS

1. Elimination

Control a hazard by eliminating and removing the danger. Examples include changing a work process in a way that will get rid of a hazard, substituting a non-toxic chemical for a toxic substance, having workers

perform tasks at ground level rather than working at heights, prefabricating items and lifting them in place and other methods that remove the hazard all together.

2. Substitution
Control a hazard by substituting something else in its place that would be non-hazardous or less hazardous to workers. For example, permanent rails installed versus temporary ones.

3. Engineering Controls (Safeguarding Technology)
If a hazard cannot be eliminated or a safer substitute cannot be found, the next best approach is to use engineering controls to keep the hazard from reaching the worker. For example, using mechanical lifting devices or using local exhaust ventilation that captures and carries away the contaminants before they can get in the breathing zone of workers, installing guardrails around work or using a work platform versus a ladder, installing netting under decking operations and steel erectors.

4. Administrative Controls (Training and Procedures)
If engineering controls cannot be implemented or cannot be implemented right away, administrative controls should be considered. Administrative controls involve changes in workplace policies and procedures. Examples include such things as:

- Warning alarms
- Labeling systems
- Reducing the time workers are exposed to a hazard, and
- Training.

5. Personal Protective Equipment (PPE)
The use of personal protective equipment is a way of controlling hazards by placing protective equipment directly on workers' bodies. Examples of personal protective equipment include harness and 100% tie-off, respirators, gloves, protective clothing, hard hats, goggles and ear plugs.

The Contractor should recognize that PPE is the least effective method for protecting workers from hazards. PPE should be used only while other more effective controls are being developed or installed or if there are no other more effective ways to control the hazard.

3.2 PROTECTION OF THE PUBLIC

A. The Contractor shall perform its work in a manner that will protect the public from any hazards including falling materials and the movement of vehicles into/out of the project site. The Contractor shall establish safe pathways for the public whenever public access ways are blocked off due to construction activities.

B. Separation of construction and public/students/staff should always be by hard barrier when feasible.

C. The Contractor must keep all public walkways and roadways in the vicinity of the project clean and free of construction-related hazards and debris at all times.

D. The Contractor must ensure that all loads are adequately secured and covered prior to leaving the project site. Materials stored outside compound shall be secured and adequately protected.

E. The Contractor shall plan the use of any temporary site lighting so that it does not negatively impact the public.

F. The public shall be protected from falls of materials at all times.

3.3 SKILLS AND TRAINING

A. The Contractor is required to have a competent person on site whenever work is taking place.

B. Project Orientation: The Contractor shall provide each worker on the project site with a site specific project orientation prior to commencing their work. The orientation should include content specific to the project including site rules, environmental standards, safety specific standards, emergency procedures and any other information the Contractor deems pertinent. Records shall be kept of each orientation.

C. The Contractor is responsible for providing all visitors to the project site with adequate safety instructions when entering the premises. The Contractor shall maintain records of all visitors to the project site. Contractor shall also have 10 extra sets of the sites required PPE available for visitors

D. The Contractor shall ensure that all personnel performing specialized or high risk activities are aware of all EHS responsibilities and are adequately trained.

E. The Contractor shall insure that EHS briefings, tool box talks and any other relevant safety training takes place for all site personnel.

F. The Contractor's Superintendent/Competent Person shall hold a valid OSHA 30-hour training certification acquired within the previous 3-years. In addition, it is recommended that all of the subcontractors provide a foreman/superintendent who holds an OSHA 30-hour training certification.

G. Contractor shall have a site hazardous communication plan; maintain current MSDS/SDS sheets that are site specific and ensure all workers have access to this information. Plan shall conform to OSHA's Global Harmonization System (GHS) requirements.

3.4 EHS PERFORMANCE MONITORING

A. The Contractor shall ensure that activities are appropriately monitored and that any EHS issues that arise are being promptly identified, reported (as required) and resolved.

B. Observations
1. The Contractor shall stop any activities observed which could result in an injury or environmental damage. Corrective actions must be taken.
2. The Contractor is responsible to ensure that daily checks are performed for all high risk work.
3. The Contractor is responsible for recording all incidents that occur on, or are related to the project.
4. The Contractor shall investigate any incidents deemed critical and determine an action plan to prevent a similar incident.
5. All observations should be documented and available for review.

C. The Contractor shall document and provide to the Owner the following environmental data:
1. Recycled material data
2. Storm water inspection reports upon request

3.5 FALL PROTECTION

A. The Contractor shall develop and utilize a detailed plan describing its intent to prevent falls of personnel, equipment and materials during the execution of the project.

B. The Contractor should apply the hierarchy of risk control (Section 3.1.J) when planning and performing all work at height. Where work at height must be performed and physical barriers to prevent falls are not practical, as a last resort appropriate PPE (full body harness, etc.) must be used. The use of safety monitors as the only approach to fall protection is not acceptable.

C. If contractor does have to utilize personal fall protection equipment on the project, they must have documented rescue procedures and proof of training as required by government regulations (OSHA).

D. The Contractor shall provide a method of a hard physical perimeter protection at all elevated locations to prevent fall of materials and/or persons.

E. The Contractor shall establish exclusion zones using a hard physical barrier or adequately designed covered walkway where there is a risk of persons being struck by falling material or tools.

F. The Contractor shall remove or secure all materials that could be blown or swept off of roofs, exposed floors or scaffolds when the material is not being used.

G. The Contractor shall install permanent stairs and rails as soon as practical. Until permanent stairs are available provide temporary stairs. Cover finished permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at the time of acceptance.

H. Should the Contractor determine that suspended access equipment (bosun's chairs, swing stages, etc.), mast climbers or other similar systems are to be utilized, the Contractor must develop a written detailed plan of use including the following:
1. Selection and installation procedure
2. Periodic or regular maintenance, testing, and inspection processes
3. Emergency retrieval procedures
4. Operator training process
5. Primary and secondary fall protection measures
6. Removal or disassembly process

I. The Contractor shall provide a full height physical barrier at all shaft openings, including elevator, which shall include security measures to prevent unauthorized use or entry.

J. The Contractor is responsible for providing protection at every floor opening 2" or larger. The protection is to be screwed or bolted to the adjoining surface and marked "Hole Below – Do Not Remove" in English and Spanish. Where holes are larger than 24" X 24" the Contractor will provide two means of protecting a worker. Two separate/independent hole coverings, mesh or netting poured in the floor or a hole cover and guardrail system are acceptable measures.

K. The Contractor is responsible to ensure that all scaffolds and other similar working platforms are installed, set up, maintained, inspected and utilized per the manufactures recommendations and under the supervision of a competent person. The Contractor shall provide temporary stairs to access scaffolds whenever possible. Where there is a risk of falling materials, the Contractor shall provide appropriate protection (netting, fencing, etc.) on open sides of work platforms. All scaffolding must be inspected and tagged at the beginning of each work shift by the competent person.

L. The Contractor is responsible to ensure that all personnel utilizing a Mechanically Elevated Work Platform shall be required to wear fall protection.

M. Following the "Hierarchy of Controls" (as defined in Section 3.1.J) the contractor shall utilize man lifts while erecting steel frame, structure or roof and avoid "walking" the steel whenever possible. Crash decks, netting, guardrail system, or other types of protection must be considered underneath of decking operations versus relaying on 100% tie-off.

3.6 PROJECT SITE LOGISTICS

A. The Contractor shall develop a detailed site logistics plan for review and coordination with the Owner. The logistics plan shall be displayed in the project trailer, discussed with all site personnel during orientations and updated on a monthly basis by the Contractor. The logistics plan should include the following information:
1. Delineation of site fencing
2. Location of all gates
3. Emergency and Non-Emergency Entrances/Exits, both pedestrian and vehicular
4. Evacuation procedures and muster point
5. Parking areas
6. Staging areas
7. Project trailer location

8. Dumpster location(s)
9. Temporary toilet locations
10. First aid station(s)
11. AED location(s)
12. Fire extinguisher locations
13. Worker welfare area
14. Known underground utilities
15. Other pertinent information

B. The Contractor shall separate pedestrian and vehicular traffic wherever possible, using barriers, cones, guard rails or similar materials and provide signage delineating routes.

C. Contractor shall ensure that gates remain closed and guarded in all areas where students, school staff or other uninvited public may gain access to the site.

D. The Contractor shall have as a Minimum the following signage at the main entrance to the site:
1. Site's personal protection requirements
2. Name of Contractor
3. Emergency contact information
4. Requirement of all visitors to sign in at construction office
5. No tobacco products
6. The day's high risk activities taking place

E. The Contractor shall ensure that trained traffic signalmen are provided to control vehicle movement in confined or congested areas and/or along public roadways.

F. The Contractor is responsible for keeping the project site in a clean and orderly fashion at all times (See Specification Section 01 74 13 Part 3 Execution). The Contractor shall provide waste receptacles throughout the project site at a minimum ratio of 1 per 20 workers. The Contractor should consider utilizing a composite cleanup crew weekly at a minimum

G. The Contractor shall provide signs throughout the site where necessary to provide clear instruction (i.e., "No Smoking", "No Entry", "Emergency Exit", etc.) All signage shall be provided in English and Spanish. Perimeter signage shall be attached to the fencing at approximately 50 foot intervals and be maintained throughout the duration of the project.

H. The contractor shall require all visitors to sign in and out at Construction office. The log should include date, name of visitor, Company name, reason for visit, time entering and time exiting.

I. The contractor shall maintain a daily man count board of all trades working on site. Include name of company and count of workers.

J. Contractor shall provide necessary signage to indicate delivery times and routes at all gates entering and exiting the site.

3.7 CIVIL / GROUNDWORKS / EQUIPMENT

A. The Contractor is responsible to ensure that all existing underground services are properly located and marked prior to ground works taking place. Underground services (existing, temporary and new) should be documented on the site logistics plan and markers installed and maintained at a 50' minimum to identify locations for future excavations during the project. Tracer wire is required for all underground utilities and shall be color coded per industry standards for easy identification; to be buried at 18" below finish grade.

B. Contractor must do their due-diligence in locating all underground/concealed utilities, both known and unknown, prior to any site work (including but not limited to temporary erosion control measures and perimeter fencing), demolition, or construction activities. Methods shall include professional locating services, ground penetrating radar and potholing (vacuum or water injection) all utilities to verify location and depth.

C. Contractor must initiate and utilize a permit system for all excavations.

D. The Contractor shall provide barriers, signage and lighting to prevent falls into excavations.

E. The Contractor shall ensure that all civil/ground works are regularly inspected by a competent person.

F. Where tunneling or other enclosed ground works are required, the Contractor shall develop a plan to safely execute the work. The Contractor shall coordinate a meeting to communicate the plan with all pertinent parties prior to performing the work.

G. Where work is to take place adjacent to or in the vicinity of water, the Contractor shall develop a plan to safely execute the work, including rescue procedures. The Contractor shall coordinate a meeting to communicate the plan with all pertinent parties prior to performing the work.

H. The Contractor is responsible to ensure that all equipment is maintained, tested and inspected per the manufacturers' recommendations and to maintain records of all equipment on site. All mobile equipment must be equipped with visual and audible warning equipment and inspected per manufacturers' requirements. . All mobile equipment shall be properly braked and/or chocked when parked. All mobile equipment shall be fitted with rollover protection per manufacturers' recommendations or where there is a risk of rollover or falling objects.

I. The Contractor shall ensure that seatbelts are worn at all times while equipment is under operation.

J. The Contractor is responsible to maintain operator certifications for all operators on the project site.

3.8 CRANES, HOISTS, LIFTING AND SLINGING

A. Where cranes and other lifting equipment are required the Contractor shall develop and maintain a plan to execute the work in a safe manner. The plan should include the following items at a minimum:

1. Erection, climbing and dismantling process
2. Inspection process for all equipment and rigging
3. Exclusion zones by hard barrier
4. Maintenance processes
5. Identification of Qualified/Competent persons
6. Lifting plan
7. Process for identifying and working around aerial hazards
8. Signalmen communication
9. Working around energized lines
10. Ground conditions and underground hazards

B. The Contractor is responsible to ensure that all cranes and lifting equipment are certified for use by a Qualified/Competent person prior to first use and annually (at a minimum). The Contractor is responsible to ensure that all cranes and lifting equipment are inspected as required by a 3rd party Qualified/Competent person.

3.9 ELECTRICAL SAFETY

A. The Contractor shall develop and execute a written comprehensive testing, inspection and maintenance plan covering all temporary electrical supplies, including panels, circuits, cables, cords, plugs, sockets, etc. The plan shall include a method to correct any deficiencies noted during the inspection process. The plan shall address locations of all temporary electrical services throughout the course of the project.

B. The Contractor shall develop and execute a written plan for inspection and testing of all electrical tools and equipment. The plan should address correcting any deficiencies found and method of visually identifying inspections such as color coding with electrical tape at the end of cords.

3.10 PROTECTIVE EQUIPMENT AND WORKER WELFARE

A. The Contractor shall address the following items related to personal protective equipment in their site specific safety plan:
   1. Full time requirement for hardhats, eye protection, Hi-Vis vest or shirt, gloves
   2. Full face protection while chipping, grinding or working with tar kettle or as needed
   3. Hearing protection, clothing requirements, etc.
   4. Respiratory protection
   5. Other special PPE requirements
   6. Hazardous substances
      i. Dust
      ii. Noise
      iii. Foul weather protection requirements

B. The Contractor shall develop and execute a written plan to address any work required in confined spaces. The plan should include use of safety equipment, rescue procedures, monitoring requirements and process to schedule the work.

C. The Contractor shall provide an eyewash station.

D. The Contractor is responsible to provide first aid supplies in accordance with all governing regulations. Provide an AED in a location known to trained users.

3.11 FIRE AND EMERGENCY PLANNING

A. While building is considered under construction install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses per OSHA guidelines.
   1. Comply with NFPA 10 “Standard for Portable Fire Extinguishers” and NFPA 241 “Standard for Safeguarding Construction, Alterations and Demolition Operations”.
   2. Locate fire extinguishers where convenient and effective for their intended purpose. Quantity shall be in accordance with OSHA requirements but not less than one extinguisher per floor or work area.
   3. To limit risks associated with welding, cutting and burning, or any other activity which has the potential to cause a fire, provide an appropriate number of designated fire watch individuals with fully charged fire extinguishers, welding blankets and welding screens as required.
   4. Store combustible materials in containers in fire-safe locations.
   5. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes used for fighting fires.
   6. Provide supervision of welding operations, combustion type temporary heating units and similar sources of fire ignition.

B. Contractor shall prohibit the use of all tobacco products in all areas of the project site.

C. The Contractor shall develop and execute a written plan for hot works processes (Hot Work Permit System). The Contractor shall coordinate a meeting to communicate the plan with all pertinent parties prior to performing any hot work.

D. Emergency escape drills should be performed quarterly at a minimum. Include local fire and emergency authorities whenever possible.

E. Contractor shall develop an emergency procedure plan. Plan shall be detailed with the roles and responsibilities of all personnel. Provide training for emergency responders as needed.

3.12 PROTECTION OF THE ENVIRONMENT

A. Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations and minimize the possibility that air, waterways and soils might be contaminated or polluted or that other undesirable effects might result. Avoid use of tools and equipment that produce harmful levels of noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

B. Contractor will designate an area for the wash out of concrete trucks, pump trucks and mixers catching and disposing of the extra material in a proper and environmentally sound way. Preventing contamination of the surrounding environment.

C. The Contractor shall collect waste daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Handle hazardous, dangerous or unsanitary waste materials separately from other waste. Dispose of material in a lawful manner. The Owner requires that all contractors implement and participate in the recycling program on this project for construction debris.

3.13 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES, AND SECURITY

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Contractor will locate field offices, storage sheds, sanitary facilities, other temporary construction, and support facilities for easy access. Remove prior to Substantial Completion and restore the site to the condition it was in prior to mobilization unless otherwise directed.

C. The Contractor will provide non-combustible construction for offices, shops and sheds located within the construction area or within thirty (30) feet of building lines. Comply with requirements of NFPA 241.

D. Temporary walls or barriers inside of an existing building shall be built with non-combustible materials. Insulation shall be installed as needed for sound or conditioned areas. Weather proof materials shall be used in areas exposed to moisture or long term exposure.

E. Temporary Roadways and Building Access: Construct and maintain temporary roads to adequately support required loading and to withstand exposure to traffic during the construction period. Locate temporary roads, storage areas and parking where the same permanent facilities will be located.

1. Paving: Comply with Division 32 - Asphalt Paving Specification Section for construction and maintenance of temporary paving.
2. Coordinate temporary paving development with sub-grade grading, compaction, installation and stabilization of sub-base and installation of base and finish courses of permanent paving.
3. Installation of temporary paving should be performed in a manner to minimize the need to re-work the installations and to result in permanent roads and paved areas that are without damage or deterioration when occupied by the Owner.
4. Delay installation of the final course of permanent asphalt concrete paving until immediately before Substantial Completion. Coordinate with weather conditions to avoid unsatisfactory results.
5. Provide temporary roads in and around the construction area as necessary to accommodate delivery and storage of materials, equipment usage, administration and supervision for the duration of the Project.
6. Unless otherwise specified the first 100’-0” of each temporary access road joining to a public road shall be constructed with a stone base in accordance with the NC Erosion and Sediment Control Planning Regulations to prevent soiling of adjacent and permanent roadways from construction traffic. The Contractor shall reapply stone base at gravel entry aprons as necessary to comply with governmental agencies and as directed by the Architect and Owner for the duration of the Project and shall keep all adjacent public roads clean of mud and dirt as work progresses.
7. The Contractor shall maintain in an accessible condition an area forty (40) feet wide from the outside face of the building and completely around the new construction. This area is

to be maintained to provide access to the building by all trades. Once building is shelled-in a dedicated path that will allow workers a clean way into the building shall be provided and maintained to keep building clean.

F. De-watering Facilities and Drains: For temporary drainage and de-watering facilities and operations not directly associated with construction activities included under individual Sections comply with de-watering requirements of applicable Division 31 Sections. Where feasible, utilize the same facilities. Maintain the site, excavations and construction free of water.

G. Temporary Enclosures: Provide temporary enclosures for protection of construction in progress and completed work as required from exposure, foul weather, other construction operations and similar activities.

H. Where climate conditioning is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of conditioning. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

I. Install tarpaulins securely with non-combustible wood framing and other materials.

J. Separate occupied areas of existing facilities from the construction areas with non-combustible enclosures and dust partitions as needed.

K. Temporary Lifts and Hoists: Provide equipment for hoisting materials and employees. Truck cranes and similar devices used for hoisting materials are considered “tools and equipment” and not temporary facilities.

L. Maintain dust partitions as required to preclude dust and dirt generated by the work from contaminating occupied or completed spaces. Take other precautions to preclude dust from being drawn into air intake louvers and ductwork.

M. Where projects are adjacent to residential neighborhoods resulting in sight, noise or safety issues the Contractor shall provide appropriate temporary fence barrier with fabric cover for visual barrier as indicated on Contract Documents. If not indicated, the extent of the barrier will be determined by the Owner’s Representative based on the proximity of the adjacent properties.

N. Provide storage and/or construction parking areas as designated by Contractor on new projects and by the Owner’s Representative on renovation/expansion projects. Under no circumstances will construction employee vehicles be allowed to park next to the buildings. All streets used as access will be kept clean of all mud, construction debris, etc. by the Contractor on a daily basis.

O. Contractor will not switch from the use of temporary security and protection of facilities to permanent protection of facilities until Substantial completion or longer as requested by the Architect.

P. Warning Signs and Lights: Comply with standards and code requirements for erection of structurally adequate barricades with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting including flashing red or amber lights.

1. Furnish, install and maintain all necessary temporary barricades at elevated floor and roof edges perimeters and openings immediately after placement of each roof deck, slab form, deck and or concrete slab. All other protection and safety barricades, devices, covers, etc., shall be provided by the Contractor in accordance with OSHA requirements. Provide temporary hard barricades between work and occupied areas and site fencing for work area staging.

2. The Contractor will furnish, install and maintain “No Trespassing” signs at 50’ intervals around the perimeter of the construction area. Signs will be attached to the construction

fence. In areas where there is no fence the signs will be backed with plywood and mounted on 2x4 stakes set at least 18" in the ground. Signs will be clearly visible.

Q. At Substantial Completion clean and maintain permanent equipment that has been used during the construction period including but not limited to replacement of air filters, significantly worn parts and parts that have been subject to unusual operating conditions and lamps that are burned out or noticeably dimmed by substantial hours of use. (See Specification Section 01 74 13)

R. Security Enclosure and Lockup: Install substantial temporary enclosure for partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security. Where materials and equipment must be stored and are of value or attractive for theft provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

S. Protection of Installed work: The Contractor shall take all precautions to protect installed work, including, but not limited to the following:
1. Within seven (7) days after any portion of the Work has received roofing, the Contractor will secure that portion of the Work with lockable door units and window enclosures. Should lockable doors not be available for installation at this time, provide temporary means such as plywood to secure all openings for a secure area. Provide at this time and for the remainder of the Project, someone to arrive before starting time and remain 1/2 hour after quitting time to unlock and lock the building or building areas.
2. Protect installed work and provide any additional special protection as required in individual Specification Sections. The Contractor shall repair, replace or restore work that is damaged prior to final acceptance of the work.
3. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.
4. Provide protective coverings at walls, projections, jambs, sills and soffits of openings.
5. Protect, with durable sheet materials, finished floors, stairs and other surfaces from traffic, dirt, wear, damage or movement of heavy objects.
6. Prohibit traffic on landscaped areas.
7. All materials shall be protected from the elements as required.

T. Protection of Roof and Waterproofing
1. Protect from damage due to subsequent construction operations.
2. Limit traffic and prohibit storage upon waterproofed or roofed surfaces. If traffic or activity is necessary comply with recommendations for protection from waterproofing or roofing material manufacturer. For construction materials stored on the roof, store over plywood, particleboard or other approved protection board. Do not exceed the design load with stored materials and other anticipated live loads.
3. Where mechanical and other construction work is performed from the roof, the immediate area shall be protected with plywood, particleboard or other approved protection board. Where construction workers are likely to walk protect similarly. Contractor shall provide protective covering on the roof after roofing is installed.
4. Materials stored on roof must be secured to prevent windblown materials
5. Remove protection board from the site upon completion of the work.

3.14 TEMPORARY UTILITIES

A. Engage the appropriate Utility Company to install temporary service or connection to existing service. Where the utility provides only part of the service, provide the remainder with matching compatible materials and equipment; comply with the utilities recommendations.
1. Locating existing utilities is the sole responsibility of the contractor. The contractor shall use every method available to them to ensure all existing, new or temporary utilities are located and color coded markings are installed and maintained at 50' intervals for the duration of the project. Professional locating services as well as ground penetrating radar shall be utilized.
2. Arrange with the utility and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.

3. Obtain easements to bring temporary utilities to the site, where the Owners easements cannot be used for that purpose.
4. Provide adequate capacity at each stage of construction. Prior to temporary utility availability provide trucked-in services.
5.
6. Temporary utilities' maintenance and operational expenses shall be borne by the Contractor
7. Utilities or facilities not referenced in this section for installation, but required for the full development of the Project shall be installed and maintained in a workmanlike manner. The cost for unspecified facilities shall be borne by the Contractor if reasonable inferable from the construction documents.

B. Operation, Termination and Removal of Temporary Utilities
1. Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
2. Maintain facilities in good operating condition until removal. Protect from damage by adverse weather conditions.
3. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24-hour day basis where required to achieve indicated results and to avoid possibility of damage.
4. Prevent water filled piping from freezing.
5. Prevent temporary facilities and materials from blowing in high winds.
6. Maintain markers for underground lines. Protect underground lines from damage during excavation operations.
7. Unless the Architect requests that it be maintained longer, remove each temporary facility when the need has ended and replaced by authorized use of a permanent facility or not later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.
8. Materials and facilities that constitute temporary facilities are property of the Contractor.
9. The Owner reserves the right to take possession of project identification signs.
10. Remove temporary paving that is not intended for or acceptable for integration into permanent paving.
11. Where the area is intended for landscape development remove soil and aggregate fill that does not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other chemical compounds and other substances which might impair growth of plant materials or lawns. Repair or replace street paving, curbs and sidewalks at the temporary entrances as required by the governing authority.

C. Temporary Water Service and Distribution
1. Install temporary water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.
2. Sterilize temporary water piping prior to use.
3. Comply with authorities having jurisdiction regarding backflow prevention.
4. Connect to existing public water systems **with a below grade two inch (2") PVC pipe-size connection run to best accommodate the workforces and staging areas.** The consumable water and any monthly temporary meter rentals / fees will be paid for by the Contractor. Contractor will make utility arrangements with the local utility and pay the initial hookup, temporary tap or temporary meter fee if required for construction. The Contractor will maintain the water distribution system through the life of the project and protect from freezing. Contractor to monitor use of water to guard against waste or excessive use. Should the Owner's or a public water system not be available, the Contractor should make arrangements to have water necessary for construction made available on the jobsite via a well or delivered to the job site and stored on-site for use on the project.
5. All hoses utilized on the project site should be equipped to prevent uncontrolled water flow.

D. Temporary Electrical Power Service
1. Provide weatherproof, grounded electric power service and distribution system of sufficient capacity and power characteristics for the duration of the construction period to accommodate the temporary job trailers and construction operations requiring power for use of power tools and lighting. Include meters, transformers, overload protected disconnects, automatic ground-fault interrupters and main distribution switchgear as required.
2. Install temporary electric power service overhead except where underground service must be used.
3. Install temporary power distribution wiring overhead and rise vertically where least exposed to damage. Where permitted by code/OSHA standards, wiring circuit's not exceeding 120V- 20A and lighting circuits may run in nonmetallic sheathed cable provided they are run overhead and exposed for inspection and maintenance.
4. Temporary supply panels shall be secured by the Contractor to prevent unauthorized access.
5. All temporary wiring and devices shall be removed from the work prior to completion.
6. Provide main and supplement temporary power panels of 120/240v, 60 hertz alternating current service with ground-fault circuit interrupter feature fitted at the source.
7. Locate multiple outlets (not less than 4-gang) at each story of construction spaced so that the entire area of construction can be reached by power tools on a single extension cord of one-hundred (100) feet maximum length.

E. Temporary Lighting
1. When overhead floor or roof deck has been installed provide GFCI protected temporary lighting with local switching. Install and operate temporary lighting that will fulfill security and protection requirements and provide adequate illumination for construction operations and traffic conditions. The temporary lighting system shall be installed in a manner such that it can be operated without operating the entire electrical system.
2. Provide sufficient temporary lighting to insure proper workmanship everywhere by combined use of daylight and general lighting. Provide a source of switching to enable energy conservation during periods of varying activity (work-in-progress, traffic only, security check, lock-up, etc.) As a minimum, assure that lighting level meets the requirements of OSHA and that there is a minimum of 1 bulb in each room. Equip each lamp with a cage to protect the bulb.
3. Locate temporary lighting to avoid electric shocks, burns and glares.

F. Storm and Sanitary Sewer
1. If sewers are available, provide temporary connections to remove effluent waste lawfully.
2. Filter out soil, construction debris, chemicals, oils and similar contaminants that might clog sewers or pollute waterways before discharge.

G. Temporary Climate Conditioning
1. Provide temporary climate conditioning in any building area until the permanent HVAC system is operational especially if the current Project schedule indicates the start of the ceiling tiles, carpeting, or wood flooring. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy. Provide vented self-contained LP gas or fuel oil heaters with individual space thermostatic control. Use of gasoline-burning space heaters, open flame or salamander type heating units is prohibited. The Contractor must coordinate with utilities and include in their schedule all requirements for electrical power, natural gas service, water, sewer and storm drainage utilities to be fully functional and available to enable the HVAC systems to be operated as required to facilitate the installation of the ceiling tile, carpet or wood flooring. He shall assume responsibility for providing heating or cooling after the current Project schedule indicates the start of the ceiling tiles, carpeting or wood flooring. The permanent systems in any area of the building shall not be started unless all doors and windows in exterior walls are installed, or suitable

temporary construction is in place and building is relatively dust free (i.e., floors are broom clean, drywall finishing and paint spraying are completed). If in the Architects sole opinion, conditions exist sufficient to comprise the "quality of the system" at the date of Acceptance by the Owner; the authorization to startup the permanent systems shall be withheld until such time as the unsatisfactory conditions are corrected. The additional cost to maintain the operation of the temporary heating or cooling system shall be the Contractor's. Systems shall operate sufficiently to maintain the minimum temperature and relative humidity of the designed system +/- 15 percent.

2. The Contractor shall be responsible for operating and maintaining the permanent systems as they become operable and shall extend the warranty accordingly.
3. Temporary heat shall be provided as follows:
    i. At all times during the placing, setting and curing of concrete provide sufficient heat in accordance with technical specifications.
    ii. The building shall be properly ventilated to allow the proper curing of materials, control humidity and to control dust, fumes, vapors or gases.
    iii. When the permanent equipment is to be used the Contractor shall verify that the equipment is operational, properly lubricated and that filters are in place in accordance with the technical specifications. The Contractor is responsible for maintenance and replacement of filters and replacement of depleted parts to protect equipment and insure warranties remain in effect.
    iv. As a condition precedent to the use of the permanent HVAC system in any work area where temporary heat or AC is needed, the building or portions thereof shall be closed in by the Contractor with permanent or temporary doors and windows, thoroughly cleaned and maintained in a clean condition for the remaining duration of the Work. Close-in of the building or portions thereof, shall be accomplished in accordance with the schedule.
    v. The Contractor shall provide temporary heat and enclosures as necessary to properly install the masonry and concrete work and prevent freezing of the mortar. Provide tarpaulins with UL label and flame spread of fifteen (15) or less; provide translucent type (nylon reinforced polyethylene) where day lighting of enclosed space would be beneficial for workmanship and reduce use of temporary lighting. Heat with listed and labeled self-contained LP gas/fuel oil heaters appropriate for application to maintain a minimum enclosed temperature of 40 degrees F. Vent fuel-burning heaters per OSHA standards and equip units with individual-space thermostatic controls. Use electric-resistance space heaters only where no other more energy-efficient type of heater is available and allowable.

4. Warranty requirements are as indicated in Section 017837 Schedule of Warranties. The warranties on all equipment used for temporary heating will be extended from the time of start-up to one (1) year past the date of substantial completion of the Project or longer as specified. The Contractor and manufacturers may, in lieu of providing a manufacturer's extended warranty, provide a service/replacement contract to extend the normal one year warranty period to one (1) year past the date of substantial completion of the Project or longer as specified.

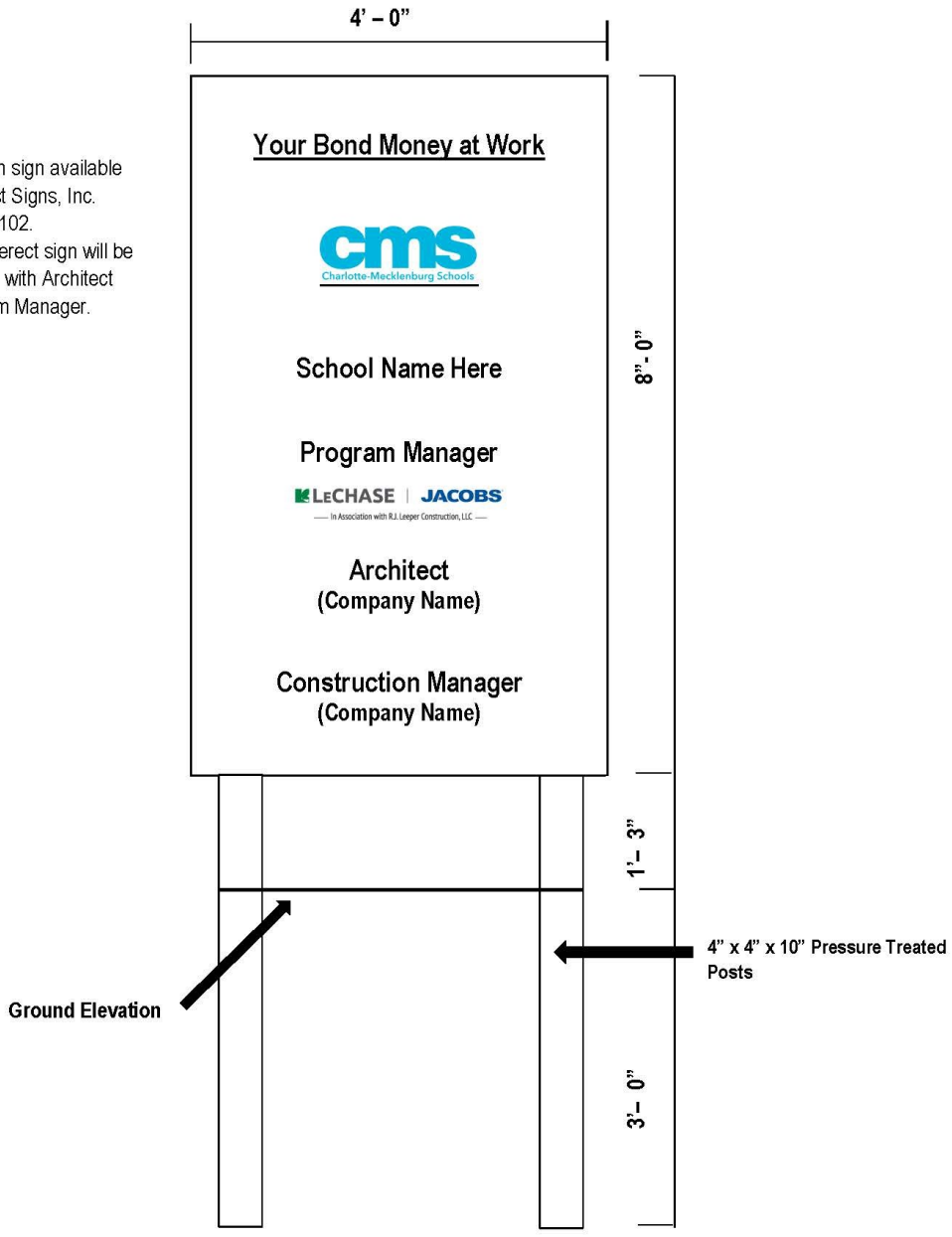
END OF SECTION

Figure 1

Construction Sign Detail

Notes:

1. Construction sign available through Fast Signs, Inc. (704) 527-9102.
2. Location to erect sign will be coordinated with Architect and Program Manager.



SECTION 015639
TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes: General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary controls, utilities, support facilities, temporary site fencing, and, if applicable, temporary erosion and sedimentation controls if not specified in Section 311000 "Site Clearing".
2. Section 311000 "Site Clearing" for removing existing trees and shrubs and for temporary erosion- and sedimentation-control measures if not specified in Section 015000 "Temporary Facilities and Controls".

1.2 DEFINITIONS

A. Caliper: Diameter of a trunk measured by a diameter tape at a height 6 inches above the ground for trees up to and including 4-inch size at this height and as measured at a height of 12 inches above the ground for trees larger than 4-inch size.

B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

a. Tree-service firm's personnel and equipment needed to make progress and avoid delays.
b. Quality-control program.
c. Coordination of Work and equipment movement with the locations of protection zones.
d. Trenching by hand or with air spade within protection zones.

1.4 ACTION SUBMITTALS

A. Samples: For each type of the following:

1. Organic Mulch: 1-quart volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.

B. Tree-Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

C. Maintenance Recommendations: From tree service firm, for care and protection of trees affected by construction during and after completing the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For tree service firm.

B. Quality-control program.

1.6 QUALITY ASSURANCE

A. Tree-Service Firm Qualifications: An experienced tree-service firm that has successfully completed temporary tree- and plant-protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

B. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection-zone fencing and signage, the tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.7 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

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

D. Take precautions to protect plants from airborne contaminants, such as paint or fireproofing overspray.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: Comply with Owner's standard.

B. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements: Previously used materials may be used when approved by Architect.

1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb./ft.; remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi; secured with plastic bands or galvanized-steel or stainless steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches apart.

a. Height: 48 inches.
b. Color: High-visibility orange, nonfading.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Tie a 1-inch blue vinyl tape around each tree trunk at 54 inches above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.3 TREE PROTECTION

A. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.

1. Apply 4-inch uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches of tree trunks.

3.4 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected areas except by entrance gates.

Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Plastic Fencing: Stretch fabric taut and secure to posts without bows or sags.

B. Maintain protection zones free of weeds and trash.

C. Maintain hydration of plants to assure plant survival.

D. Maintain protection-zone fencing in good condition as acceptable to Architect and remove when construction operations are complete, and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.5 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones in accordance with requirements in Section 312000 "Earth Moving" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow tine spading forks to comb soil and expose roots.

C. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.6 ROOT PRUNING

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

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Cut Ends: Do not paint cut root ends.
3. Temporarily support and protect roots from damage until they are permanently covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible in accordance with requirements in Section 312000 "Earth Moving."

B. Root Pruning at Edge of Protection Zone: Prune tree roots 12 inches outside of the protection zone by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.7 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by Owner's Representative.

1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
3. Pruning Standards: Prune trees in accordance with ANSI A300 (Part 1).

a. Type of Pruning: Cleaning.

B. Unless otherwise directed by Owner's Representative, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance pruning during Contract period.

F. Chip removed branches and dispose of off-site.

3.8 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.9 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Owner's Representative.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Owner's Representative.

B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Plant and maintain new trees as specified in Section 329300 "Plants."

END OF SECTION 015639

SECTION 015713
TEMPORARY EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Temporary erosion and sedimentation control measures during construction.

1.2 DEFINITIONS

A. Soil Stabilization: Measures which protect soil from the erosive forces of raindrop impact and flowing water.

B. Temporary Erosion Control Structures: Silt fences, sediment traps, outlet traps, diversion berms, stabilized construction entrances, and similar devices constructed for the purpose of retaining and controlling sediment.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site prior to commencement of site work.

1. Attendees: Shall include Owner, Contractor/Construction Manager, Civil Engineer, excavating and grading trade contractor, and other prime or trade contractors responsible for installation of erosion and sedimentation control measures. Invite representative of NCDENR to attend.
2. Agenda: Shall include review of plans and construction sequence, inspections, maintenance requirements, phasing of operations, and plan revisions.

1.4 SYSTEM DESCRIPTION

A. Performance Requirements: Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to the Erosion and Sediment Control Plan specific to the site that complies with EPA 832/R-92-005, or requirements of authorities having jurisdiction, whichever is more stringent. Meet the following requirements:

1. Control erosion on the construction site.
2. Protect existing undisturbed areas from effects of erosion.
3. Retain sediment within the boundaries of the site.
4. Prevent damage to properties outside the construction limits from silting due to construction of the project.

1.5 ACTION SUBMITTALS

A. Storm Water Pollution Prevention Plan (SWPPP): Submit initial plan concurrently to Architect and Owner within fifteen days of Notice to Proceed.

1. Submit final approved plan to Architect and Owner.

B. Documentation indicating compliance with EPA requirements cited in Quality Assurance Article, or of authorities having jurisdiction, whichever are more stringent.

1.6 INFORMATIONAL SUBMITTALS

A. EPA authorization under the EPA's "2017 Construction General Permit (CGP)."

B. Stormwater Pollution Prevention (SWPP) Training Log: For each individual performing Work under the SWPPP.

C. Photographic Documentation: Of existing conditions on site and adjacent to site potentially affected by erosion and sedimentation control measures.

D. Field reports of authorities having jurisdiction.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements

1. Comply with erosion and sedimentation control requirements of authorities having jurisdiction.

a. Comply with requirements of North Carolina Department of Environmental and Natural Resources (NCDENR).

2. Obtain all necessary permits for work of this Section.
3. Pay all fees, fines, and assessments related to Work of this Section charged or levied by authorities having jurisdiction.

B. Storm Water Pollution Prevention Plan (SWPPP): Prepare plan specific to Project site, consistent with the intent of the erosion and sedimentation and erosion control Drawings, with due allowance for phasing, maintenance, and site logistics.

1. Maintain the SWPPP in concert with the NPDES SGP through Project completion.

C. Stormwater Pollution Prevention Plan (SWPPP) Coordinator: Experienced individual or firm with a record of successful water pollution control management coordination of projects with similar requirements.

1. SWPPP Coordinator shall complete and finalize the SWPPP form.
2. SWPPP Coordinator shall be responsible for inspections and maintaining of all requirements of the SWPPP.

D. Installers: Trained as indicated in the SWPPP.

1.8 SEQUENCING AND SCHEDULING

A. Coordinating and Scheduling of Work

1. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place and approved.
2. Schedule and perform clearing and grubbing operations such that subsequent grading operations and erosion control applications can be installed immediately.

3. Conduct excavation, borrow, and embankment operations such that cuts and fills will be completed to final grades in a continuous operation.
4. Plant all construction areas not otherwise protected with permanent vegetative cover within time limits required by authorities having jurisdiction, but no later than the following:

    a. Within 30 working days after completion of active construction on any portion of the site.
    b. Within 14 working days of disturbance to denuded areas that may not be at final grade but will remain undisturbed for longer than 30 days.
    c. Within 7 working days on graded slopes.

1.9 FIELD CONDITIONS

A. If during the course of site construction, it becomes necessary to modify erosion control measures to execute the Work, notify Architect in writing within sufficient time to allow Architect to review the proposed change, modify and resubmit erosion and sedimentation control Drawings, and receive approval from authorities having jurisdiction.

    1. Allow not less than three weeks' notice. Field modifications are not allowed without written consent from the Architect and concurrence by NCDENR.

PART 2 - PRODUCTS

2.1 TEMPORARY STORMWATER POLLUTION CONTROLS

A. Provide temporary stormwater pollution controls as required by the SWPPP.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect Project site, areas of property adjacent to Project site, and surrounding properties potentially affected by storm water runoff and Work of this Section.

    1. Verify that condition of Project site corresponds to information indicated on Drawings.
    2. Note and bring to the immediate attention of the Architect existing disturbed soil conditions, erosion, or sedimentation requiring abatement or documentation. Examine and report downstream blockages to streams, creeks, and backwash channels that may impact or be impacted by the Work.

B. Provide project site border documentation in the form of a complete series of photographs clearly showing the existing conditions at the construction limits of the Project site. Submit copy to Architect for record purposes.

3.2 INSTALLATION, GENERAL

A. Sequence construction in a manner that maintains both function and capacity of erosion and sedimentation devices. During transitions between initial phase erosion and final phase erosion measures, leave initial phase measures in place until final phase measures are installed and functional. Do not leave site unprotected.

B. Commence erosion and sedimentation control work prior to site clearing.

1. Remove debris, timber, and other accumulations from the channel and banks of streams, creeks, and backwash channels. Maintain channels and banks in an unobstructed state throughout construction.
2. Excavate and grade temporary sedimentation and erosion control basins, if required, prior to other construction activity.
3. Install storm drainage system with inlet protection at construction entrance.
4. Install temporary gravel construction entrance.
5. Construct temporary diversion ditches above the proposed building site. Install level spreaders and sediment traps.
6. Vegetate disturbed areas.

C. Complete site clearing in accordance with Division 31 Section "Site Clearing."

1. Clear waste disposal area as required. Stockpile and protect topsoil.

D. Rough grade site in accordance with Division 31 Section "Earth Moving" and as follows:

1. Do not perform grading activities beyond the limits indicated.
2. Establish the angle for graded slopes of soil stockpiles and fills no greater than the angle which can be retained by vegetative cover or other adequate erosion control devices. Finish slopes as soon as rough grading is complete. Leave the surface slightly roughened and vegetate and mulch immediately.
3. Maintain diversions along top of fill slopes.

E. Correct erosion and sedimentation control issues within time frames set forth in the applicable statutes and regulations or as set forth in any NCDENR Notice of Violation (NOV), as defined by the Division of Land Resources or the Sedimentation and Pollution Control Act.

1. Owner will notify Contractor of any NOV issued by NCDENR within two business days of Owner's receipt. Commence remedial actions within two business days after receipt of written notice from Owner.
2. In the event that Contractor fails to commence remedial actions within the requisite time period, Owner may proceed to have required work performed by another vendor, unless (1) Contractor submits a request for an extension of time to NCDENR which is subsequently approved by NCDENR or (2) Contractor begins remedial work before Owner begins remedial work.
3. In the event Contractor fails to begin remedial actions within the requisite time period, Contractor shall reimburse Owner for remedial work performed by Owner.
4. Requests to NCDENR for extension of time shall state the reasons for such request and the length of the extension requested, and shall be made as soon as possible, but no later than three business days after receipt of the NOV by Owner. Owner shall simultaneously be provided a copy of any request of extension. If NCDENR denies the request, Contractor shall begin responsive actions no later than the day following the Contractor’s receipt of the denial.

F. Final grade site in accordance with Division 31 Section "Earth Moving" and as follows:

1. Complete final grading for roads and parking and stabilize with gravel.
2. Complete final grading for buildings.
3. Complete final grading of grounds, topsoil critical areas, and permanently vegetate, landscape and mulch.

3.3 SEDIMENT CONTROL DEVICES

A. Construct all sediment control devices prior to beginning clearing and grubbing of the site. Construct as indicated and as additionally required to provide sediment control specified and required by authorities having jurisdiction.

1. Silt fences: Construct as indicated utilizing wood or metal posts of length adequate to remain firmly secured. Secure filter fabric to posts. Lap fabric ends minimum 12 inches and secure lap with post. Bury bottom edge of filter fabric in subgrade as indicated.
2. Sediment traps: Construct as indicated utilizing wood or metal posts of length adequate to remain firmly secured. Use nonwoven fabric specified. Secure filter fabric to posts. Lap fabric ends minimum 24 inches and secure lap with posts. Bury bottom edge of filter fabric in subgrade as indicated.
3. Outlet traps: Construct as indicated.
4. Diversion Berms: Construct as indicated and as additionally required to control runoff from construction operations.
5. Stabilized construction entrances: Construct as indicated.
6. Install riprap at all piped outlets and channels as required.

3.4 TEMPORARY SEEDING FOR EROSION CONTROL

A. Seed graded slopes within seven calendar days of completion or achieving grade. Seed all other site areas within 14 calendar days of achieving grade or following suspension of work in area.

B. Establish ground cover on denuded areas of the site which, in the opinion of the Architect and authorities having jurisdiction, is mature enough to control soil erosion satisfactorily and to survive severe weather conditions.

1. Stabilize soil stockpiles with temporary vegetative cover or provide sediment trapping measures to prevent soil loss.
2. Establish a permanent vegetative cover on denuded areas not otherwise stabilized.
3. Rip areas to be seeded and spread with available topsoil minimum 3 inches deep. Prepare seedbed to 4 to 6 inches' depth. Remove loose rocks and other obstructions from soil surface so that they will not interfere with the establishment and maintenance of vegetation. Grade surface for seedbed preparation reasonably smooth and uniform.

C. Apply fertilizer and lime according to seeding specifications below. Provide additional 15 lb per 1000 sq. ft. of superphosphate.

1. If soil test is taken, provide lime and fertilizer according to soil test report.
2. Apply lime and fertilizer uniformly and mixed with the soil during seedbed preparation.

D. Mulch seeded areas. Tack or mechanically tie mulch after application. Stabilize slopes greater than 2.5:1 with jute mesh.

E. Seeding Specifications: 3:1 slope or less:

1. Apply agricultural lime at the rate of 90 lb per 1000 sq. ft.
2. Apply 10-10-10 commercial fertilizer at the rate of 20 lb per 1000 sq. ft.
3. Seed in accordance to the following schedule and application rates:

Date:	Type:	Planting Rate:

a.	Aug 15 – Nov 1	Tall Fescue	300 lb/ac or 7 lb/1000 sq. ft.
b.	Nov 1 – Mar 1*	Tall Fescue and	300 lb/ac or 7 lb/1000 sq. ft.
		Abruzzi Rye	25 lb/ac or ½ lb/1000 sq. ft.
c.	Mar 1 – April 15	Tall Fescue	300 lb/ac or 7 lb/1000 sq. ft.
d.	April 15 – July 30	Mulled Common Bermuda Grass	25 lb/ac or ½ lb/1000 sq. ft.
e.	July 15 – Aug 15	Tall Fescue and	300 lb/ac or 7 lb/1000 sq. ft.
		Brown Top Millet	35 lb/ac or ¾ lb/1000 sq. ft.
		or Sorghum Sudan Hybrids	30 lb/ac or ¾ lb/1000 sq. ft.

4. Mulch with straw applied at the rate of 75 - 100 lb/1000 sq. ft.
5. *Heavily mulched during January to March period.

F. Seeding Specifications: Slopes greater than 3:1:

1. Apply agricultural lime at the rate of 90 lb/1000 sq. ft.
2. Apply 10-10-10 commercial fertilizer at the rate of 20 lb/1000 sq. ft.
3. Seed in accordance to the following schedule and application rates:

	Date:	Type:	Planting Rate:
a.	Mar – Jun 1	Sericea Lespedeza (Scarified) and	50 lb/ac or 1 1/2 lb/1000 sq. ft.
b.	Mar – April 1	Tall Fescue or	150 lb/ac or 3-1/2 lb/1000 sq. ft.
c.	Mar – June	Weeping Lovegrass	5 lb/ac or 7 lb/1000 sq. ft.
d.	Jun – Sept 1***	Tall Fescue and	60 lb/ac or 1-½ lb/1000 sq. ft.
		Brown Top Millet	35 lb/ac or ¾ lb/1000 sq. ft.
		or Sorghum Sudan Hybrids	30 lb/ac or ¾ lb/1000 sq. ft.
e.	Sep – Mar 1	Sericea Lespedeza and	70 lb/ac or 1-¾ lb/1000 sq. ft.
		Tall Fescue or	150 lb/ac or 3-½ lb/1000 sq. ft.
		Millet or Sudan (unhulled – unscarified)	20 lb/ac or ½ lb/1000 sq. ft

4. Mulch with 6-inch-deep straw applied at the rate of 60-70 lb/1000 sq. ft and anchor with asphalt emulsion tack coat applied at the rate of 14 - 28 gal/1000 sq. ft or 800 - 1200 gal/ac.
5. ***Temporary reseed Sept. 1 at recommended rates.

3.5 FIELD QUALITY CONTROL

A. Owner will engage qualified representative to inspect initial installation of temporary erosion and sedimentation control measures and will also perform periodic spot checks to determine that Contractor is properly maintaining temporary erosion and sedimentation control measures.

B. Monitor and document erosion and sedimentation control devices as required by the NPDES Stormwater General Permit, Number NCGO 1000. Maintain documentation required by the NPDES SGP on Project site available for review by Owner, Architect, and NCDENR erosion control inspector.

C. Immediately correct work indicated in field quality control reports as not meeting project requirements.

D. Immediately corrrect work cited in NCDENR Notice of Violation.

3.6 PROTECTION AND CLEANING

A. Maintain devices for sediment control in proper working order for the duration of the Project. Check erosion and sediment control structures for stability and operation following runoff-producing rainfall but in no case less than once per week. Repair damaged or dislodged structures to working condition immediately.

B. Remove sediment from sediment traps and inlet protection devices when storage capacity has been approximately 50 percent filled. Clean gravel structures or replace when sediment pool no longer drains properly.

C. Remove sediment from behind sediment fence when sediment reaches 6 inches deep. Repair sediment fence as required to maintain sediment barrier.

D. Fertilize, reseed, and mulch seeded areas as required to maintain a vigorous dense vegetative cover. Restore protection to protected stockpiles and slopes immediately following disturbance. Maintain vegetation less than 12 inches tall. Remove debris no less than weekly.

E. Remove sediment, dirt, and debris deposited on roadways as a result of construction activity by end of same working day.

F. Clean, repair, and restore adjoining properties as necessitated by erosion and sedimentation from the Project site during the course of the project.

G. Any accumulated silt, materials, etc. shall be hauled off and disposed of in a legal manner.

3.7 REMOVAL OF TEMPORARY DEVICES

A. Request approval of Architect and authorities having jurisdiction prior to dismantling of erosion control devices.

B. Dismantle and remove silt fences; clean out and fill silt basins and remove all other temporary erosion and sediment control devices.

C. Provide fine grading and seeding of remaining unfinished areas as indicated.

END OF SECTION 015713

SWPPP Template (CMS)

Instructions

To help you develop the narrative section of your site specific SWPPP. This template is designed to help guide you in the development of a process to address all the necessary elements in your NPDES permit.

Using the SWPPP Template

Each section of this template includes "instructions" and space for "project information." You should read the instructions for each section as you complete the project information. This template was developed in Word so that you can easily add tables and additional text. Some sections may require only a brief description while others may require several pages of explanation.

Tips for completing the SWPPP template

- If there is more than one construction operator for your project, consider coordinating development of your SWPPP with the other operators.
- Multiple operators may share the same SWPPP, but make sure that responsibilities are clearly described.
- Modify this SWPPP template so that it addresses the requirements in your erosion/sedimentation plan and NPDES permit and meets the needs of your project.

Stormwater Pollution Prevention Plan

For:

Insert Project Name
Insert Project Site Location/Address
Insert City, State, Zip Code
Insert Project Site Telephone Number (if applicable)

Operator(s):

Insert Company or Organization Name
Insert Name
Insert Address
Insert City, State, Zip Code
Insert Telephone Number
Insert Fax/Email

Preparation Date:

Estimated Project Dates:

Start of Construction: __ __ / __ __ / __ __ __ __

Completion of Construction: __ __ / __ __ / __ __ __ __

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SECTION 1: SITE EVALUATION, ASSESSMENT, AND PLANNING

1.1 Project/Site Information

Instructions:

- In this section you can gather some basic site information that will be helpful to you later.
- For more information, see Developing Your Stormwater Pollution Prevention Plan: NCDENR Field Manual and NCDENR Erosion and Sediment Control Planning and Design Manual.

Project Information:

Project/Site Name: _____

Project Street/Location: _____

City: _____ State: _____ Zip Code: _____

NPDES project or permit tracking number:_____

(This is the unique identifying number assigned to your project by your permitting authority after you have applied for coverage under the appropriate NPDES construction general permit.)

1.2 Contact Information/Responsible Parties

Instructions:

- List the Owner, project managers, storm water manager, and person or organization that prepared the Storm Water Pollution Prevention Plan. Indicate respective responsibilities, where appropriate.
- Also, list subcontractors expected to work on-site. Notify subcontractors of stormwater requirements applicable to their work.

Project Information:

Owner(s):
Insert Company or Organization Name
Insert Name
Insert Address
Insert City, State, Zip Code
Insert Telephone Number
Insert Fax/Email

General Contractor Project Manager(s) or Site Supervisor(s):
Insert Name
Insert Company or Organization Name
Insert Address
Insert City, State, Zip Code
Insert Telephone Number
Insert Fax/Email
Insert area of control (if more than one operator at site)
Repeat as necessary

Grading Contractor:
Insert Name
Insert Company or Organization Name
Insert Address
Insert City, State, Zip Code
Insert Telephone Number
Insert Fax/Email (Optional)
Repeat as necessary

Landscape Contractor:
Insert Name
Insert Company or Organization Name
Insert Address
Insert City, State, Zip Code
Insert Telephone Number
Insert Fax/Email (Optional)

Subcontractor(s):
Insert Company or Organization Name
Insert Name
Insert Address
Insert City, State, Zip Code
Insert Telephone Number

This SWPPP Was Prepared By:
Insert Name
Insert Company or Organization Name
Insert Address
Insert City, State, Zip Code
Insert Telephone Number
Insert Fax/Email
Insert Fax/Email
Repeat as necessary

Emergency 24 hour contact:
Insert Name
Insert Telephone Number

Emergency Services contact:
Fire Department
NCDENR Inspector

1.3 Nature and Sequence of Construction Activity

Instructions:

- Briefly describe the nature of the construction activity and approximate timeframes (one or more paragraphs, depending on the nature and complexity of the project).

Project Information:

- Describe the general scope of the work for the project, major land disturbing phases of construction, etc:

INSERT TEXT HERE

Estimated Project Start Date: __ __ / __ __ / __ __ __ __

Estimated Project Completion Date: __ __ / __ __ / __ __ __ __

1.4 Soils, Slopes, Vegetation, and Current Drainage Patterns

Instructions:

- Describe the existing soil conditions at the construction site including soil types, slopes and slope lengths, drainage patterns, and other topographic features that might affect erosion and sediment control.
- Also, note any historic site contamination evident from existing site features and known past usage of the site.

Project Information:

Soil type(s):

- **INSERT TEXT HERE**
- **INSERT TEXT HERE**

Slopes (describe current slopes and note any changes due to grading or fill activities):

- **INSERT TEXT HERE**
- **INSERT TEXT HERE**

Drainage Patterns (describe current drainage patterns and note any changes dues to grading or fill activities):

- **INSERT TEXT HERE**
- **INSERT TEXT HERE**

Vegetation:

- **INSERT TEXT HERE**
- **INSERT TEXT HERE**

Other:

- **INSERT TEXT HERE**
- **INSERT TEXT HERE**

1.5 Construction Site Impacts

Instructions:

- Estimate the area to be disturbed by excavation, grading, or other construction activities, including dedicated off-site borrow and fill areas.

Project Information:

The following are estimates of the construction site:

Construction Site Area to be disturbed acres

Total Project Area acres

1.6 Receiving Waters

Instructions:

- List the waterbody(s) that would receive stormwater from your site, including streams, rivers, lakes, coastal waters, and wetlands. Describe each as clearly as possible, such as *Mill Creek, a tributary to the Potomac River*, etc.
- Note any stream crossings, if applicable.
- List the storm sewer system or drainage system that stormwater from your site could discharge to and the waterbody(s) that it ultimately discharges to.
- If any of the waterbodies above are impaired and/or subject toTMDLs, please list the pollutants causing the impairment and any specific requirements in the TMDL(s) that are applicable to construction sites. Your SWPPP should specifically include measures to prevent the discharge of these pollutants.

Project Information:

Description of receiving waters: INSERT TEXT HERE

Description of storm sewer systems: INSERT TEXT HERE

Description of impaired waters: INSERT TEXT HERE

1.7 Site Features and Sensitive Areas to be Protected

Instructions:

- Describe unique site features including streams, stream buffers, wetlands, specimen trees, natural vegetation, steep slopes, or highly erodible soils that are to be preserved.
- Describe measures to protect these features.
- Include these features and areas on your site maps.

Project Information:

Description of unique features and measures to protect them:

- INSERT TEXT OR TABLE HERE

1.8 Potential Sources of Pollution

Instructions:

- Identify and list all potential sources of sediment from construction materials and activities which may reasonably be expected to affect the quality of stormwater discharges from the construction site.
- Identify and list all potential sources of pollution, other than sediment, from construction materials and activities which may reasonably be expected to affect the quality of stormwater discharges from the construction site.

Project Information:

Potentials sources of sediment to stormwater runoff:

- INSERT TEXT OR TABLE HERE
- INSERT TEXT HERE

Potential pollutants and sources, other than sediment, to stormwater runoff:

- INSERT TEXT OR TABLE HERE
- INSERT TEXT HERE

SECTION 2: EROSION AND SEDIMENT CONTROL BMPS

Instructions:

- Describe the BMPs that will be implemented to control pollutants in stormwater discharges. For each major activity identified:
  - ☐ Clearly describe appropriate control measures.
  - ☐ Describe the general sequence during the construction process in which the measures will be implemented.
  - ☐ Describe the maintenance and inspection procedures that will be undertaken for that specific BMP.
  - ☐ Include protocols, thresholds, and schedules for cleaning, repairing, or replacing damaged or failing BMPs.
  - ☐ Identify staff responsible for maintaining BMPs.
- Categorize each BMP under one of the following 10 areas of BMP activity as described below:
  - ☐ *Minimize disturbed area and protect natural features and soil*
  - ☐ *Grading Phase Activity*
  - ☐ *Control Stormwater flowing onto and through the project*
  - ☐ *Stabilize Soils*
  - ☐ *Protect Slopes*
  - ☐ *Protect Storm Drain Inlets*
  - ☐ *Establish perimeter controls and sediment barriers*
  - ☐ *Retain Sediment On-Site and Control Dewatering Practices*
  - ☐ *Establish Stabilized Construction Exits*
  - ☐ *Any Additional BMPs*
- Any structural BMPs should have design specifications and details.
- Consult the Architect, Civil Engineer, GEO Tech Engineer should you have questions.

Project Information:

1. Minimize Disturbed Area and Protect Natural Features and Soil:

Describe the areas that will be disturbed with each phase of construction and the methods (signs, fences, etc.) that you will use to protect those areas that should not be disturbed. Describe natural features identified earlier and how each will be protected during construction activity. Also describe how topsoil will be preserved. Include these areas and associated BMPs on your site map.

- INSERT Text or TABLE HERE, include inspection and maintenance schedules as appropriate and staff responsible for maintenance
- Phase Construction Activity:

Describe the intended construction sequencing and timing of major activities, including grading activities, road and utility installation, and building phases. It may be useful to develop a separate, detailed site map for each phase of construction.

- Phase I
  - ☐ Describe phase
  - ☐ Duration of phase (start date, end date)
  - ☐ List BMPs associated with this phase

☐ List BMPs associated with this phase
☐ Describe stabilization methods for this phase (describe any temporary stabilization methods that will be used before final stabilization)

Repeat as needed

- Phase II
  ☐ Describe phase
  ☐ Duration of phase (start date, end date)
  ☐ List BMPs associated with this phase
  ☐ List BMPs associated with this phase
  ☐ Describe stabilization methods for this phase (describe any temporary stabilization methods that will be used before final stabilization)

  Repeat as needed

2. Control Stormwater Flowing Onto and Through the Project:

Describe structural practices (i.e., diversions, berms, ditches, storage basins) including design specifications and details used to divert flows from exposed soils, retain or detain flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site.

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff INSERT TEXT HERE

4. Stabilize Soils:

Describe controls (i.e., temporary seeding with native vegetation, hydroseeding, etc.) to stabilize exposed soils where construction activities have temporarily or permanently ceased. Also describe measures to control dust generation. Use of impervious surfaces for stabilization should be avoided whenever possible.

- BMP Description: INSERT TEXT HERE
  ☐ Permanent ☐ Temporary
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE

☐ Permanent ☐ Temporary

- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

5. Protect Slopes:

Describe controls (i.e., erosion control blankets, tackifiers, etc.) including design specifications and details that will be implemented to protect all slopes.

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

6. Protect Storm Drain Inlets:

Describe controls (i.e., inserts, rock-filled bags, or block and gravel, etc.) including design specifications and details that will be implemented to protect all inlets receiving stormwater from the project during the entire duration of the project.

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

7. Establish perimeter controls and sediment barriers:

Describe structural practices (i.e., silt fences or fiber rolls) including design specifications and details to filter and trap sediment before it leaves the construction site.

- BMP Description: INSERT TEXT HERE

- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

8. Retain Sediment On-Site and Control Dewatering Practices:

Describe sediment control practices (i.e., sediment trap or sediment basin), including design specifications and details (volume, dimensions, outlet structure) that will be implemented at the construction site to retain sediments on-site. Describe dewatering practices that will be implemented if water must be removed from an area so that construction activity can continue.

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

9. Establish Stabilized Construction Exits:

Describe location(s) of vehicle entrance(s) and exit(s), procedures to remove accumulated sediment off-site (i.e., vehicle tracking), and stabilization practices (i.e., stone pads and/or wash racks) to minimize off-site vehicle tracking of sediments and discharges to stormwater.

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE

- Responsible Staff: INSERT TEXT HERE

SECTION 3: GOOD HOUSEKEEPING BMPS

3.1 Good Housekeeping BMPs

Instructions:

- Describe the key good housekeeping and pollution prevention measures that will be implemented to control pollutants in stormwater.
- Categorize each good housekeeping and pollution prevention BMP under one of the following 7 categories and follow the instructions to SWPPP Guide your description:

☐ ***Material Handling and Waste Management:***
☐ ***Establish Proper Building Material Staging Areas:***
☐ ***Designate Washout Areas:***
☐ ***Establish proper equipment/vehicle fueling and maintenance practices:***
☐ ***Allowable non-stormwater discharges and control equipment/vehicle washing:***
☐ ***Spill Prevention and Control Plan:***
☐ ***Any Additional BMPs:***

- Consult your state's design manual.

Project Information:

1. Material Handling and Waste Management:

Describe measures (i.e., trash disposal, sanitary wastes, recycling, and proper material handling) to prevent the discharge of solid materials to waters.

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

2. Establish Proper Building Material Staging Areas:

Describe construction materials expected to be stored on-site and procedures for storage of materials to minimize exposure of the materials to storm water.

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

3. Designate Washout Areas:

Describe location(s) and controls to minimize the potential for stormwater pollution from washout areas for concrete mixers, paint, stucco, etc.

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

4. Establish proper equipment/vehicle fueling and maintenance practices:

Describe equipment/vehicle fueling and maintenance practices that will be implemented to control pollutants to stormwater (e.g., secondary containment, drip pans, spill kits, etc.)

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

5. Allowable non-stormwater discharges and control equipment/vehicle washing:

For the allowable non-stormwater discharge(s) associated with construction industrial activity identified, describe controls and measures that will be implemented at those sites to minimize pollutant discharges.

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

6. Spill Prevention and Control Plan:

Describe the spill prevention and control plan to include ways to reduce the chance of spills, stop the source of spills, contain and clean up spills, dispose of materials contaminated by spills, and train personnel responsible for spill prevention and control.

- INSERT TEXT HERE

7. Any Additional BMPs:

Describe any additional BMPs that don't fit into the above categories. Indicate the problem they are intended to address.

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

SECTION 4: DELETE POST-CONSTRUCTION BMPs

Instructions:

- Describe all post-construction stormwater management measures that will be installed during the construction process to control pollutants in stormwater discharges after construction operations have been completed. Examples of post-construction BMPs include:

  ☐ Biofilters
  ☐ Detention/retention devices
  ☐ Earth dikes, drainage swales, and lined ditches
  ☐ Infiltration Basins
  ☐ Other proprietary permanent structural BMPs
  ☐ Outlet protection/velocity dissipation devices
  ☐ Slope protection
  ☐ Vegetated strips and/or swales

- Describe low impact designs or smart growth considerations have been incorporated into the design.
- Any structural BMPs should have design specifications and details referred to and attached.

Project Information:

- BMP Description: INSERT TEXT HERE

- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

- BMP Description: INSERT TEXT HERE
- Installation Schedule: INSERT TEXT HERE
- Maintenance and Inspection: INSERT TEXT HERE
- Responsible Staff: INSERT TEXT HERE

SECTION 5: INSPECTIONS and MAINTENANCE

5.1 Inspections

Instructions:

- Identify the individual(s) responsible for conducting inspections and describe their qualifications. Attach the NCDENR inspection form that will be utilized. Provide a copy of their CMCSI certification.
- Describe the frequency that inspections will occur at your site including any correlations to storm frequency and intensity.
- You should also document the repairs and maintenance that you undertake as a result of your inspections. These actions can be documented in the corrective actions log.

Project Information:

1. Inspection Personnel:

Identify the person(s) who will be responsible for conducting inspections and describe their qualifications.

- INSERT TEXT HERE

2. Inspection Schedule and Procedures:

i. Describe the inspection schedules and procedures you have developed for your site (include frequency of inspections for each BMP or group of BMPs, indicate when you will inspect, e.g. before/during/and after rain events, spot inspections, etc.).

- INSERT TEXT OR TABLE HERE

ii. Describe the general procedures for correcting problems when they are identified. Include responsible staff and timeframes for making corrections.

- INSERT TEXT OR TABLE HERE

iii. Attach a copy of the NCDENR inspection report you will use for your site.

- REFERENCE ATTACHMENT

5.2 Maintenance of Controls

Instructions:

- Summarize routine maintenance of structural and non-structural BMPs. Include schedules (daily, weekly, etc.) as well as the staff responsible.
- Maintenance procedures for individual BMPs.
- Specific maintenance activities can be documented in the corrective action log.

Project Information:

Maintenance Procedures: INSERT TEXT OR TABLE HERE

5.3 Corrective Action Log

Instructions:

- Insert corrective action log. This log should describe repair, replacement, and maintenance of BMPs undertaken based on the inspections and maintenance procedures described above. Actions related to the findings of inspections should reference the specific inspection report.
- This log should describe actions taken, date completed, and note the person that completed the work.

Project Information:

Corrective Action Log: INSERT TABLE HERE or REFERENCE ATTACHMENT

SECTION 6: Recordkeeping and Training

6.1 Recordkeeping

Instructions:

The following is a list of records you should keep at your project site available for inspectors to review:

- Dates of grading, construction activity, (and stabilization which is covered in Section 7).
- A copy of the NCDENR permit (attach).
- NCDENR Site Inspection reports (attach).
- Check your NCDENR permit for additional details.

Project Information:

Dates when major grading activities occur:

- INSERT TEXT OR TABLE HERE

Dates when construction activities temporarily or permanently cease on a portion of the site

- INSERT TEXT OR TABLE HERE

6.2 Log of Changes

Instructions:

Document a log of changes and updates to the approved erosion and sedimentation plan. You should include additions of new BMPs, replacement of failed BMPs, significant changes in the activities or their timing on the project, changes in personnel, changes in inspection and maintenance procedures, and updates to site maps, etc. Use the NCDENR change log to document these changes.

Project Information:

Log changes and updates to the approved erosion and sedimentation plan.

- CREATE LOG HERE or as an ATTACHMENT

6.3 Training

Instructions:

- Training your staff and subcontractors is an effective BMP. Describe what other steps you take to prevent stormwater problems at your site, you should document the training that you conduct for your staff, for those with specific stormwater responsibilities (e.g. installing, inspecting, and maintaining BMPs), and for subcontractors.

- Include dates, number of attendees, subjects covered, and length of training.
- Provide copies of your staff's CMCSI Certification Certificates.

Project Information:

Describe Training Conducted:

- General stormwater and BMP awareness training for staff and subcontractors
  INSERT TEXT HERE
- Detailed training for staff and subcontractors with specific stormwater responsibilities
  INSERT TEXT HERE

Individual(s) Responsible for Training:

- INSERT TEXT HERE
- INSERT COPIES OF CMCSI CERTIFICATIONS

SECTION 7: FINAL STABILIZATION

Instructions:

- Describe procedures for final stabilization.
- Update your site plans to indicate areas that have achieved final stabilization and approved by NCDENR and the Architect/Engineer.

Project Information:

- INSERT TEXT HERE

SECTION 8: CERTIFICATION AND NOTIFICATION

Instructions:

- This document shall be signed and certified by the construction operator(s).

Project Information:

I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant consequences for submitting false information, including the possibility of fines from CMS or NCDENR.

Name: _____ Title: _____

Signature: _____ Date: _____

I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant consequences for submitting false information, including the possibility of fines from CMS or NCDENR.

Name: _____ Title: _____

Signature: _____ Date: _____

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's selection of products, materials and equipment for use in the Project.

B. The Contractor's construction schedule and the Schedule of Submittals are included in Section 01 33 00 - Submittal Procedures.

C. Administrative procedures for handling requests for substitution made after award of the Contract are included in Section 01 25 00 - Substitution Procedures

1.2 DEFINITIONS

A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties", "systems", "structure", "" finishes" "accessories" and similar terms. Such terms are self-explanatory and have well recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product": includes the terms "material", "equipment", "system" and terms of similar intent.
2. "Named Products" are items identified by manufacturer's product name, including the make or model designation, as indicated in the manufacturer's published product literature, current as of the date of the Contract Documents.
3. "Materials" are products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed or installed to form a part of the Work.
4. "Equipment" is a product with operational parts; whether motorized or manually operated that requires service connections such as wiring or piping.

1.3 SUBMITTALS

A. Product List Schedule: Prepare a schedule showing products specified in a tabular form acceptable to the Architect. Include generic names of products required. Include the manufacturer's name and proprietary product names for each item listed.

1. Coordinate: Coordinate the product list schedule with the Contractor's Construction Schedule and the Schedule of Submittals.
2. Form: Prepare the product listing schedule with information on each item tabulated under the following column headings:
    a. Related Specification Section number.
    b. Generic name used in Contract Documents.
    c. Proprietary name, model number and similar designations.
    d. Manufacturer's name and address.
    e. Supplier's name and address.
    f. Installer's name and address.
    g. Projected delivery date, or time span of delivery period.
    h. Lead time from order to the first possible delivery date (in work days)
3. Submittal: With thirty (30) days after date of the Notice to Proceed or a Letter of Intent, which ever comes first, submit three (3) copies of an initial product list schedule. Provide a written explanation for omissions of data and for known variations from Contract requirements. At the Contractor's option, the initial submittal may be limited to product selections and designations that must be established early in the Contract period.
4. Completed Schedule: Within sixty (60) days after date of the Notice to Proceed or a Letter of Intent, which ever comes first, submit three (3) copies of the completed product list schedule. Provide a written explanation for omissions of data and for known variations from Contract requirements.

5. After all requests of substitutions have been considered, and not later than thirty (30) days from the Contract Date, the Contractor shall furnish to the Architect for review a complete list of all Subcontractors and of all material and equipment to be used in the Project showing the manufacturer, supplier, trade name and model number of each. Where the Specifications allow a choice, the list shall indicate the Contractor's choice. The list shall follow the sequence of the sections of the Specifications.
6. No later than fifteen (15) days after the Notice to Proceed the Contractor shall provide to the Architect and Owner a list of all manufacturers and suppliers whose products are proposed for inclusion in the Work and, where applicable, the names of the installing subcontractors. The Architect shall promptly reply in writing to the Contractor stating whether he or the Owner has any reasonable objection to the proposed manufacturers, suppliers, or installers or shall request additional information if adequate data is not submitted with the Contractor's proposal. If the Contractor receives no written objection or request for additional information from the Architect within ten (10) days the list shall be taken as approved. The absence of any written objection to any manufacturer, supplier, or installer by the Owner and Architect shall not constitute a waiver of any Contract requirement.

1.4 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.

B. Compatibility of Options: When the Contractor is given the option of selecting between two (2) or more products for use on the Project; the product selected shall be compatible with products previously selected even if the previously selected products were also options.
   1. The Contractor and Telecommunications Contractor are responsible for providing products and construction methods that are compatible with products and construction methods of the other Contractor.
   2. If a dispute arises between Contractors over concurrently selectable, but incompatible products, the Architect will determine which products shall be retained and which are incompatible and must be replaced.

C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.
   1. Labels: Locate required product labels and stamps on a concealed surface or, on an easily accessible surface that is inconspicuous in occupied spaces where required for observation after installation.
   2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
      a. Name of product and manufacturer.
      b. Model and serial number.
      c. Capacity.
      d. Speed.
      e. Ratings.
      f. Service disconnect breaker or valve.

D. Owner's Right of Final Approval: The Owner reserves the right of Final Approval of all labor, material and equipment.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products in accordance with the manufacturer's recommendations using means and methods that will prevent damage, deterioration and loss, including theft.

1. Transport and handle products in accordance with manufacturer's instructions.

2. Promptly inspect shipments to ensure that products comply with requirements, that quantities are correct, and products are undamaged.
3. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
4. Store and protect products in accordance with manufacturers' instructions, with seals and labels intact and legible.
5. Store sensitive products in weather tight, climate controlled enclosures.
6. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
7. For exterior storage of fabricated products, place on sloped supports, above ground.
8. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
9. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.
10. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
11. Maintain storage in a neat and clean condition at all times.
    a. The Owner's Representative will not receive Contractor Materials, nor sign shipping bills. On-site storage shall be in areas designated by the Contractor, with the approval of the Owner.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents that are undamaged and, unless otherwise indicated, unused at the time of installation.
   1. Provide products complete with all accessories, trims, finishes, safety guards and other devices and details needed for a complete installation and for the intended use and effect.
   2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other Projects.
   3. Reference in the project manual or on the drawings to an article device, product, material, fixture, form or type of construction by name, make or catalog number (product or method) whether or not followed by "or equal" establishes a standard of quality, and does not eliminate from competition other products or methods of equal or better quality by other manufacturers, where fully suitable, as approved by the Architect. Applications for approval of substitutions for the specified products or methods will be considered only upon request of the Contractor, not of Subcontractors individual trades or suppliers, and only for a specific purpose; no blanket approvals will be granted. No approval of a substitution will be valid unless it is in written form and submitted in accordance with 01 25 00 Substitution Procedures.

B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include the following:
   1. Semi-proprietary Specification Requirements: Where two (2) or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted. Where products or manufacturers are specified by name, accompanied by the term "or equal", or "or approved equal", comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

2. Non-Proprietary Specifications: When the Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
3. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with the Contract requirements.
4. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated. Overall performance of a product is implied where the product is specified for a specific application. Manufacturer's recommendations may be contained in published product literature or by the manufacturer's certification of performance.
5. Compliance with Standards, Codes and Regulations: Where the Specifications only requires compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.
6. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily. Where no product available within the specified category matches satisfactorily and also complies with other specified requirements, comply with the provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category or seek the Architects recommendation in writing.
7. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern and texture from the product line selected.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other work. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION

SECTION 01 71 23
FIELD ENGINEERING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and supervisory requirements for field engineering services, including, but not necessarily limited to the following:
   1. Land survey Work: **By Owner**.
   2. Civil engineering services.
   3. Structural engineering services.

1.2 SUBMITTALS

A. Certificates: Submit a certificate signed by the Land Surveyor or Professional Engineer certifying that the location and elevation of improvements installed under this contract comply with the Contract Documents.

B. Final as-built Survey: **By Owner**.

1.3 QUALITY ASSURANCE

A. **Deleted**.

B. Engineer: Engage a Professional Engineer of the discipline required, registered in the State of North Carolina to perform required engineering services.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Deleted**.

B. The Contractor will verify layout information shown on the Drawings, in relation to the ~~property survey and~~ existing benchmarks before proceeding to layout the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.
   1. Do not change or relocate benchmarks or control points without prior written approval. Promptly report lost or destroyed reference points, or requirements to relocate reference points because of necessary changes in grades or locations.
   2. Promptly replace lost or destroyed project control points. Base replacements on the original survey control points.

C. Establish and maintain a minimum of two permanent benchmarks on the site, referenced to data established by survey control points.
   1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

D. Existing utilities and equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction.
   1. Prior to construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer and water service piping.

3.2 PERFORMANCE

A. Working from lines and levels established by the property survey, establish benchmarks and markers to set lines and levels at each story of construction and elsewhere as needed to properly locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions.
   1. Advise entities engaged in construction activities of marked lines and levels provided for their use.
   2. As construction proceeds, check every major element for line, level and plumb.

B. Surveyor's Log: Maintain a surveyor's log of control and other survey Work. Make this log available for reference.
   1. Record deviations from required lines and levels and advise the Architect when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted and not corrected.
   2. On completion of building(s) layout, major site improvements, and other Work requiring field engineering services, the contractor shall verify that the dimensions, locations, angles and elevations of construction and site work are in conformance with the documents. Upon completion of the work the contractor will submit an as-built survey of the work.

C. Site Improvements: Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similarly appropriate means.

D. Building Lines and Levels: Locate and lay out batter boards for structures, building foundations, column grids and locations, floor levels and control lines and levels required for mechanical and electrical Work.

E. Existing Utilities: Furnish and confirm information necessary to adjust, move or relocate existing structures, utility poles, lines, services or other appurtenances located in, or affected by construction. Coordinate with local utility providers and authorities having jurisdiction.

F. Final As-Built Survey: **By Owner**.

G. DRAWINGS **(Deleted)**

H. BOUNDARY REQUIREMENT **(Deleted)**

I. TOPOGRAPHIC REQUIREMENTS **(Deleted)**

END OF SECTION

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and supervisory requirements for cutting and patching.

B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

C. The Contractor shall do all cutting, fitting or patching of his work that may be required to insure various parts fit together properly and are prepared to receive or be received by Work of others as indicated or reasonably implied by the drawings and specifications for the completed structure. The Contractor will make corrections as the Architect may direct.

D. Any cost brought about by defective or ill-timed work shall be borne by the Contractor.

E. The Contractor shall not endanger any existing or newly completed work by cutting, digging or other activity and shall not cut or alter the Work of any other Prime Contractor except with the consent of the Architect.

F. Cutting and patching should be performed by workers skilled in the trade and sequenced to avoid delays.

G. The Contractor shall not perform cutting or patching operations that impact the structural, functional, or aesthetic qualities of the Work.

1.2 SUBMITTALS

A. Cutting and Patching Plan: Where approval of procedures for cutting and patching is required before proceeding, the Contractor shall submit a plan describing procedures well in advance of the time the cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the plan:
   1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.
   2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
   3. List products to be used and firms or entities that will perform Work.
   4. Indicate dates when cutting and patching is to be performed.
   5. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
   6. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.
   7. Approval by the Architect to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.

1.3 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.
   1. Obtain written approval of the Architect and Structural Engineer for the cutting and patching proposed before cutting and patching the following structural elements:
      a. Foundation construction.
      b. Bearing and retaining walls.
      c. Structural concrete.

d. Structural steel.
e. Lintels.
f. Timber and primary wood framing.
g. Structural decking.
h. Stair systems.
i. Miscellaneous structural metals.
j. Exterior curtain wall construction.
k. Equipment supports.
l. Piping, ductwork, vessels and equipment.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect's professional judgment, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Retain the original installer or fabricator if possible to cut and patch any Work that remains exposed. Remove and replace any Work that is cut and patched in a visually unsatisfactory manner.

D. Coordination: The Contractor is responsible for coordinating the Work to minimize the amount of cutting and patching.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use materials that are identical to existing materials and that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before cutting existing surfaces examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Make corrections before proceeding, if unsafe or unsatisfactory conditions are encountered.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction or finishes during cutting and patching operations to prevent damage. Provide protection from adverse weather conditions for any portions of the Project that might be exposed during cutting and patching operations.

3.3 PERFORMANCE

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction to provide for installation of other components or performance of other construction activities and provide the subsequent fitting and patching required to restore surfaces to their original condition. Where possible, review proposed procedures with the original installer; comply with the original installer's recommendations.

1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required

with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed areas.
3. Cut through concrete and masonry using appropriate cutting equipment such as a carborundum saw or diamond core drill.
4. Comply with requirements of applicable Specification Sections where cutting and patching requires excavating and backfilling.
5. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Conspicuously label any abandoned sections of pipe or conduit and, If required, support remaining sections. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Inspect and test patched areas to demonstrate integrity of the installation.
2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even plane surface of uniform appearance and color. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken area containing the patch, after the patched area has received primer and second coat.
4. Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

D. Cutting and patching shall be the responsibility of the trade whose work requires the cutting and patching unless specifically detailed and assigned in the Contract Documents. All patching shall be performed by qualified mechanics experienced in the specialty involved, to the standards of the project specifications. The Contractor shall coordinate all cutting and patching with the Owner's representative prior to commencement of the work.

E. Renovation Project Procedures

1. Materials: As specified in technical sections, match existing products and Work.
2. Employ skilled and experienced installer to perform cutting and patching.
3. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
4. Remove, cut and patch materials in a manner to minimize damage and to provide a means of restoring products and finishes to original condition.
5. Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with a neat transition to adjacent finishes.
6. Where new work abuts or aligns with existing, provide a smooth and even transition. Patch work to match existing adjacent work in texture and appearance.
7. When a smooth transition with new Work is not possible, submit recommendation to Architect for review. Terminate existing surface along a straight line at a natural line of division when possible.
8. Where a change of plane of ¼ inch or more occurs, submit recommendation for providing a smooth transition; to Architect for review.
9. Patch or replace portions of existing surfaces, which are damaged, lifted, discolored or showing other imperfections.
10. Finish surfaces as specified in individual Product sessions.

11. Cutting and patching shall be done in a manner such that the patched surfaces are compatible with the surfaces in which the repairs were made, both structurally and aesthetically as deemed appropriate by the Project Architect.

F. New Project procedures
1. Coordinate the Work to minimize cutting and patching.
2. If cutting and patching becomes necessary perform work as early in the project as feasible and follow the steps for renovation projects contained herein.

G. Restoration: Restore existing work, including concealed work not indicated or specified to be modified, and which is damaged or otherwise affected by The Contractor's operations, to a condition equal to that, which existed before the work was commenced. Use workers skilled in reconstruction and alteration work where new construction adjoins, connects to, or abuts existing work. Join new Work to existing Work in such a manner as to make the joining as inconspicuous as possible. Obvious patching of damaged Work will not be acceptable. At the completion, ensure that the buildings and grounds are in first-class condition within the intent of these specifications, with new parts well joined to the old as required, all connections completed, and facilities in full working condition.

3.4 CONNECTION TO EXISTING WORK

A. When the installation of the Work affects, and/or modifies any existing roof, the Contractor will provide roof repair of the existing roof with materials compatible with the existing roofing materials. The Contractor will test the material of the roof and certify that the materials are compatible. Where penetrations are made through existing roofing, the Contractor will strip existing material back a minimum of 2 feet and replace with all new material(s) required to form a waterproof system. If the existing roofing system is under warranty, the repairs shall be made in the manner recommended by the manufacturer, so as to preserve the existing warranty coverage.

3.5 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed where required for construction or used as access. Leave work in an acceptable completed condition.

END OF SECTION

SECTION 01 74 13
PROGRESS AND FINAL CLEANING

PART 1 – GENERAL

1.1 SUMMARY
A. Section includes administrative and procedural requirements for progress cleaning and final cleaning.

1.2 ACTION SUBMITTALS
A. Product Data:
1. Cleaning Products: Indicate compliance with quality assurance requirements.
2. Disinfectants, Metal Polish, Floor Finishes, and Strippers: Indicate compliance with quality assurance requirements.

B. Equipment Data: Indicate equipment used for final cleaning complies with quality assurance requirements.

C. Product Application Schedule: Schedule of cleaning products indicating application for each type of product.

D. Final Cleaning Program: Description of cleaning procedures and product applications for final cleaning for each type of room, surface and material.

1.3 INFORMATIONAL SUBMITTALS
A. Inspection Reports: For pest control final inspection.

1.4 QUALITY ASSURANCE
A. Product Requirements:
1. Cleaning Products: Comply with Green Seal GS-37.
2. Floor Finishes and Strippers: Comply with Green Seal GS-40.
3. Disinfectants and Metal Polish: Industry standard products with low toxicity and low VOC content.

B. Worker Qualifications: Provide cleaning services performed by experienced firm specializing in cleaning of new construction of similar type and scope, employing workers trained by suppliers of products and equipment utilized in progress and final cleaning.

C. Equipment Certification: Perform final cleaning utilizing vacuum equipment certified under Carpet and Rug Institute Green Label program, equipped with HEPA filters.

D. Final Cleaning Standard: Clean facility to APPA Appearance Level 1 in APPA *Custodial Staffing Guidelines for Educational Facilities*.

1.5 COORDINATION
A. Floor Finishing: Perform floor finishing prior to building ventilation flush out.

PART 2 – PRODUCTS

2.1 MATERIALS
A. Materials, General: Do not introduce cleaning agents, disinfectants, metal polishes, floor strippers, or other products into the facility that are not listed on approved product application schedule.

B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. Unless otherwise indicated, use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

C. Disinfectants, Metal Polishes, Floor Strippers, and Other Products: Use materials and agents recommended by manufacturer or fabricator of the affected surface. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. Unless otherwise indicated, use cleaning products that meet Green Seal GS-40, or if GS-40 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

D. Floor Sealer Products: Submit proposed products for approval by Owner.

E. Floor Waxing Products: Submit proposed products for approval by Owner.
   1. Only use a singular wax floor finish product that meets the requirements of this specification and is approved by the Architect. The wax floor finish shall provide a minimum of 21% solids. (Solids consist of plastic or polymer molecules that remain on the floor when cured.)

PART 3 – EXECUTION

3.1 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
      a. Utilize containers intended for holding waste materials of type to be stored.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written. instructions of manufacturer or fabricator of product installed, using only cleaning materials. specifically recommended. If specific cleaning materials are not recommended, use cleaning. materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

3.2 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations. Leave Project clean and ready for occupancy.

B. Cleaning: Clean each surface or unit to quality level specified. Comply with product manufacturers and equipment manufacturer's written instructions.

C. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

1. Project Site
    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean; wash walkways clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Remove snow and ice to provide safe access to building.
2. Building Exterior and Interior
    a. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    b. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    c. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    d. Remove labels and protective films that are not permanent.
    e. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    f. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint from surface to provide intended readability.
    g. Clean both sides of windows and vision lights.
3. Building Interior
    a. Clean and disinfect plumbing fixtures, vanity tops, and countertops to a sanitary condition, free of stains, including stains resulting from water exposure.
    b. Move and reset Owner's furniture, fixtures, and equipment as required to complete cleaning Work. Clean furniture, fixtures, and equipment that have become soiled following Owner's installation.
    c. Remove debris and surface dust from occupied spaces including window treatments,

furniture and shelving, casework and cabinets interiors and tops, and other surfaces as required.

4. Equipment and Systems
    a. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    b. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
    c. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    d. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection. Coordinate cleaning of ductwork with other closeout procedures.
    e. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

D. Cleaning Food Preparation Areas
1. Comply with cleaning and disinfecting requirements of authorities having jurisdiction.
2. Clean and disinfect food preparation and food storage room surfaces.
3. Clean food service equipment.

E. Floor Cleaning and Finishing:
1. Vacuum building surfaces using approved vacuum equipment.
2. Resilient and Terrazzo Flooring: Sweep, mop, strip, wax, and buff flooring in accordance with floor wax product manufacturer's recommendations.
    a. Apply wax at 3 micron dry film thickness per coat.
    b. Rooms: Strip and apply five coats of wax and buff.
    c. Corridors, Common Areas, Cafeteria, Mult-Purpose Room: Apply first two coats of wax prior to Owner's setting furniture in rooms. Following setting of furniture, strip floors and apply final five coats of wax and buff.
3. Hard Tile Flooring: Scrub mop. Do not apply wax to hard tile flooring.
4. Carpet: Vacuum carpet, removing debris and excess nap.
    a. Vacuum carpet using approved vacuum equipment.
    b. Clean new carpet using steam extraction method if visible soil or stains remain.
5. Concrete Floors: Vacuum and mop sealed concrete floors in unoccupied spaces.

F. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.

G. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls."
1. Do not utilize storm drain system for disposal of floor stripping waste water.

END OF SECTION 01 74 13

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Closeout requirements, other than the delivery of operation and maintenance manuals which are due at 50% completion, are hereby defined to include general requirements near the end of Contract time, in preparation for final acceptance, final payment, normal termination of Contract, occupancy of Owner, and similar actions evidencing completion of the Work. Specific requirements for individual units of Work are specified in other sections. Start of closeout other than the delivery of operation and maintenance manuals is directly related to "Substantial Completion," and therefore, may be either a single time period for entire Work or a series of time periods for individual parts of the Work which have been certified as substantially complete at different dates. That time variation (if any) shall be applicable to other provisions of this section, regardless of whether resulting from "phased completion" originally specified by the Contract Documents or subsequently agreed upon by Owner and Contractor.

B. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:
   1. Final Cleaning.
   2. Project record document submittal.
   3. Operating and maintenance manual submittal.
   4. Submittal of warranties.
   5. Punchlist Completion
   6. Owner Training

C. Closeout requirements are as indicated in Section 01 78 12 - Schedule of Certifications and Letters, Section 01 78 24 - Required O & M Documentation, and Section 01 78 37 - Schedule of Warranties.

1.3 SUBSTANTIAL COMPLETION

A. Procedures: Before requesting Architect's inspection for certification of Substantial Completion, complete the items listed below. Any exceptions or omissions from the items listed below should be explained, in writing, as part of the request.
   1. The Application for Payment that coincides with, or initially follows, the date Substantial Completion is claimed, indicate 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
      a. If 100 percent completion cannot be shown, indicate a list of incomplete items, the value of incomplete construction and reasons the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
   4. Deliver tools, spare parts and similar items.
   5. Extra stock/maintenance materials will remain at the project site except for door hardware, which will be delivered to CMS Auxiliary Services Lock Shop Department 3301 Stafford Drive, Charlotte, NC 28208. Attic stock materials shall be stored in the main custodial room. Consolidate materials to 1-2 units of storage shelving with plastic signage indicating these materials are "Attic Stock Materials" and are to remain undisturbed by school personnel.
      a. Paint: One Gallon of each type and color of paint and stain installed.
      b. Carpet: One box of each type/color/pattern
      c. Acoustical Ceiling Panels: Two full boxes of each type/color/pattern/size installed. .

d. Tile (Ceremac and Resilient) One box of each type/color/pattern/size installed .
e. Door hardware: Provide extra stock as indicated in Specification Section 012100 Allowances – Deliver Door Hardware to CMS Auxiliary Services Lock Shop Department 3301 Stafford Drive. Charlotte, NC 28208. .

6. Make final changeover in security upon acceptance by CMSPD.
7. Complete start-up testing of systems.
8. Discontinue, change over or remove temporary facilities from the site. Also remove construction tools, mock-ups and similar elements.
9. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.
10. Correction of previously identified deficiencies.
11. Prior to date of Substantial Completion Contractor to provide a list of pending claims or disputes with associated itemized cost breakdown.

B. Inspection Procedures: After completion of the above-specified items, submit written notice to the Architect-Engineer that the Work, or designated portion thereof, is substantially complete and request an inspection of same. Include a comprehensive list of items to be completed or corrected. Proceed promptly to complete and correct items on the list. Give a minimum of ten (10) days notice to allow the Architect-Engineer sufficient time to schedule and coordinate the inspection. On receipt of a request for inspection, the Architect will either proceed with inspection or advise the Contractor of unfilled requirements. The Architect will prepare the Certificate of Substantial Completion following inspection or advise the Contractor of construction that must be completed or corrected before the certificate will be issued. The Contractor shall remedy the noted deficiencies in the work and shall send a second written notice of substantial completion to the Architect-Engineer and request another inspection. The Architect-Engineer will then:

1. The Architect will repeat inspection when requested and ensure that the Work has been substantially completed. When the Architect-Engineer concurs that the Work is substantially complete, the Architect-Engineer will:
   a. Prepare a Certificate of Substantial Completion on AIA Document G704, accompanied by Contractor's list of items to be completed or corrected, as verified and amended by the Architect-Engineer as a result of the substantial completion inspection.
   b. Submit the Certificate of Substantial Completion to the Owner and the Contractor for their written acceptance of the responsibilities assigned to them in the certificate. If after repeated requests (two or more) by the Contractor for the Architect to inspect the Work, it is discovered not to be "substantially complete" the Contractor shall compensate the Architect for additional inspections.
2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.4 FINAL ACCEPTANCE

A. Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the items listed below. Any exceptions or omissions from the items listed below should be explained, in writing, as part of the request.

1. Submit the final payment request with consent of surety to final payment, releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
3. Submit a certified copy of the Architect's substantial completion inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance and the list has been endorsed and dated by the Architect.
4. Submit final meter readings for utilities and similar data with account # as of the date of Substantial Completion/Finalization of Commissioning or when the Owner took possession of or responsibility for corresponding elements of the Work.
5. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

6. Submit record drawings
7. Submit warranties, bonds, certifications and letters as called for in Sections 01 78 12 Schedule of Certifications and Letters, Section 01 78 24 - Required O & M Documentation and Section 01 78 37 - Schedule of Warranties.
8. Re-clean areas soiled during correction of deficiencies.
9. Certify that equipment and systems that have been tested, balanced, and are operational.
10. Submit Consent of Surety.
11. Complete systems training and instruction of the Owner's operating and maintenance personnel.
12. Deliver warranties per Section 01 78 36 - Warranties, and Section 01 78 37 - Schedule of Warranties.
13. Provide the Owner with documentation by an authorized vendor for the disposal of any mercury containing materials.

B. Re-inspection Procedure: Upon completion of the above-specified prerequisites, submit written notice to the Architect-Engineer that the work is complete and ready for final inspection on or after a specified date. Give a minimum of ten (10) days notice to allow the Architect-Engineer sufficient time to schedule and coordinate the inspection. The Architect will re-inspect the Work upon receipt of signed off punchlist and notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Architect.
1. Upon completion of re-inspection, the Architect-Engineer will either prepare a certificate of final acceptance or advise the Contractor of work that is not acceptable or obligations not fulfilled as required for final acceptance. The Contractor shall immediately take such measures as are necessary to complete such work or remedy such deficiencies.
2. If necessary, re-inspection will be repeated once. If after this re-inspection the work is discovered to be "incomplete" the Contractor shall compensate the Architect for additional inspections.

1.5 RECORD DOCUMENT SUBMITTALS

A. Record Drawings: Maintain a clean, undamaged set of blue- or black-line white prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
2. Mark new information that is important to the Owner but was not shown on Contract Drawings or Shop Drawings.
3. Note related Change Order numbers where applicable.
4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets and print suitable titles, dates and other identification on the cover of each set.
5. One set of as- built HVAC Control shop drawings shall be bound in laminated covers and mounted in the main mechanical room at the Project site. One set of MEP as-builts drawings shall be installed in a 40" long 4" diameter PVC tube with screwed covers. Tube shall be mounted on wall in mechanical room.
6. Provide As-Built Survey by a registered North Carolina surveyor per requirements indicated in Section 01 71 23 - Field Engineering.
7. Provide BIM Standard Section 7.E Requirements.

B. Record Specifications: Maintain one (1) completed copy of the Project Manual, including addenda and one (1) copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications. Give particular attention to substitutions, selection of options and similar

information or elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and product data.

1. Upon Completion of the Work, submit record Specifications to the Architect for the Owner's records.

C. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Architect for the Owner's records.

D. Maintenance Manuals: O & M manuals will be organized as indicated in Part 3 paragraph 3.7 of this Section. Submit one electronic searchable file in PDF format. Include the following types of information:

1. Emergency instructions.
2. Spare parts lists.
3. Wiring diagrams.
4. Recommended "turn around" cycles.
5. Inspection procedures.
6. Shop Drawings and Product Data.
7. Fixture lamping schedule.

E. Warranty/Letters/Certification Manuals

PART 2 – PRODUCTS

2.1 Prepare (1) one electronic copy of all information required by this section. Submit (1) one copy of all information to the architect for review, approval and forwarding to the Owner.

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:

1. Maintenance manuals.
2. Record documents.
3. Spare parts and materials.
4. Tools.
5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start-up.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.

7. Effective energy utilization.

3.2 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect-Engineer seven (7) days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of responsible Contractor's personnel in accordance with manufacturers' instructions.

G. 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.

H. Submit a written report in accordance with Section 01 45 00 Quality Control that equipment or system has been properly installed and is functioning correctly.

3.3 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products of Owner's personnel prior to date of final completion or as directed by Owner.

B. Arrange for each installer of Work requiring continuing maintenance (by Owner) or operation, to meet with Owner's personnel, at project site, to provide basic instructions needed for proper operation and maintenance of entire Work and as specifically required in the mechanical, electrical, and equipment sections.

C. Utilize operation and maintenance manuals specified in Section 01 78 23 - Operation and Maintenance Data as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

D. Prepare and insert additional data in operations and maintenance manual's when need for additional data becomes apparent during instruction.

E. Include instructions by manufacturer's representative where installers are not expert in the required procedures.

F. Review maintenance manuals, record documentation, tools, spare parts and materials, lubricants, fuels, identification system, control sequences, hazards, cleaning and similar procedures and facilities.

G. For operational equipment, demonstrate start-up, shutdown, emergency operations, noise and vibration adjustments, safety, economy/efficiency adjustments, and similar operations.

H. For equipment or systems requiring seasonal operation perform demonstration for other season within six-(6) month.

I. Review maintenance and operations in relation with applicable warranties, agreements to maintain, bonds, and similar continuing commitments.

J. Trainer shall record the attendance of the Owner's staff at each demonstration and include a copy of the attendance record in the O&M manual

3.4 FINAL ADJUSTMENT OF ACCOUNTS

Submit a final statement of accounting to Architect-Engineer. The statement shall reflect all adjustments to the Contract sum including the following:

A. The original contract sum.

B. Additions and deductions resulting from:
1. Previous change orders.
2. Allowances.
3. Unit prices.
4. Deductions of uncorrected work.
5. Deductions of liquidated damages.
6. Deductions for additional submittal reviews in accordance with Section 01 33 00 - Submittal Procedures, Reimbursement from Contractor.
7. Deductions for reinspections for substantial and final completions in accordance with this Section, Substantial Completion and Final Acceptance.
8. Other adjustments.

C. Total Contract sum, as adjusted.

D. Previous payments.

E. Sum remaining due.

3.5 FINAL CHANGE ORDER

Architect-Engineer will prepare a final change order, reflecting approved adjustments to the Contract sum which were not previously made by change orders.

3.6 FINAL APPLICATION FOR PAYMENT

Contractor shall submit the final application for payment in accordance with procedures and requirements stated in the General Conditions.

3.7 INSTRUCTIONS FOR CLOSEOUT

A. The Prime contractor(s) will provide the following separate electronic files in a searchable PDF format. These files shall be bookmarked by specification section in accordance with sections 017824, 017812, and 017837.

1. Warranty / Letters / Certifications
2. Operation and Maintenance Manuals

B. The information will be submitted to the architect for review and forwarded to CMS once acceptable.

C. Operation and Maintenance manuals must have operation and maintenance instructions. Submittals are not acceptable replacements for operation and maintenance instructions. Operation and Maintenance manuals must also contain copies of approved Submittal Product Data and Shop Drawings. Shop Drawings should be included with the appropriate spec section number and submitted electronically with the O & M manuals.

D. Provide following information on the cover page of the PDF:
1. Name of School or Project
2. Name of the Manual, i.e., Warranty & Closeout Manual or O&M Manual.
3. Contractor's Name
4. Contract Type i.e. Electrical Prime Contract

5. Name of Architect/Engineer
6. Date of substantial completion

E. Please make sure the following conditions are adhered to:
1. All warranties must be made out to the owner, (i.e. Charlotte-Mecklenburg Board of Education) and contain the project name and physical address.
2. Contractor and installer warranties must be signed specifying project, owner and warranty period. Warranties shall commence from the date of substantial completion and not require additional registration. The document can state "from substantial completion" or give the actual architect certified date. The following are considered acceptable for manufacturers' warranties:
   a. An original manufacturer warranty with name of project, owner and date of substantial completion.
   b. A manufacturer warranty accompanied by a letter from the manufacturer (or their agent with power of attorney) bearing original or electronic signatures certifying the authenticity of the manufacturer's standard warranty naming project, school, and date of substantial completion.
3. Warranties shall include labor where specified.
4. The Contractor's corporate seal (if a corporation) is required on documents provided in accordance with Section 01 78 36 - Warranties.
5. The commencement date for all warranties is the date of substantial completion. This date shall be listed on the warranty or shall say "from the date of declared substantial completion". A manufacturer's warranty on equipment shall always cover the gap from early start up to the date of substantial completion. This is a part of the contract and a cost of the work.
6. Warranties cannot contain conditional clauses (such as "this warranty is not or shall not become effective until the contractor has been paid in full").
7. A list of required training sessions including a separate training letter and associated sign in sheet for each owner training session shall be included with the warranty closeout information.
8. Stock/Extra Materials must be transported to 3301 Stafford Dr or as directed by the Owner. A copy of the signed transmittal showing delivery of stock materials took place is to be included in the closeout documents.
9. An As-Built Survey as described in Section 01 71 23 - Field Engineering is required to be submitted and approved by the civil engineer.
10. All keys including but not limited to those listed below shall be turned over to the owner in one submission package accompanied by a signed itemized transmittal identifying the contents of the submission. A copy of the signed transmittal is to be included in the closeout documents along with the hardware suppliers "key letter" sent to the owner under separate cover when the door hardware keys were sent.
    a. Door hardware keys in a key box (sent directly to CMS by the hardware supplier with separate transmittals)
    b. Kitchen equipment keys
    c. Walk-in cooler & freezer keys
    d. Roll up door & grill keys
    e. Elevator keys
    f. Electrical panel keys
    g. HVAC controls panel keys
    h. Fire alarm panel keys
    i. Security alarm panel keys
    j. Sound system cabinet keys
    k. Hose bib / wall hydrant keys
    l. Classroom teacher's cabinet keys
    m. Generator Keys
    n. Marquee Sign
    o. Toilet Accessories

Sample Cover Page

Project

☐ Warranty Manual
☐ Operations & Maintenance Manual

Document

Contractor

☐ Construction Manager at Risk
☐ Single Prime Contractor

Type of Contract

Substantial Completion Date: _____

END OF SECTION

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SECTION 017812
CERTIFICATIONS AND LETTERS SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. This schedule is provided as a summary of required documentation for Contractor's use. Provide required documentation listed in individual specifications sections but not less than items listed here.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF REQUIRED CERTIFICATION AND LETTERS SUBMITTALS

Section #	Title	Contractor	Installer
	Letters, Certifications and Payment Certifications Needed for Closeout		
017700	Certificate of Substantial Completion	√	
017700	Certificate of Occupancy	√	
017700	Contractor and Supplier Contact List (Copy to O&M Manual)	√	
006514	Asbestos Free Certification	√	
087100	Key Letter	√	√
017700	Executed Stock Materials (Bill of Materials)	√	
017900	Executed Statement of Training & Commissioning	√	
230553	Valve Tag Listing Mechanical	√	√
220553	Valve Tag Listing Plumbing	√	√
	Test & Certification Reports	√	
142100	Elevator Inspection Dept. of Labor Certificate	√	√
210500	Fire Sprinkler Inspection Report	√	√
221116	Certification of Sterilization of Potable Water	√	√
235223	NCDOL Boiler Inspection Report	√	√
260526	Ground resistance test	√	√
260526	Ground/neutral isolation test	√	√
263213	Generator Start Up & Inspection Report	√	√
283111	Fire Alarm Test & Certification Report	√	√
331000	Domestic Back Flow Preventer Test & Maintenance Report	√	√
331000	Fire Sprinkler Back Flow Preventer Test & Maintenance Report	√	√
	Executed Statement of Training	√	
263213	Generator set/TS instruction		
275116	Sound masking system(s) training		
282310	Security camera testing and training		

Section #	Title	Contractor	Installer
284621	Fire Alarm	√	
	Final Payment Requirements	√	
006514	Certification of Asbestos Free Compliance	√	
006515	Certification of Removal & Disposal of Mercury Containing Materials	√	
012900	Application for Payment (AIA G702)	√	
012900	Continuation Sheet (AIA G703)	√	
012900	Surety Statement - for Period	√	
012900	Sales tax Statement - for Period	√	
012900	MWBE Appendix V- for Period	√	
012900	Sales Tax Statement - total for Project	√	
012900	MWBE Appendix V - total for Project	√	
017700	Payment of Debts (AIA G706)	√	
017700	Release of Liens (AIA G706A)	√	
017700	Consent of Surety (AIA G707)	√	
017700	Punch list Completed	√	
017839	Red Lined As-Builts Received & Acceptable	√	
230593	T & B & Commissioning Items Completed	√	

END OF SECTION 017812

SECTION 017824
OPERATIONS AND MAINTENANCE DATA SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. This schedule is provided as a summary of required documentation for Contractor's convenience. Provide required documentation listed in individual specifications sections but not less than items listed here.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF REQUIRED OPERATIONS AND MAINTENANCE DATA

Spec Section	Title	Product Data	Shop Drawings	O & M Information	Maintenance materials
040120	Brick Masonry Repointing	x			
057311	Decorative Metal Railings	x			
057313	Glazed Decorative Metal Railings	x	x	x	
064023	Interior Architectural Woodwork	x	x		
064116	Plastic Laminated-Faced Architectural Cabinets	x	x		
066216	Plastic Laminate-Clad Paneling	x	x	x	
070151	Maintenance of Membrane Roofing, Limited Work	x			
077200	Roof Accessories	x	x		x
078100	Applied Fireproofing	x			
078413	Penetration Firestopping	x			
078443	Joint Firestopping	x			
070197	Joint Sealants Rehabilitation	x			
079219	Acoustical Joint Sealants	x			
079500	Expansion Control		x		
081113	Hollow Metal Doors and Frames	x	x		
081416	Flush Wood Doors	x	x		
083113	Access Doors and Frames	x	x		
084113	Aluminum-Framed Entrances and Storefronts	x	x	x	
084413	Glazed Aluminum Curtain Walls	x	x	x	
087100	Door Hardware	x	x	x	x
088000	Glazing	x			
092116	Gypsum Board Shaft Wall Assemblies	x			

Spec Section	Title	Product Data	Shop Drawings	O & M Information	Maintenance materials
092216	Non-Structural Framing	x			
092900	Gypsum Board	x			
093013	Ceramic Tiling	x			x
095113	Acoustical Panel Ceilings	x			x
096513	Resilient Base and Accessories	x			
096519	Resilient Tile Flooring	x		x	x
096813	Tile Carpeting	x	x	x	x
099125	Interior Painting and Repainting	x			x
099600	High-Performance Coatings	x			
101100	Visual Display Units	x	x		x
101419	Dimensional Letter Signage	x	x		
101423	Panel Signage	x	x		
101426	Box Frame Exterior Signage	x	x		
102113	Toilet Compartments	x	x		
102600	Wall Protection	x	x		
102800	Toilet and Bath Accessories	x		x	x
104413	Fire Protection Cabinets	x			
104416	Fire Extinguishers	x			
113100	Residential Appliances	x			
115233	Audio-Visual Equipment Support	x			
122113	Horizontal Louver Blinds	x	x	x	
122413	Roller Window Shades	x	x	x	
123623	Plastic-Laminate-Clad Countertops	x	x		
123661	Solid Surfacing Countertops	x	x		
126413	Upholstered Banquettes	x	x	x	x
210500	Common Work Results for Fire Protection				
210517	Sleeves and Sleeve Seals for Fire-Suppression Piping	x			
210518	Escutcheons for Fire-Suppression Piping	x			
210548	Vibration and Seismic Controls for Fire-Suppression Piping and Equipment	x			
211313	Wet-Pipe Sprinkler Systems	x	x		
220500	Common Work Results for Plumbing				
220516	Expansion Fittings and Loops for Plumbing Piping				
220517	Sleeves and Sleeve Seals for Plumbing Piping	x			

Spec Section	Title	Product Data	Shop Drawings	O & M Information	Maintenance materials
220518	Escutcheons for Plumbing Piping	x			
220519	Meters and Gages for Plumbing Piping	x			
220523	General-Duty Valves for Plumbing Piping	x			
220529	Hangers and Supports for Plumbing Piping and Equipment	x			
220548	Vibration and Seismic Controls for Plumbing Piping and Equipment	x	x		
220553	Identification for Plumbing Piping and Equipment	x			
220719	Plumbing Piping Insulation	x			
220800	Commissioning of Plumbing Systems (CxA)				
221116	Domestic Water Piping	x			
221119	Domestic Water Piping Specialties		x		
221123.21	Inline Domestic Water Pumps	x			
221316	Sanitary Waste and Vent Piping	x			
221319	Sanitary Waste Piping Specialties	x			
223300	Electric Domestic-Water Heaters	x			
224213	Commercial Water Closets	x			
224215	Commercial Urinals	x			
224216	Commercial Lavatories	x			
224217	Commercial Sinks	x			
224716	Pressure Water Coolers	x	x		
230500	Common Work Results for HVAC				
230513	Common Motor Requirements for HVAC Equipment				
230517	Sleeves and Sleeve Seals for HVAC Piping	x			
230518	Escutcheons for HVAC Piping	x			
230519	Meters and Gages for HVAC Piping	x			
230523	General-Duty Valves for HVAC Piping	x			
230529	Hangers and supports for HVAC Piping and Equipment	x			
230533	Heat Tracing for HVAC Piping	x	x		
230548	Vibration and Seismic Controls for HVAC Piping and Equipment	x	x		
230553	Identification for Hangers Piping and Equipment	x			
230593	Testing, Adjusting, and Balancing for HVAC				
230713	Duct Insulation	x			
230716	HVAC Equipment Insulation	x			

Spec Section	Title	Product Data	Shop Drawings	O & M Information	Maintenance materials
230719	HVAC Piping Insulation	x			
230800	Commissioning of HVAC Systems (CxA)				
230900	Instrumentation and Control for HVAC	x	x		
230993	Sequence of Operations for HVAC Controls (Air Cooled Chiller)				
232300	Refrigerant Piping	x	x		
232500	HVAC Water Treatment	x	x		
233113	Metal Ducts	x	x		
233300	Air Duct Accessories	x	x		
233423	HVAC Power Ventilators	x			
233600	Air Terminal Units	x			
233713	Diffusers, Registers, and Grilles	x			
233723	HVAC Gravity Ventilators	x	x		
237200	Air to Air Energy Recovery Equipment	x	x		
238126	Split-System Air-Conditioners	x	x		
238146	Water Source Unitary Heat Pumps	x	x		
260519	Low-Voltage Electrical Power conductors and Cables	x			
260523	Control-Voltage Electrical Power Cables	x			
260526	Grounding and Bonding for Electrical Systems	x			
260529	Hangers and Supports for Electrical Systems	x	x		
260533	Raceways and Boxes for Electrical Systems	x			
260536	Cable Trays for Electrical Systems	x	x		
260543	Underground Ducts and Raceways for Electrical Systems	x	x		
260544	Sleeves and Sleeve Seals for Electrical Raceways and Cabling				
260548.16	Seismic Control for Electrical Systems	x			
260553	Identification for Electrical Systems	x			
260574	Overcurrent Protective Device Arc-Flash Study	x			
260800	Commissioning of Electrical Systems (CxA)				
260923	Lighting Control Devices	x	x		
262416	Panelboards	x	x		
262726	Wiring Devices	x	x		
262813	Fuses	x			
262816	Enclosed Switches and Circuit Breakers	x	x		

Spec Section	Title	Product Data	Shop Drawings	O & M Information	Maintenance materials
264313	Surge Protection for Low-Voltage Electrical Power Circuits	x			
265119	LED Interior Lighting	x	x		
265219	Emergency and Exit Lighting	x	x		
265619	LED Exterior Lighting	x			
270101	Communications General Requirements				
270110	Equipment Room Fittings				
270200	Cabling				
275123.10	Two-Way Communication Systems	x	x		
275123.50	Intercom	x	x		
280513	Conductors and Cables for Electronic Safety and Security	x	x		
281300	Access Control				
281310	Access Control Cabling	x	x		
281600	Intrusion Detection	x	x		
282300	IP-Based Video Surveillance System	x	x		
282310	Video Surveillance Cabling	x	x		
283111	Digital, Addressable Fire-Alarm System		x		
321216.02	Asphalt Paving Existing Construction	x	x		
321313	Concrete Paving	x			
321723	Pavement Markings	x			
323131	Metal Gates at Dumpsters	x	x		
328400	Planting Irrigation (Repairs to Existing and Training)	x			
329200	Turf and Grasses	x			
329300	Plants	x			
331000	Water Utilities	x	x		

END OF SECTION 017824

SECTION 01 78 36
WARRANTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for warranties required by the Contract Documents including manufacturer's standard warranties on products and special warranties.

1. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.
2. General close-out requirements are included in Section 01 77 00 - Closeout Procedures.
3. Specific requirements for warranties for the Work and products and installations that are specified to be warranted are included in the individual Specification Sections, and/or as indicated in Section 01 78 37 - Schedule of Warranties whichever is more stringent.
4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products nor does it relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the Contractor.

All warranties are in addition to Seller's implied warranties of merchantability and fitness for a particular purpose which shall not be disclaimed by Seller. In addition to its rights to reject nonconforming goods, CMBE shall be entitled to all rights and remedies provided by the uniform Commercial Code, Chapter 25 of the North Carolina General Statutes, for breach of express warranties and implied warranties of merchantability and fitness for a particular purpose, including but not limited to consequential and incidental damages.

C. Separate Prime Contracts: Each prime Contractor is responsible for warranties related to its own Contract.

1.2 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Replacement of Warranty: When a component of the Work fails three (3) times within the warranty period and the effect of the failure disables or disrupts the performance of the life safety, HVAC, sanitary or power distribution system, the manufacturer of the system(s) shall assume maintenance of the component for the balance of the warranty period plus one (1) year. If the component fails again within the now extended warranty period, the manufacturer shall replace the component with a new unit compatible with the system and reinstate a warranty equal to that of the original component.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or re-build the Work to an acceptable condition complying with requirements of Contract Document. The Contractor is responsible for the cost of replacing or re-building defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life. Repair damage to other building materials and finishes damaged by failure of product, material, equipment or system under warranty. Cost of repairs to be borne by the Contractor who's product caused the damage.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights and remedies otherwise available under the law nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

E. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification or similar commitment is required on such Work or part of the Work until evidence is presented that entities required to countersign such commitments are willing to do so.

F. The warranty on all equipment will be extended from start-up to one (1) year past the date of substantial completion of the Project. The Contractor and manufacturers may, in lieu of providing a manufacturer's extended warranty, provide a service/replacement contract to extend the normal one year warranty period to a minimum of one year beyond the date of acceptance of the building by the Charlotte-Mecklenburg Schools. Extended warranties such as five year compressor warranties shall be extended beyond the period established by the actual start-up date of the equipment (as defined herein) to commence on the date of substantial completion as established by the architect.

1.3 SUBMITTALS

A. Submit written warranties to the Architect prior to the date certified for Substantial Completion

1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect within fifteen (15) days of completion of that designated portion of the Work only when occupancy is substantially ahead of original planned occupancy and not identified in the schedule contained in the Contract Documents

B. When a special warranty is required to be executed by the Contractor or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification ready for execution by the required parties. Submit a draft to the Owner through the Architect for approval prior to final execution.

1. Refer to individual Specification Sections for specific content requirements and particular requirements for submittal of special warranties.

C. Form of Submittal: Organize the warranty documents as specified in 017700.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF WARRANTIES

A. Schedule: Provide copies of warranties on products and installations as indicated in Section 01 78 37 - Schedule of Warranties. Also check other Specification Sections for warranty requirements.

END OF SECTION

SECTION 017837
WARRANTY DOCUMENTATION SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. This schedule is provided as a summary of required documentation for Contractor's convenience. Provide required documentation listed in individual specifications sections but not less than items listed here.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF REQUIRED WARRANTY DOCUMENTATION

		Warranty	
Section	Item	Installer	Manufacturer
070151	Maintenance of Membrane Roofing	2 years	Balance
079200	Joint Sealants Silicone	2 years	15 years
079200	Joint Sealants Urethane and Latex	2 years	5 years
081416	Flush Wood Doors		Lifetime
084113	Aluminum-Framed Entrances and Storefronts		5 years
084113	Aluminum-Framed Entrances and Storefronts Finish		10 years
087100	Door Hardware		3 years
087100	Magnetic Door Holders		5 years
087100	Exit Devices		3 years
087100	Manual Closers		25 years
088000	Glazing: Coated Glass, Laminated Glass, Insulating Glass		10 years
096813	Tile Carpeting		10 years
098433	Sound-Absorbing Wall Units		2 years
101100	Visual Display Units		Lifetime
101426	Box Frame Exterior Signage		5 years
102113	Plastic Toilet Compartments Panels		25 years
102113	Plastic Toilet Compartments Hardware		10 years
102800	Toilet and Bath Accessories		15 years
113100	Microwave Oven		1 years
113100	Refrigerator/Freezer System		2 years
113100	Refrigerator/Freezer Components		1 years
113100	Dishwasher System		2 years
113100	Dishwasher Components		1 year
113100	Clothes Washer		1 year
113100	Clothes Dryer		1 year

		Warranty	
Section	Item	Installer	Manufacturer
113100	Icemaker		1 year
223300	Electric Domestic Water Heater		5 years
232123	Hydronic Pumps		2 years
232923	Variable Frequency Motor Controllers		5 years
233116	Nonmetal Ducts		10 years
235100	Breechings, Chimneys, and Stacks		10 years
235400	Furnaces – Heat exchanger and control circuit board		10 years
237200	Air to Air Energy Recovery Equipment		5 years
237412	Single Zone Packaged Rooftop Units Compressor		5 years
237412	Single Zone Packaged Rooftop Units Control Bands		3 years
238126	Split-System Air-Conditioners Compressor		5 years
238126	Split-System Air-Conditioners Complete Unit		1 years
238126	Split-System Air-Conditioners Parts		1 years
238126	Split-System Air-Conditioners Labor	1 years	
238146	Water-Source Unitary Heat Pumps compressor		5 years
262416	Panelboards		1.5 years
264313	Surge Protection for Low-Voltage Electrical Power Circuits		5 years
265119	LED Interior Lighting		5 years
265219	Emergency and Exit Lighting Components		2 years
265619	LED Exterior Lighting		2 years
275123.10	Two-Way Communication Systems		2 years
275123.50	Intercom		2 years
281300	Access Control		
281310	Access Control Cabling		
281600	Intrusion Detection		2 years
282300	IP-Based Video Surveillance System		2 years
283111	Digital, Addressable Fire-Alarm System	2 years	2 years
329300	Trees, Shrubs, Vines, and Ornamental Grasses		1 year
329300	Ground Covers, Biennials, Perennials, and Other Plants		1 year
329300	Annuals		3 months
331000	Facility Water Distribution Piping		5 years

END OF SECTION 017837

SECTION 018113 – INTERIOR ENVIRONMENTAL QUALITY ("CLEAN BUILDING")

PART 1 - GENERAL

1.1 SUMMARY

A. Non-Certified Project: Section includes general requirements and procedures for compliance with certain sustainable design standards for occupant well-being including Interior Environmental Quality standards. Details of requirements are found in the individual specification Sections.

1. This Section includes requirements for volatile organic compound (VOC) limits for field applications of adhesives, sealants, paints and coatings used for the Project and located inside the weatherproofing system.

a. These requirements are comparable to LEED v4 / v4.1 EQc1 requirements but require no separate documentation.

1.2 REFERENCE STANDARDS

A. General: Comply with the applicable provisions of the referenced standards except as modified by governing codes and the Contract Documents. Where a recommendation or suggestion occurs in the referenced standards, such recommendation or suggestion shall be considered mandatory. In the event of conflict of referenced standards and this specification or within the standards themselves, the more stringent standard or requirement shall govern.

1. CARB SCM: California Air Resource Board Suggested Control Measure for Architectural Coatings.
2. CDPH: California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version v1.2-2017."
3. EPA TSDA: Environmental Protection Agency Toxic Substance Control Act Title VI Compliance Rule, 2016.
4. GS-11: Green Seal Paint Standard GS-11.
5. GS-36: Green Seal Commercial Adhesive Standard GS-36.
6. SCAQMD 1113: South Coast Air Quality Management District Rule 1113.
7. SCAQMD 1168: South Coast Air Quality Management District Rule 1168.

1.3 ACTION SUBMITTALS

A. General: Submit sustainable design submittals required by other Specification Sections as part of Product Data submittal. Provide manufacturer's technical information for all applied adhesives, sealants, paints and coatings, and other interior materials indicating VOC content in grams/Liter (g/L), including:

1. Product data indicating compliance with general emissions evaluation and VOC content requirements.

B. EQ Documentation Submittals:

1. EQ submittals are part of the normal Project submittal process.

2. Product data for adhesives and sealants used inside the weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials.
3. Product data for paints and coatings used inside the weatherproofing system, indicating VOC content and laboratory test reports or acceptable product data showing compliance with requirements for low-emitting materials.
4. Laboratory test reports or acceptable product data for flooring, indicating compliance with requirements for low-emitting materials.
5. Hard surface flooring products demonstrate compliance with FloorScore.
6. Carpet demonstrate compliance with CRI Green Label Plus.
7. Laboratory test reports or acceptable product data for products containing composite wood or agrifiber products or wood glues, indicating compliance with requirements for low-emitting materials.
8. Laboratory test reports or acceptable product data for ceilings, walls, and thermal insulation, indicating compliance with requirements for low-emitting materials.
9. Construction Indoor Air Quality (IAQ) Management:

    a. Product data for temporary filtration media.
    b. Product data for filtration media used during occupancy.

1.4 INFORMATIONAL SUBMITTALS

A. Construction Indoor-Air-Quality (IAQ) Management:

1. Product data for temporary filtration media.
2. Product data for filtration media used during occupancy.

B. IAQ Assessment: Not required.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Provide products and procedures necessary satisfy sustainable design requirements indicated as Contractor's responsibility. Although other Sections may specify some requirements that contribute to satisfying sustainable design requirements, Contractor provides additional materials and procedures necessary to satisfy sustainable design requirements indicated.

2.2 LOW-EMITTING MATERIALS

A. Adhesives and Sealants: For field applications of field-applied adhesives, adhesive bonding primers, and adhesive primers that are inside the weatherproofing system, including flooring adhesive, 75 percent of adhesives and sealants meet the VOC emissions evaluation and 100 percent meet the VOC content evaluations.

1. VOC Content: For field applications that are inside the weatherproofing system, provide product data stating TVOC content in grams per Liter (d/L) that comply with VOC content limits of SCAQMD 1168.

B. Paints and Coatings: For field applications that are inside the weatherproofing system, 75 percent of paints, coatings, and primers meet the VOC emissions evaluation and 100 percent meet the VOC content evaluations.

1. VOC Content: For field applications that are inside the weatherproofing system, provide product data stating TVOC content in grams per Liter (d/L) that comply with VOC content limits of CARB SCM or SCAQMD 1113.
2. Added Methylene chloride and perchloroethylene is not permitted.

C. Composite Wood: A minimum of 75 percent of all composite wood meet the formaldehyde emissions evaluation using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde. Composite wood materials include particleboard, MDF, hardwood veneer plywood, and structural composite wood.

1. Provide product data stating compliance with CARB ATCM or EPA TSCA.

D. Flooring: A minimum of 90 percent of flooring products meet the VOC emissions evaluation or inherently non-emitting sources criteria. Subflooring is included under Wood.

1. VOC Content: Provide product data stating TVOC content in grams per Liter (d/L) that comply with VOC content limits of CDPH and specified VOC content limits.

E. Insulation: A minimum of 75 percent of insulation products meet the VOC emissions evaluation. Insulation products include all thermal and acoustic boards, batts, rolls, blankets, sound attenuation fire blankets, and foamed-in-place, loose-fill, blown, and sprayed insulation. HVAC duct and plumbing piping insulation are excluded.

1. VOC Content: Provide product data stating TVOC content in grams per Liter (d/L) that comply with VOC content limits of CDPH and specified VOC content limits.

F. Foam Insulation: Provide foam insulation with fire retardants that contain no hexabromocyclododecane (HBCD) flame retardants. Use Polymeric flame retardants (PolyFR) in lieu of these products.

2.3 ADHESIVES AND SEALANTS VOC LIMITS (SCAQMD 1168 g/L)

A. Architectural Adhesives:

1. Building Envelope Membrane Adhesive 250
2. Indoor carpet adhesive 50
3. Carpet Pad Adhesive 50
4. Wood Flooring Adhesive 100
5. Rubber Floor Adhesive 60
6. Subfloor adhesive 50
7. Ceramic Tile Adhesive 65
8. VCT and asphalt tile adhesive 50
9. Drywall and panel adhesive 50
10. Cove base adhesive 50
11. Multipurpose construction adhesive 70
12. Structural glazing adhesive 100

B. Specialty Adhesives:

1. PVC welding 510
2. CPVC welding 490

3. ABS welding 325
4. All other plastic welding cements 250
5. Adhesive primer for plastic 550
6. Contact Adhesive 80
7. Special Purpose Contact Adhesive 250
8. Adhesive Primer for Traffic Marking Tape 150
9. Structural Wood Member Adhesive 140
10. Top and trim adhesive 250

C. Substrate Specific Adhesives:

1. Metal to metal 30
2. Plastic foams 50
3. Porous material (except wood) 50
4. Wood 30
5. Fiberglass 80
6. Reinforced Plastic Composite 250

D. Other Adhesives

1. Other adhesives 250
2. Adhesive bonding primers 250
3. Adhesive primers, or any other primers 250

E. Sealants:

1. Clear, Paintable, and Water-Resistant Sealant 280
2. Foam insulation and sealant 250
3. Grout Sealant 65
4. Non-Staining Plumbing Putty 150
5. Potable Water Sealant 100
6. Single Ply Roof Membrane Sealants 450
7. Other Roof Sealants 300
8. All other Architectural Sealants 250
9. All other Sealants 420

F. Sealant Primers:

1. Architectural - Nonporous 250
2. Architectural- Porous 775
3. Modified Bituminous 500
4. Other 750

2.4 PAINTS AND COATINGS VOC LIMITS (CARB SCM or SCAQMD 1113 g/L)

A. Architectural Paints

1. Flat 50
2. Non-Flat 100
3. Non-Flat High Gloss Coatings 150

B. Coatings:

1. Concrete/Masonry Sealers 100
2. Fire resistive Coatings 350
3. Floor coatings 100
4. Low-Solids Coatings 120
5. Primers, Sealers, and Undercoaters 100
6. Rust Preventative Coatings 250
7. Wood Coatings 275
8. Clear Wood Finish:
9. Varnish 275
10. Sanding Sealers 275
11. Lacquer 275
12. Concrete-Curing Compounds 100
13. Dry Fog Coatings 50
14. Floor Coatings 50
15. Low-solids Coatings 120
16. Magnesite Cement Coatings 450
17. Primers, Sealers and Undercoaters 100
18. Shellac
19. Clear 730
20. Pigmented 550
21. Stains 100
22. Waterproofing Sealers 100
23. Waterproofing Concrete/Masonry Sealers 100
24. Wood Preservatives 350

PART 3 - EXECUTION

3.1 NONSMOKING BUILDING

A. Smoking is not permitted on the Project site.

3.2 CONSTRUCTION IAQ MANAGEMENT

A. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction 2nd edition, 2007, ANSI/SMACNA 008–2008, Chapter 3."

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 015000 "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
2. Replace all air filters immediately prior to occupancy.

END OF SECTION

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SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 017300 "Execution" for cutting and patching procedures in new and existing work.
2. Section 070151 " Maintenance of Membrane Roofing, Limited Work" for minor modifications to existing roof.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

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

1.4 PREINSTALLATION MEETINGS

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

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.
6. Review requirements of NFPA 241.

1.5 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain including means of egress from those buildings.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

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

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

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

1.8 FIELD CONDITIONS

A. Before building demolition, Owner will remove items so indicated on the Drawings.

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

1. Existing single ply roof system.
2. Heating, ventilating, and air conditioning equipment.
3. Emergency generators.

B. Notify warrantor on completion of selective demolition and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Existing Information: Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

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

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off utilities with utility companies.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 5000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

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

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable,

protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Carpet and Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

1. On stairs scheduled to receive sealer over existing concrete treads, remove carpet and adhesive and prepare concrete surface in accordance with requirements for sealer specified in Section 099600 "High Performance Coatings."

E. Roofing: Refer to Section 07 0150 "Preparation for Reroofing."

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.8 CLEANING

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

3.9 SELECTIVE DEMOLITION SCHEDULE

A. Refer to schedule on Drawings.

END OF SECTION 024119

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Owner Salvage List

The items listed below are scheduled to be salvaged by the Owner (CMS). CMS will remove the material.

Security Surveillance System:

Head end/server
All cameras
Front office monitor and bracket
Intrusion detection system
- Motion Censors
- Control Panel
- Key Pads

Access Controls:

Door hardware access control devices
- AD 400 locks.
- AD 300 locks.
- MT-11 and 15 readers. This will include standard,485 and blue tooth readers.
- Programmable Interface Module. (PIM)
- D-Controllers.
- NSC-100 and 200 Sub controls.
- Electrified Strikes This includes mortise and flush mount.
- Electrified exit devices.
- Electrified mortise locks.
- Non electrified exit devices on access control doors only.
- Power supplies that power all of our access control devices.
- EPT's (Electric power transfer device).
- Electric power transfer hinges.

Fire Alarm System:

- Fire alarm panel
- Fire alarm strobes Yes They want all
- Detectors
- Pull Stations Yes They want all

Electrical:

Main Circuit Breaker
3Pole 60Amp +Breaker
ALL Federal Pacific Breakers

IT:

Network Equipment
Data Racks
All Wireless Access Points
All Network Electronics
All Wall Mounted Telcom Cabinets
Coaxial Amplifier
Channel Elimination Filter
TV Console and All Video Equipment
School Resource Officer's (SRO) Desktop Computer
Lobby Guard Computer on Wall In Office
Helios unit – front entry

Plumbing

The Plumbing Department will perform an assessment relevant to each site to determine what is salvageable.

HVAC: Morris is out until 10Feb23

HVAC Department will perform an assessment relevant to each site to determine what is salvageable.
CMS to salvage/reclaim all R-22 refrigerant from the existing HVAC mechanical equipment.
Mechanical Components of Chillers/ Unit Ventilators
CMS to salvage all HVAC DOC control devices.
Building Automation (BAS) programmable devices

Food Services

Silverware carts x 2
Cold counters x 2
Hot counters x 2
Dish machine
Disposal
Walk-in freezer

Walk-in cooler
Hobart refrigerator
Victory refrigerator
Traulsen pass through refrigerator
Traulsen pass through warmer
All shelving
All sinks
Cashier stands x 4
All work tables
Tilt skillet

Door Hardware

All Door Lock Set (Non-Access controlled)

Lock Set is Door handles with mechanism, cylinders door plates
Exit / Panic Devices

Other:

Knox Boxes (Fire & Police)
Intercom headend and phones Yes they want all the phones

SECTION 033053 - MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes limited requirements for cast-in-place concrete for infill of trenching required by other work, housekeeping pads, and equipment pads, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 ACTION SUBMITTALS

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

B. Other Action Submittal:

1. Design Mixtures: For each concrete mixture.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete 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.

B. Comply with the following sections of ACI 301, unless modified by requirements in the Contract Documents:

1. "General Requirements."
2. "Formwork and Formwork Accessories."
3. "Reinforcement and Reinforcement Supports."
4. "Concrete Mixtures."
5. "Handling, Placing, and Constructing."

C. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

PART 2 - PRODUCTS

2.1 FORMWORK

A. Furnish formwork and formwork accessories according to ACI 301.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, Type I.

B. Normal-Weight Aggregate: ASTM C 33, graded, 1-1/2-inch nominal maximum aggregate size.

C. Water: ASTM C 94/C 94M.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 RELATED MATERIALS

A. Vapor Retarder: Plastic sheet, ASTM E 1745, Class A or B.

B. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.

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

C. Water: Potable.

2.7 CONCRETE MIXTURES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301, as follows:

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: Maintain within range permitted by ACI 301. Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

2.8 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 above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, construct, erect, brace, and maintain formwork according to ACI 301.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

A. Install, protect, and repair vapor retarders according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.

1. Lap joints 6 inches and seal with manufacturer's recommended adhesive or joint tape.

3.4 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Locate and install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3.6 CONCRETE PLACEMENT

A. Comply with ACI 301 for placing concrete.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

C. Do not add water to concrete during delivery, at Project site, or during placement.

D. Consolidate concrete with mechanical vibrating equipment.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding 1/2 inch.

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 defective areas. Remove fins and other projections exceeding 1/8 inch.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following rubbed finish, defined in ACI 301, to smooth-formed finished as-cast concrete where indicated:

1. Smooth-rubbed finish.

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.

3.8 FINISHING UNFORMED SURFACES

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

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.

1. Do not further disturb surfaces before starting finishing operations.

C. Scratch Finish: Apply scratch finish to surfaces indicated and surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes, unless otherwise indicated.

D. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, fluid-applied or direct-to-deck-applied membrane roofing, or sand-bed terrazzo.

E. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab 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.

F. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set methods. Immediately after a second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

G. Nonslip Broom Finish: Apply a nonslip broom finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.9 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 with ACI 301 for hot-weather protection during curing.

B. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

C. Curing Methods: Cure formed and unformed concrete for at least seven days 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.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests: Perform according to ACI 301.

1. Testing Frequency: One composite sample shall be obtained for each 100-cu. yd. or fraction thereof of each concrete mix placed each day.

3.11 REPAIRS

A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION 033053

SECTION 040120 - BRICK MASONRY REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes repairing missing or damaged brick masonry units and limited repointing of deteriorated mortar.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.3 MASONRY MATERIALS

A. Face Brick: As required to complete brick masonry repair work.

1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork.

1.4 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Mortar Cement: ASTM C1329/C1329M.

E. Water: Potable.

1.5 ACCESSORY MATERIALS

A. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of bricks, less the required depth of pointing materials unless removed before pointing.

B. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could leave residue on surfaces.

1.6 BRICK REMOVAL AND REPLACEMENT

A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that surrounds removal area.

C. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

D. Replace removed damaged brick with other removed brick in good condition, where possible, matching existing brick. Do not use broken units unless they can be cut to usable size.

E. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

1. Maintain joint width for replacement units to match existing joints.
2. Use setting buttons or shims to set units accurately spaced with uniform joints.

3. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.

1.7 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040120

SECTION 040120.64 - BRICK MASONRY REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Repointing joints with mortar.

1.2 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to repointing brick masonry including, but not limited to, the following:

a. Verify brick masonry repointing specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Materials, material application, sequencing, tolerances, and required clearances.
c. Quality-control program.
d. Coordination with building occupants.

1.4 SEQUENCING AND SCHEDULING

A. Order sand for pointing mortar immediately after approval of Samples. Take delivery of and store at Project site enough quantity to complete Project.

B. Work Sequence: Perform brick masonry repointing work in the following sequence, which includes work specified in this and other Sections:

1. Remove plant growth.
2. Inspect masonry for open mortar joints and permanently or temporarily point them before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
3. Remove paint.
4. Clean masonry.
5. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
6. Repair masonry, including replacing existing masonry with new masonry materials.
7. Rake out mortar from joints to be repointed.
8. Point mortar and sealant joints.
9. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
10. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.

C. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in bricks according to Section 040120.63 "Brick Masonry Repair." Patch holes in mortar joints according to "Repointing" Article.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use.
3. Include test data substantiating that products comply with requirements.

B. Samples for Verification: For the following:

1. Each type, color, and texture of pointing mortar in the form of sample mortar strips, 6 inches long by 1/4 inch wide, set in aluminum or plastic channels.

a. Include with each Sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.

2. Sealant materials.
3. Accessories: Each type of accessory and miscellaneous support.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For brick masonry repointing specialist.

1.7 QUALITY ASSURANCE

A. Brick Masonry Repointing Specialist Qualifications: Engage an experienced brick masonry repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repointing work.

B. Mockups: Prepare in-place mockups of brick masonry repointing to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas, where directed by Architect and repoint one of the areas.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. **Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion**.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on masonry units as follows:

1. **Existing Mortar: Test according to ASTM C1324, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength**.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

D. Store sand where grading and other required characteristics can be maintained and contamination avoided.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit repointing work to be performed according to product manufacturers' written instructions and specified requirements.

B. Temperature Limits: Repoint mortar joints only when air temperature is between 40 and 90 deg F and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

C. Cold-Weather Requirements: Comply with the following procedures for mortar-joint pointing unless otherwise indicated:

1. When air temperature is below 40 deg F, heat mortar ingredients and existing masonry walls to produce temperatures between 40 and 120 deg F.
2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for seven days after pointing.

D. Hot-Weather Requirements: Protect mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F and above unless otherwise indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Source Limitations: Obtain each type of material for repointing brick masonry (cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Mortar Sand: ASTM C144.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

D. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

E. Water: Potable.

2.3 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Do not use admixtures in mortar unless otherwise indicated.

C. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar by Type: ASTM C270, Proportion Specification, Type N unless otherwise indicated. Add mortar pigments to produce mortar colors required to achieve match to existing adjacent sound mortar.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
2. Keep wall area wet below pointing work to discourage mortar from adhering.
3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

3.2 MASONRY REPOINTING, GENERAL

A. Appearance Standard: Repointed surfaces are to have a uniform appearance as viewed from 20 feet away by Architect.

3.3 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints at locations of the following defects:

    a. Holes and missing mortar.
    b. Cracks that can be penetrated 1/4 inch or more by a knife blade 0.027 inch thick.
    c. Cracks 1/16 inch or more in width and of any depth.
    d. Hollow-sounding joints when tapped by metal object.
    e. Eroded surfaces 1/4 inch or more deep.
    f. Deterioration to point that mortar can be easily removed by hand, without tools.
    g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of joint width plus 1/8 inch but not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches deep; consult Architect for direction.
2. Remove mortar from brick and other masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of brick or other masonry units or widen joints. Replace or patch damaged brick or other masonry units as directed by Architect.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
6. Hairline cracking within mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.4 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Clean adjacent nonmasonry surfaces. Use detergent and soft brushes or cloths.

C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Remove masking materials, leaving no residues that could trap dirt.

3.5 FIELD QUALITY CONTROL

A. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

B. Notify Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

END OF SECTION 040120.64

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Slotted channel framing.
5. New roof opening framing for rooftop equipment not otherwise detailed.
6. Metal ladders.
7. Metal bollards.
8. Loose bearing and leveling plates for applications where they are not specified in other Sections.
9. Metal gates.
10. Existing stair and railing modifications.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Information:

1. Section 323131 "Metal Utility Gates" for dumpster gates.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Slotted channel framing.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Metal ladders.
5. Metal bollards.
6. Existing stair and railing modifications.

D. Design Submittal: For slotted channel framing, including manufacturers' published load tables annotated to indicate selections required for Project.

1.4 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:

1. Low-Emitting Materials: Adhesives and sealants
2. Responsible Sourcing: Chemicals of concern

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.

D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.

E. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

F. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches, unless larger size required by manufacturer's written recommendation for supported item and span.
2. Material: Cold-rolled steel, ASTM A1008/A1008M, commercial steel, Type B; 0.0677-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.

H. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

I. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.

J. Aluminium Extrusions: ASTM B221, Alloy 6063-T6.

K. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

L. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum and stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

G. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings."

B. Universal Shop Primer: For interior items not indicated to receive paint: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

1. Product: CRL Bituminous Coating.

E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

F. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

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

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated, coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

2.7 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders, Interior:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 1-inch-square, steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
8. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
9. Prime ladders, including brackets and fasteners, with zinc-rich primer.

C. Aluminum Ladders, Exterior:

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. O'Keeffe's Inc.
   b. Precision Ladders, LLC.
   c. Royalite Manufacturing, Inc.

2. Source Limitations: Obtain aluminum ladders from single source from single manufacturer.
3. Space siderails 18 inches apart unless otherwise indicated.
4. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches deep, 3/4-inch-wide, and 1/8 inch thick.
5. Rungs: Extruded-aluminum tubes, not less than 3/4-inch-deep and not less than 1/8 inch thick, with ribbed tread surfaces.
6. Fit rungs in centerline of siderails; fasten by welding or with stainless steel fasteners or brackets and aluminum rivets.
7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted aluminum brackets.
8. Provide minimum 72-inch-high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use in applications where bottom of ladder extends to area where it can be accessed by public.

2.8 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Prime miscellaneous steel trim.

D. Prime exterior miscellaneous steel trim with primer specified in Section 099600 "High-Performance Coatings."

2.9 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe.

B. Fabricate bollards with 3/8-inch-thick, steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

C. Prime steel bollards with primer specified in Section 099600 "High-Performance Coatings."

2.10 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize bearing and leveling plates.

2.11 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.13 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to, and rigidly brace from, building structure.

C. Permanently Installed Bollards: Fill bollards solidly with concrete. Set domed bollard caps in place according to manufacturer's written instructions, clean excess concrete fill and allow concrete to cure seven days before installing.

1. Anchor bollards in concrete in formed or core-drilled holes not less than 42 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.

D. Bollards at Existing Construction: Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.

1. Embed anchor bolts at least 4 inches in concrete.

3.3 INSTALLATION OF BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

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SECTION 057300 –DECORATIVE METAL RAILINGS, INTERIOR

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior steel decorative railings, shop primed for field applied high performance coating, including modifications to existing railings.
2. Stainless-steel decorative railings for indicated components.

1.2 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

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

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Working Stresses: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Stainless Steel: 60 percent of minimum yield strength.
2. Steel: 72 percent of minimum yield strength.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
b. Infill load and other loads need not be assumed to act concurrently.

C. Metal Surfaces: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

D. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

1. Provide metal brackets as indicated on Drawings.

2.2 STAINLESS STEEL

A. Tubing: ASTM A554, Grade MT 304.

B. Castings: ASTM A743/A743M, Grade CF 8 or CF 20.

C. Sheet, Strip, Plate, and Flat Bar: ASTM A666, Type 304.

D. Bars and Shapes: ASTM A276, Type 304.

2.3 STEEL

A. Tubing: ASTM A500/A500M (cold formed) or ASTM A513.

B. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.

C. Plates, Shapes, and Bars: ASTM A36/A36M.

D. Fastener Materials: Unless otherwise indicated, provide the following:

1. Stainless-Steel Components: Type 304 stainless-steel fasteners.
2. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
3. Dissimilar Metals: Type 304 stainless-steel fasteners.

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

F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Shop Primers: Provide primers that comply with Section 09 9600 "High-Performance Coatings."

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.5 FABRICATION

A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces. Make handrails smooth to the touch.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.

I. Form changes in direction as follows:

1. As detailed.

J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

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

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

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

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

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

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

2.6 FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.7 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: ASTM A480/A480M, No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.8 STEEL AND IRON FINISHES

A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, but galvanize anchors to be embedded in exterior concrete or masonry.

B. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

C. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For stainless-steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
2. For steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

3.5 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with sleeves concealed within railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

C. Attach handrails to walls with wall brackets except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

3.6 RENEWING FIELD FINISH

A. Existing Stainless-Steel Railings: Renew existing stainless-steel components to "like new" condition resulting in match between existing and new components.

3.7 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 9600 "High-Performance Coatings."

3.8 PROTECTION

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

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION 057300

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SECTION 057313 - GLAZED DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glazed decorative metal railings including modifications to existing railings as indicated on Drawings.

1.2 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Metal railings.
2. Fasteners.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Samples: Finished wood cap.

1.4 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.5 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.

B. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

1.6 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

1.7 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Castings: ASTM B26/B26M, Alloy A356.0-T6.

1.8 STEEL AND IRON

A. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M.

1.9 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Aluminum Components: Type 304 stainless steel fasteners.
2. Stainless Steel Components: Type 304 stainless steel fasteners.
3. Dissimilar Metals: Type 304 stainless steel fasteners.

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

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.

1. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/ASTM F1941M, Class Fe/Zn 5, unless otherwise indicated.

1.10 MISCELLANEOUS MATERIALS

A. Wood Rails:

1. Hardwood rails complying with Section 064023 "Interior Architectural Woodwork."

B. Handrail Brackets: Cast stainless steel, center of rail 2-1/2 inches (63.5 mm) from face of structural glass balusters.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1.11 FABRICATION OF METAL RAILINGS

A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

H. Form changes in direction as follows:

1. As detailed.

I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

J. Close exposed ends of hollow railing members with prefabricated end fittings.

K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

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

1.12 FABRICATION OF GLASS PANELS AND BALUSTERS

A. Fabricate glass to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

B. Structural Glass Balusters: Provide laminated tempered structural glass balusters.

1. Edge Finish: Grind smooth and flat polish exposed edges of glass, including those at open joints, to produce smooth, square edges with glass edge finishes.
2. Factory-bond structural glass balusters to aluminum base and top-rail channels in railing manufacturer's plant using material to comply with manufacturer's written instructions.
3. Fabricate structural glass balusters to maintain equal length glass widths and uniform spacing of 1/2 inch (13 mm) between glass balusters.

1.13 METAL FINISH REQUIREMENTS, GENERAL

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

1.14 STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Steel Tubing Finishes: Match existing chrome finish.

PART 2 - EXECUTION

2.1 INSTALLATION, GENERAL

A. Comply with Drawings and manufacturer's written instructions for installing glazed decorative metal railings, accessories, and other components.

B. Perform cutting, drilling, and fitting required for installing metal railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of metal railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

2.2 METAL RAILING CONNECTIONS

A. Nonwelded Connections:

1. Use mechanical or adhesive joints for permanently connecting railing components.
2. Use wood blocks and padding to prevent damage to railing members and fittings.
3. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

2.3 INSTALLATION OF GLASS BALUSTERS

A. Structural Glass Railings:

1. Install assembly to comply with railing manufacturer's written instructions.
2. Attach base channel to building structure, then insert and connect factory-fabricated and -assembled glass balusters if glass was bonded to base and top-rail channels in factory.
3. For field-assembled balusters, attach base channel to building structure, insert glass in base channel, and bond with manufacturer’s recommended material.

    a. Support glass balusters in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement.
    b. Fill remaining space in base channel with glazing cement for uniform support of glass.

4. Adjust spacing of glass balusters so gaps between balusters are equal before securing in position.

2.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made by Owner.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings in accordance with ASTM E894, ASTM E935, ASTM E2353, and ASTM E2358 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

2.5 CLEANING

A. Clean aluminum and steel by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.

B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

2.6 PROTECTION

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

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057313

SECTION 061053 – MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood blocking, cants, and nailers.
2. Plywood backing panels.

1.2 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

1.3 ACTION SUBMITTALS

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

1. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
2. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Cants.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

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

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

2.3 PLYWOOD BACKING PANELS

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

1. All walls as indicated in Data/Telecommunications Rooms.
2. Where indicated as blocking and substrates.
3. Plywood 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."

2.4 FASTENERS

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

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

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

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Metal Framing: ASTM C 1002 for non-load-bearing steel framing and ASTM C 954 for cold-formed metal framing, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1.

G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material for Interior Use: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material for Exterior and Wet Interior Use: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.5 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

B. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Flexible Flashing Separator Sheet: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required by respective manufacturers to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

J. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 BACKING PANELS

A. Prime backing panels with moisture resistant primer prior to mounting to wall.

B. Paint backing panels, leaving FRTW grade stamp unpainted, prior to installation of equipment. Refer to Section 099123 "Interior Painting."

3.3 WOOD SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.4 WOOD FURRING INSTALLATION

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

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal-size furring vertically at 24 inches o.c.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal-size furring vertically at 16 inches o.c.

3.5 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

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

END OF SECTION 061053

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SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standing and running trim.
2. Interior stair railing components.
3. Wood veneer.
4. Wood tambour.
5. Shop priming of interior architectural woodwork.
6. Shop finishing of interior architectural woodwork.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.

1.2 COORDINATION

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

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Anchors.
2. Adhesives.
3. Shop finishing materials.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Shop Drawings:

1. Include the following:

a. Dimensioned plans, elevations, and sections.
b. Attachment details.

2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.

D. Samples for Verification: For the following:

1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished interior architectural woodwork.
3. Installer Qualifications: Manufacturer of products.

E. Comply with the Architectural Woodwork Standards, Section 2.

F. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

G. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

1.6 COORDINATION

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

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

B. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Composite Wood or Agrifiber Products.

2.2 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Premium.

B. Hardwood Lumber:

1. Species: Clear white oak.
2. Cut: Plain sliced/plain sawn.
3. Wood Moisture Content: 5 to 10 percent.
4. For trim items other than base wider than available lumber, use veneered construction. Do not glue for width.
5. For base wider than available lumber, glue for width. Do not use veneered construction.

2.3 INTERIOR WOOD STAIR RAILINGS

A. Architectural Woodwork Standards Grade: Premium.

B. Wood for Transparent Finish:

1. Species: Clear white oak.
2. Wood Moisture Content: 5 to 10 percent.

2.4 HARDWOOD SHEET MATERIALS

A. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of the Architectural Woodwork Standards for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.

1. Particleboard: ANSI A208.1, Grade M-2 except Grade M-2-Exterior Glue within 48 inches of sinks.
2. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.5 WOOD FINISH PRODUCTS

A. Architectural Woodwork Standards Grade: Premium.

B. Wood Veneer: Where scheduled for application to products: Scheduled veneer and cut.

C. Tambour: Solid wood tambour: Scheduled species and size.

2.6 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.

2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.7 FABRICATION

A. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
b. Edges of Rails and Similar Members More Than 3/4-Inch-Thick: 1/8 inch.

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.
4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

2.8 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

B. Interior Architectural Woodwork for Transparent Finish: Shop-seal concealed surfaces with required pretreatments and first coat of finish as specified in Section 09 9300 "Staining and Transparent Finishing."

1. Backpriming: Apply one coat of sealer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.9 SHOP FINISHING

A. Finish interior architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.

C. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.
2. Finish: System - 5, Varnish, Conversion.
3. Finish: System - 11, Polyurethane, Catalyzed.
4. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
5. Staining: Match approved sample for color.
1. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
2. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter according to ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion.

1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.
3. For shop-finished items, use filler matching finish of items being installed.

F. Standing and Running Trim:

1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.

2. Do not use pieces less than 60 inches long, except where shorter single-length pieces are necessary.
3. Scarf running joints and stagger in adjacent and related members.
4. Fill gaps, if any, between top of base and wall with latex sealant, painted to match wall.
5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

G. Railings:

1. Install rails with no more than 1/8 inch in 96-inch variation from a straight line.

3.3 REPAIR

A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.

B. Where not possible to repair, replace defective woodwork.

C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.

1. Fill nail holes with matching filler where exposed.
2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.4 CLEANING

A. Clean interior architectural woodwork on exposed and semi-exposed surfaces.

END OF SECTION

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

D. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

E. Samples for Verification: For the following:

1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.

a. Provide one sample applied to core material with specified edge material applied to one edge.

2. Thermoset Decorative Panels: 8 by 10 inches, for each color, pattern, and surface finish.

a. Provide edge banding on one edge.

3. Corner Pieces:

   a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
   b. Miter joints for standing trim.

4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Manufacturer of products.

C. Mockups: Build mockups of typical base and wall cabinets to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the ANSI/AWI 0641 – Architectural Wood Casework Standard, which replaces Section 10 of the 2014 edition of Architectural Woodwork Standards, for grades of architectural cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.
2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

A. ANSI/AWI 0641 Aesthetic Grade: Premium.

B. ANSI/AWI 0641 Duty Level: 3.

2.2 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Composite Wood or Agrifiber Products.

B. Type of Construction: Frameless.

C. Door and Drawer-Front Style: Flush overlay.

D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product scheduled on Drawings or comparable product with color match acceptable to Architect by one of the following:

a. Formica Corporation.
b. Lamin-Art, Inc.
c. Wilsonart LLC.

E. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Vertical Surfaces: Grade HGS.
3. Edges: ABS edge banding, 0.12-inch thick, matching laminate in color, pattern, and finish.
4. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

F. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.

a. Edges of Plastic-Laminate Shelves: ABS edge banding, 0.12-inch thick, matching laminate in color, pattern, and finish.
b. Edges of Thermoset Decorative Panel Shelves: ABS edge banding.
c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade CLS.

2. Drawer Sides and Backs: Thermoset decorative panels with ABS edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

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

H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

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

1. As indicated by basis of design laminate manufacturer's designations.

2.3 WOOD MATERIALS

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

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Softwood Plywood: DOC PS 1, void-free core.
2. Thermoset Decorative Panels: Particleboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

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

    a. Accuride International.
    b. Blum, Julius & Co., Inc.
    c. Grass America Inc.
    d. Knape & Vogt Manufacturing Company.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.

C. Wire Pulls: Back mounted, solid metal, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter.

D. Catches: Roller catches, BHMA A156.9, B03071.

E. Shelf Rests: BHMA A156.9, B04013; two-pin plastic with shelf hold-down clip.

F. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer.

    a. Type: Full extension.
    b. Material: Zinc-plated or epoxy-coated steel with polymer or steel rollers.

2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-overtravel-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.
4. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.
6. For computer keyboard shelves, provide Grade 1HD-100.
7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-200.

G. Door Locks: BHMA A156.11, E07121. Locate where indicated on cabinet elevations.

H. Drawer Locks: BHMA A156.11, E07041. Locate where indicated on cabinet elevations.

I. Door and Drawer Silencers: BHMA A156.16, L03011.

J. Grommets for Cable Passage: Match type indicated on Drawings.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

M. Millwork Reveals:

1. Base: 4 inch recessed metal base. Fry Reglet, Model as scheduled.
2. F Reveal: Fry Reglet, Model as scheduled.

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesive for Bonding Plastic Laminate: PVA.

1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.6 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION 064116

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SECTION 064216 - FLUSH PLASTIC LAMINATE-CLAD PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flush plastic-laminate-clad paneling.
2. Wood tambour paneling.
3. Wood furring, blocking, shims, and hanging strips for installing flush wood paneling that is not concealed within other construction.
4. Shop finishing of flush wood paneling.

1.2 COORDINATION

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

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Shop Drawings: For flush plastic-laminate-clad paneling.

1. Include plans, elevations, sections, and attachment details.
2. Show details full size.
3. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
4. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.
5. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

D. Samples: For each exposed product and for each color and finish specified, in manufacturer's or fabricator's standard size.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer/fabricator.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of products.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical paneling as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver paneling until painting and similar operations that might damage paneling have been completed in installation areas. Store paneling in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PANELING, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of flush wood paneling (wood-veneer wall surfacing) indicated for construction, finishes, installation, and other requirements.

2.2 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Composite Wood or Agrifiber Products.

2.3 FLUSH PLASTIC-LAMINATE-CLAD PANELING

A. Grade: Premium.

B. Panel Core Construction: Hardwood veneer-core plywood, particleboard, or MDF.
1. Thickness: 3/4 inch.

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product scheduled on Drawings or comparable product with color match acceptable to Architect by one of the following:

a. Formica Corporation.
b. Lamin-Art, Inc.
c. Wilsonart LLC.

D. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Vertical Surfaces: Grade HGS.
3. Edges: ABS edge banding, 0.12-inch thick, matching laminate in color, pattern, and finish.
4. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

E. Exposed Panel Edges: Match panel face.

F. Panel Reveals: As indicated on Drawings.

G. Assemble panels by gluing and concealed fastening.

2.4 WOOD TAMBOUR PANELING

A. Refer to details on Drawings.

2.5 MATERIALS

A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

B. Wood Moisture Content: 5 to 10 percent.

C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

1. MDF: ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2.

2.6 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, fire-retardant-treated where required, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.

C. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

2.7 FABRICATION

A. Arrange paneling in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.

1. Lay out one elevation at a time if approved by Architect.
2. Notify Architect seven days in advance of the date and time when layout will be available for viewing.
3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by Architect.
4. Rearrange paneling as directed by Architect until layout is approved.
5. Obtain Architect's approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.

B. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times paneling fabrication will be complete.

C. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition paneling to humidity conditions in installation areas.

B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install paneling to comply with quality standard grade of paneling to be installed.

B. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.

1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/32 inch.

C. Anchor paneling to supporting substrate with concealed panel-hanger clips.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective paneling, where possible, to eliminate defects. Where not possible to repair, replace paneling. Adjust for uniform appearance.

B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064216

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SECTION 070151 – MAINTENANCE OF MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal and replacement of certain flashings and counterflashings affected by removal and installation of rooftop-mounted equipment.

2. Infill of roofing at equipment to be removed or relocated.

3. Walkway pads.

1.2 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1. Include certificate that Installer is approved by manufacturer of existing roofing system.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Approved by manufacturer of existing roofing system to work on existing roofing.

1.4 FIELD CONDITIONS

A. Existing Roofing System:

1. 6600: Single ply roofing.

2. 6623: Single ply roofing.

3. 6635: SBS-modified bituminous roofing.

B. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.

1. Construction Drawings for existing roofing system are provided for Contractor's convenience and information, but they are not a warranty of existing conditions. They are intended to supplement rather than serve in lieu of Contractor's own investigations. Contractor is responsible for conclusions derived from existing documents.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during reroofing, by methods and with materials so as not to void existing roofing system.

1. Notify warrantor before proceeding with the Work.

2. Notify warrantor of existing roofing system on completion of reroofing and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect.

    a. Submit documentation at Project closeout.

B. Special Project Warranty: Submit roofing Installer's warranty, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarder / air barrier, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INFILL AND REPLACEMENT MATERIALS

A. Use infill materials matching existing roofing system materials unless otherwise indicated.

1. Infill materials shall match existing adjacent materials.

B. Fasteners: Factory-coated steel fasteners with metal or plastic plates listed in FM Approvals' RoofNav, and acceptable to new roofing system manufacturer.

2.2 AUXILIARY REROOFING MATERIALS

A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing roofing system.

B. Walkway Pads: Polymer-modified, reconstituted rubber pads with slip-resisting textured surface, manufactured as a traffic pad for foot traffic and acceptable to roofing membrane manufacturer, **1/2-inch-thick**, minimum.

1. Pad Size: Not less than **30 by 30 inches**.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Protect existing roofing system that is not to be reroofed.

B. Test existing roof drains to verify that they are not blocked or restricted.

1. Immediately notify Architect of any blockages or restrictions.

C. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work.

D. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

E. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.

1. Prevent debris from entering or blocking roof drains and conductors.

a. Use roof-drain plugs specifically designed for this purpose.

b. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.

2. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding.

a. Do not permit water to enter into or under existing roofing system components that are to remain.

3.2 INFILL MATERIALS INSTALLATION

A. Immediately after roof tear-off, and inspection and repair, if needed, of deck, fill in tear-off areas to match existing roofing system construction.

B. Install new roofing patch over roof infill area.

1. If new roofing is installed the same day tear-off is made, roofing patch is not required.

3.3 BASE FLASHING REMOVAL

A. Remove existing base flashings at equipment to be removed.

1. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.

3.4 INSTALLATION OF FLASHING AND STRIPPING

A. Install base flashing over cant strips and other sloped and vertical surfaces at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:

1. Backer Sheet Application:

a. Adhere backer sheet to substrate in cold-applied adhesive.

a. Seal all laps.

2. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.

B. Extend base flashing up curbs a minimum of 8 inches above roofing membrane and 4 inches onto field of roofing membrane.

3.5 INSTALLATION OF WALKWAYS

A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size, according to walkway pad manufacturer's written instructions.

1. Install walkways at the following locations:

a. Perimeter of each rooftop unit.

b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.

c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.

d. Top and bottom of each roof access ladder.

e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.

f. Additional locations indicated on Drawings and as required by roof membrane manufacturer's warranty requirements.

2. Provide **3-inch** clearance between adjoining pads.

3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.6 DISPOSAL

A. Collect demolished materials and place in containers.

1. Promptly dispose of demolished materials.

2. Do not allow demolished materials to accumulate on-site.

3. Storage or sale of demolished items or materials on-site is not permitted.

B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION

SECTION 070197 - JOINT SEALANTS REHABILITATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone glazing sealants.
2. Silicone joint sealants.
3. Urethane joint sealants.
4. Preformed joint sealants.

1.2 PRECONSTRUCTION TESTING

A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.3 ACTION SUBMITTALS

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

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

B. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

C. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's approved installer who is trained for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period for Silicone Sealants: Fifteen years from date of Substantial Completion.
2. Warranty Period for Urethane Sealants: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Colors of Exposed Joint Sealants: As selected from manufacturer's full range.

2.2 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials, Interior: Adhesives and Sealants.

2.3 SILICONE GLAZING SEALANTS

A. General: Refer to Division 08 Section "Glazing" for general requirements for application of glazing sealants.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Tremco Incorporated; Spectrem 1.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Products: Tremco Incorporated; Spectrem 2.

D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT, with enhanced tensile strength not less than 350 psi (2.40 MPa) per ASTM D 412.

1. Products: Tremco Incorporated; Proglaze SSG.

2.4 SILICONE JOINT SEALANTS

A. Silicone, Nonstaining, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT. SWRI Certificate.

1. Pecora Corporation; Pecora 890FTS/TXTR.
2. Sika Corporation - Building Components; Sikasil WS-290.
3. Tremco Incorporated; Spectrem 1.

B. Silicone, Nonstaining, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT. SWRI Certificate

1. Pecora Corporation; Pecora 895NST.
2. Sika Corporation - Building Components; Sikasil WS-395.
3. Tremco Incorporated; Spectrem 2.

C. Silicone, Field-Tintable, ASTM C 920, Type S, Grade NS, Class 50, for Use NT: Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant. SWRI Certificate.

1. Pecora Corporation; ___.
2. Sika Corporation - Building Components; ___.
3. Tremco Incorporated; Spectrem 4TS.

2.5 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type B (bicellular material with a surface skin).
2. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

PART 3 - EXECUTION

3.1 EXAMINATION OF EXISTING JOINT SEALANTS

A. Examine joints and indicate extent of required joint sealant removal and replacement work. Examine joints for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

3.2 PREPARATION

A. Removal of Failed Joint Sealant Materials: Cut out and remove joint materials and associated backing materials.

B. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning

operations above by vacuuming or blowing out joints with oil-free compressed air. Remove laitance and form-release agents from concrete.

3. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

C. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

D. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

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

3.5 PROTECTION

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

3.6 GLAZING SEALANT SCHEDULE

A. Glazing-Sealant Application: Exterior joints in glazing systems.

1. Joint Locations:

    a. Glass-to-glass structural glazing.
    b. Joints between glass perimeter and framing.
    c. Concealed metal-to-metal framing joints.
    d. Glazing cap and weather beads.
    e. Other joints as indicated.

2. Silicone Glazing Sealant: Single component, nonsag, neutral curing, Class 100/50 and Single component, nonsag, neutral curing, Class 50 structural glazing sealant.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
    a. Control and expansion joints in unit masonry.
    b. Joints between different materials listed above.
    c. Perimeter joints between materials listed above and frames of doors windows and louvers.
    d. Other joints as indicated.

2. Silicone Joint Sealant: Non-Staining Single component, nonsag, neutral curing, Class 50.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 070197

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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber blanket.
2. Mineral-wool blanket.
3. Low-expansion detailing foam insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

1.3 DELIVERY, STORAGE, AND HANDLING

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

B. Protect foam-plastic board insulation as follows:

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

PART 2 - PRODUCTS

2.1 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 including the following:

1. Low-Emitting Materials: Insulation.

2.2 GLASS-FIBER BLANKET

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

1. Available 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) CertainTeed Corporation.
2) Johns Manville; a Berkshire Hathaway company.
3) Knauf Insulation.
4) Owens Corning.

2.3 MINERAL-WOOL BLANKETS

A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Available 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) Johns Manville; a Berkshire Hathaway company.
2) ROCKWOOL (ROXUL Inc.).
3) Thermafiber, Inc.; an Owens Corning company.

2.4 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Angle: Formed from 0.030-inch-thick, perforated, galvanized carbon-steel sheet with each leg 2 inches square.
2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.

1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:

a. Ceiling plenums.

D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 2 inches between face of insulation and substrate to which anchor is attached.

E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.5 DETAILING FOAM INSULATION

A. Low-Expansion Detailing Foam: Single-component urethane foam with low-expansion pressure, and 10 percent flexibility, suitable for installation adjacent to fenestration. Provide product complying with AAMA 812.

1. Available Products: 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) Dow Chemical; Great Stuff Pro Window & Door.
2) Zerodraft Products, Inc.; Zero Draft Foam Sealant.
3) Hilti; Window & Door Pro Foam.

2.6 ACCESSORIES

A. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

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

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically.

3.4 MISCELLANEOUS VOID INSULATION

A. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
2. Detailing Foam Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.5 PROTECTION

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

END OF SECTION 072100

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Pipe supports.
3. Pipe portals.
4. Preformed flashing sleeves.

B. Preinstallation Conference: Conduct conference at Project site in conjunction with roofing preinstallation conference.

1.2 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.4 CLOSEOUT SUBMITTALS

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

1.5 WARRANTY

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

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

    a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

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. AES Industries, Inc.
    b. Curbs Plus, Inc.
    c. Greenheck Fan Corporation.
    d. LMCurbs.
    e. Pate Company (The).
    f. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
    g. Thybar Corporation.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: Indicated on Drawings.

D. Material: Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet, not less than 0.064 inch thick.

1. Finish: Two-coat fluoropolymer.
2. Color: White.

E. Material: Aluminum sheet, not less than 0.090 inch thick.

1. Finish: Two-coat fluoropolymer.
2. Color: White.

F. Construction:

1. Curb Profile: Profile as indicated on Drawings compatible with roofing system.
2. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
3. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
4. Insulation: Polyisocyanurate board.

    a. R-Value: 12.0 according to ASTM C 1363.

5. Liner: Same material as curb, of manufacturer's standard thickness and finish.
6. Nailer: Factory-installed wood nailer under top flange on side of curb, continuous around curb perimeter.
7. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
8. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch-thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
9. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
10. Damper Tray: Provide damper tray or shelf with opening 3 inches less than interior curb dimensions indicated.

2.3 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced perimeter or Rail-type metal equipment supports as indicated on Drawings, capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded corner joints, and integrally formed structure-mounting flange at bottom.

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. AES Industries, Inc.
    b. Curbs Plus, Inc.
    c. Greenheck Fan Corporation.
    d. LMCurbs.
    e. Pate Company (The).
    f. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
    g. Thybar Corporation.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: As indicated on Drawings.

D. Material: Zinc-coated (galvanized) Aluminum-zinc alloy-coated steel sheet, not less than 0.064 inch thick.

1. Finish: Two-coat fluoropolymer.
2. Color: White.

E. Material: Aluminum sheet, not less than 0.090 inch thick.

1. Finish: Two-coat fluoropolymer.
2. Color: White.

F. Construction:

1. Curb Profile: Profile as indicated on Drawings compatible with roofing system.
2. Insulation: Polyisocyanurate board.

a. R-Value: 12.0 according to ASTM C 1363.

3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
4. Nailer: Factory-installed continuous wood nailers 3-1/2 inches wide under top flange on side of curb, continuous around support perimeter.
5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch-thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
8. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.
9. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.4 PIPE AND DUCT SUPPORTS

A. Fixed-Height Cradle-Type Pipe Supports: Polycarbonate pipe stand accommodating up to 1-1/2-inch- diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type as required for quantity of pipe runs and sizes.

B. Fixed-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand with polycarbonate or stainless-steel roller carrying assembly accommodating up to 7-inch- diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type as required for quantity of pipe runs and sizes.

C. Adjustable-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand base, pipe support, and roller housing, with stainless-steel threaded rod designed for adjusting support height, accommodating up to 18-inch diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type as required for quantity of pipe runs and sizes.

D. Adjustable-Height Structure-Mounted Pipe Supports: Extruded-aluminum tube, filled with urethane insulation; 2 inches in diameter; accommodating up to 7-inch- diameter pipe or conduit, with provision for pipe retainer; with aluminum baseplate, EPDM base seal, manufacturer's recommended hardware for mounting to structure or structural roof deck as indicated, stainless-

steel roller and retainer, and extruded-aluminum carrier assemblies as required for quantity of pipe runs and sizes.

2.5 PIPE PORTALS

A. Curb-Mounted Pipe Portal: Insulated roof-curb units with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom; with weathertight curb cover with single or multiple collared openings and pressure-sealed conically shaped EPDM protective rubber caps sized for piping indicated, with stainless-steel snaplock swivel clamps.

B. Flashing Pipe Portal: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless-steel snaplock swivel clamps.

2.6 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.

1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 coated.

1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

C. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

D. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

E. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

F. Galvanized-Steel Tube: ASTM A 500/A 500M, round tube, hot-dip galvanized according to ASTM A 123/A 123M.

2.7 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, thickness and thermal resistivity as indicated.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

E. Underlayment:

1. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
2. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
3. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
4. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

G. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

H. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

I. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required for application.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.

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

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

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

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

E. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.

1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

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

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

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.

B. Clean exposed surfaces according to manufacturer's written instructions.

C. Clean off excess sealants.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078100 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sprayed fire-resistive materials (SFRM) as required for repair and patching of existing SFRM and limited new work.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its SFRM to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

B. Field quality-control test reports.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life if applicable, and fire-resistance ratings applicable to Project.

B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.

C. Store materials inside, under cover, and aboveground; keep dry until ready for use. Remove from Project site and discard wet or deteriorated materials.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 40 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fire protection, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fire protection from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

2.2 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Field Paints and Coatings.
3. Low-Emitting Materials: Thermal and Acoustic Insulation.
4. Responsible Sourcing: Recycled content.

B. Asbestos: Provide products containing no detectable asbestos.

2.3 MATERIALS, GENERAL

A. Fire-Resistance Design: Match existing adjacent work.

2.4 SPRAYED FIRE-RESISTIVE MATERIALS

A. Concealed SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with fire-resistance design indicated on Drawings, and mixed with water at Project site to form a slurry or mortar before conveyance and application.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer.

C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire-resistance designs indicated and fireproofing manufacturer's written

recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.

E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.

F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.

G. Sealer: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by fireproofing manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following:

1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Verify that roof construction, installation of roof-top HVAC equipment, and other related work is complete before beginning fireproofing work.

C. Conduct tests according to fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.

1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Metal Decks:

1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, has been completed.
2. Do not apply fireproofing to underside of metal roof deck until roofing has been completed; prohibit roof traffic during application and drying of fireproofing.

E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

F. Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

G. Extend fireproofing in full thickness over entire area of each substrate to be protected.

H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

I. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.

J. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.

K. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.

L. Cure fireproofing according to fireproofing manufacturer's written recommendations.

M. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

N. Finishes: Where indicated, apply fireproofing to produce the following finishes:

1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.

3.4 APPLICATION, CONCEALED SFRM

A. Apply concealed SFRM in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition.

B. Cure concealed SFRM according to product manufacturer's written recommendations.

C. Apply sealer to concealed SFRM.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078100

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SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls including inspection and repair of existing penetrations.
2. Penetrations in horizontal assemblies.

B. Preinstallation Conference: Conduct conference at Project site.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

1.3 INFORMATIONAL SUBMITTALS

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

1.4 QUALITY ASSURANCE

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

1. Utilize same Installer as providing Work of Division 07 Section "Fire-Resistive Joint Sealants."

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

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

a. Penetration firestopping systems shall bear the classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."

2.2 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Insulation.

2.3 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

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

a. 3M Fire Protection Products.
b. Hilti, Inc.
c. Specified Technologies, Inc.
d. Tremco, Inc.

2. Source Limitations: Provide penetration firestopping materials through one source from a single manufacturer.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems in spaces above occupied spaces showing no evidence of water leakage when tested according to UL 1479.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

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

2.4 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.5 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine existing conditions revealed following selective demolition and identify penetrations requiring application of firestopping to meet requirements of authorities having jurisdiction.

B. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.

2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

B. Penetration Identification: Identify each existing and new penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

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SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions including inspection and repair of existing firestopping joints.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

1. Utilize same Installer as providing Work of Division 07 Section "Penetration Firestopping."

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

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

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."

2.2 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Insulation.

2.3 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. 3M Fire Protection Products.
b. Hilti, Inc.
c. Specified Technologies, Inc.
d. Tremco, Inc.

2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine existing conditions revealed following selective demolition and identify penetrations requiring application of firestopping to meet requirements of authorities having jurisdiction.

B. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

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

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Latex joint sealants.

1.2 ACTION SUBMITTALS

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

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

1.4 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

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

1.5 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace joint sealants that do not comply

with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period, Silicone Sealants: 15 years from date of Substantial Completion.
2. Warranty Period, Urethane and Latex Sealants: 5 years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Low-Emitting Interior Sealants and Sealant Primers: Sealants and sealant primers shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

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

2.2 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Insulation.

2.3 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Non-Staining, Neutral-Curing Silicone Joint Sealant **JSS-1**: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 790; 756 SMS.
b. Pecora Corporation; 890; 890FTS.
c. Tremco Incorporated; Spectrem 2.

2. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
3. SWRI Certificate.

B. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant **JSS-2**: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 795.
b. Pecora Corporation; 864.
c. Tremco Incorporated; Spectrem 2.

2. SWRI Certificate.

C. Single-Component, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant **JSS-3**: ASTM C 920, Type S, Grade P, Class 100/50, for Use T.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 890-SL.
b. Pecora Corporation; 300 SL.
c. Tremco Incorporated; Spectrem 900 SL.

D. Mildew-Resistant, Single-Component, Nonsag, Silicone Joint Sealant **JSS-4**: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pecora Corporation; 898.
b. Tremco, Incorporated; Tremsil 200.

2.4 LATEX JOINT SEALANTS

A. Latex Joint Sealant **JSL-1**: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Bostik, Inc.; Chem-Calk 600.
b. Pecora Corporation; AC-20+.
c. Tremco Incorporated; Tremflex 834.

2.5 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean, porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning

operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

a. Concrete.
b. Masonry.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

a. Metal.
b. Glass.
c. Porcelain enamel.
d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates unless not recommended by joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

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

3.5 PROTECTION

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

END OF SECTION 079200

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each acoustical joint sealant.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For special warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.

2.2 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials: Adhesives and Sealants.

2.3 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.

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

   a. GE Construction Sealants; Momentive Performance Materials Inc.
   b. Pecora Corporation.
   c. Tremco Incorporated.

2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas at interface with partitions indicated as having an acoustical rating. Apply in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

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

3.5 PROTECTION

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

END OF SECTION 079219

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Interior standard steel frames.
2. Exterior standard steel doors and frames.
3. Interior borrowed lites.

1.2 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Attendees: Contractor, Installer, Architect, Owner, Owner's locksmith, door hardware Installer, electrical Installer, access control system Installer; Installers of walls and partitions accepting hollow metal frames.
2. Agenda: Review specification section and cited standards for this Work and Work of related Installers; verify submittal approvals and outstanding issues; verify qualifications including qualifications of Contractor's inspectors. Refer to Division 01 for additional requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of removable stops, and glazing.

C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector and Installer.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, section 5.2.3.1.
2. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Product Test Reports: Upon Architect Request: For each type of fire-rated hollow-metal door and frame assembly fire-rated borrowed-lite assembly thermally rated door assemblies for tests performed by a qualified testing agency indicating compliance with performance requirements.

C. Field quality control reports.

1.6 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Experienced Installer with track record of successful installation of similar work on minimum five projects.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification or alternate certification acceptable to authorities having jurisdiction.

C. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification or alternate certification acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Ceco Door; ASSA ABLOY.
2. Concept Frames, Inc.
3. Curries Company; ASSA ABLOY.
4. Mesker Door Inc.
5. Pioneer Industries.
6. Republic Doors and Frames.
7. Steelcraft; an Allegion brand.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.40 deg Btu/F x h x sq. ft. when tested according to ASTM C 518.

2.3 INTERIOR STANDARD STEEL FRAMES

A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Frames: SDI A250.8, Level 2; SDI A250.4, Level B.

1. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

2. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS

A. Construct hollow-metal doors to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors: SDI A250.8, Level 3; SDI A250.4, Level A. At exterior and vestibule doors.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
d. Edge Construction: Model 2, Seamless.
e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
h. Core: Polyurethane.

2. Exposed Finish: Prime.

2.5 BORROWED LITES

A. Fabricate of uncoated steel sheet, minimum thickness of 0.042 inch.

B. Construction: Face welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.

2.7 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

F. Glazing: Comply with requirements in Section 088000 "Glazing."

2.8 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.9 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.
4. Solidly pack mineral-fiber insulation inside frames.

5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, section 5.2
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 CLEANING AND TOUCHUP

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Five-ply and seven-ply flush wood veneer-faced doors for transparent finish.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers, if applicable.
5. Factory-machining criteria.
6. Factory- finishing specifications.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
2. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

~~1.4 INFORMATIONAL SUBMITTALS~~

~~A. Qualification Data: For door inspector.~~

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
3. Submit copy of DHI's Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Special warranties.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification or alternate certification acceptable to authorities having jurisdiction.

B. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies shall comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification or alternate certification acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Delamination of veneer.
    b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

~~2.1 PERFORMANCE REQUIREMENTS~~

A. ~~Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252~~.

2.2 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Composite Wood or Agrifiber Products.

2.3 MANUFACTURERS

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

1. Lambton Doors.
2. Masonite Architectural.
3. Oshkosh Door Company.
4. VT Industries Inc.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.4 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

1. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

~~C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C.~~

~~1. Cores: Provide core specified as needed to provide fire-protection rating indicated.~~
~~2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.~~
~~3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.~~
4. ~~Pairs: Provide formed-steel edges and astragals with intumescent seals~~.

~~a. Finish steel edges and astragals with baked enamel same color as doors.~~

D. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde.
2. Blocking: Provide wood blocking in particleboard-core doors as follows:

   a. 5-inch top-rail blocking, in doors indicated to have closers.
   b. 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
   c. 5-inch midrail blocking, in doors indicated to have exit devices.

3. Contractor Option: Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

E. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.

   a. Screw Withdrawal, Face: 700 lbf.
   b. Screw Withdrawal, Edge: 400 lbf.

F. Mineral-Core Doors: Not allowed.

2.5 SOLID-CORE FIVE-PLY OR SEVEN-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Veneer Grade: Premium (Grade A faces).
2. Species: Clear White oak unless otherwise indicated on Drawings.
3. Cut: Quarter sliced.
4. Match between Veneer Leaves: Slip match.
5. Assembly of Veneer Leaves on Door Faces: Balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.
8. Exposed Vertical Edges: Applied wood edges of same species as faces and covering edges of crossbands.
9. Core: Particleboard or Structural composite lumber.

10. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.
11. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.6 SOLID-CORE FIVE- OR SEVEN- PLY FLUSH WOOD DOORS FOR OPAQUE FINISH

A. Interior Solid-Core Doors:

1. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
2. ANSI/WDMA I.S. 1A Grade: Custom.
3. Faces: MDO.

a. Apply MDO to standard-thickness, closed-grain, hardwood face veneers or directly to high-density hardboard crossbands.

4. Exposed Vertical Edges: Any closed-grain hardwood.

a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
b. Fire-Rated Pairs of Doors: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
c. Mineral-Core Doors: Not allowed.

5. Core for Non-Fire-Rated Doors:

a. ANSI A208.1, Grade LD-2 particleboard.

1) Provide doors with WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."

b. WDMA I.S. 10 structural composite lumber.

1) Screw Withdrawal, Door Face: 550 lbf.
2) Screw Withdrawal, Vertical Door Edge: 550 lbf.

6. Core for Fire-Rated Doors: None required.
7. Construction: Five- or seven- plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.7 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

2.8 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.9 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. ANSI/WDMA I.S. 1A Grade: Premium.
2. Finish: ANSI/WDMA I.S. 1A TR-6 Catalyzed Polyurethane.
3. Finish: ANSI/WDMA I.S. 1A TR-8 UV Cured Acrylated Polyester/Urethane
4. Staining: Match Architect's sample.
5. Effect: Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores.
6. Sheen: Satin.

D. Opaque Finish:

1. ANSI/WDMA I.S. 1A Grade: Premium.
2. Finish: Architectural Woodwork Standards System-9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.

3. **Finish: Architectural Woodwork Standards System-11, Polyurethane, Catalyzed.**
4. **Finish: ANSI/WDMA I.S. 1A OP-6 Catalyzed Polyurethane.**
5. **Color: As scheduled.**
6. **Sheen: Semigloss.**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide1/4 inch from bottom of door to top of threshold unless otherwise indicated.

a. Comply with NFPA 80 for fire-rated doors.
b. 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

2. ~~Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency~~.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes access doors and frames for walls and ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings if applicable, material descriptions, dimensions of individual components and profiles, and finishes.

B. Product Schedule: For access doors and frames, keyed to floor plan.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For access doors, annotated product schedule and key plan with Owner's room numbers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Nystrom; Architectural Access Door. or a comparable product by one of the following:

1. Cendrex Inc.
2. JL Industries, Inc.; a division of the Activar Construction Products Group.
3. Karp Associates, Inc.
4. Larsens Manufacturing Company.
5. Milcor; a division of Hart & Cooley, Inc.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Concealed Flanges:

1. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
2. Locations: Wall and ceiling.
3. Door Size: 16 by 16 inches unless otherwise indicated on Drawings.
4. Metallic-Coated Steel Sheet for Door: Nominal 0.064-inch, 16 gage factory primed.
5. Frame Material: Same material and thickness as door.
6. Latch and Lock: Prepared for mortise cylinder.

2.3 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

C. Frame Anchors: Same material as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.

D. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087100 "Door Hardware."

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

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SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glazed aluminum curtain wall systems modifications including entrance door frame and door replacement and matching framing and glazing infill.

    a. Conventionally glazed.

B. Preinstallation Conference: Conduct conference at Project site.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

    a. Joinery, including concealed welds.
    b. Anchorage.
    c. Expansion provisions.
    d. Glazing.
    e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

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

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

C. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

3. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
4. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
5. Test Durations: As required by design wind velocity, but not less than 10 seconds.

D. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SOURCE LIMITATIONS

A. Obtain all components of curtain-wall system and storefront system, including framing entrances and accessories, from single manufacturer.

2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Provide match to existing profile and finish.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Match existing.
4. Finish: Match existing.
5. Fabrication Method: Either factory- or field-fabricated system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

C. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Basis of Design: EFCO, Series T500 Tie Rod.

2. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and bottom stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated, and fillet welded or that incorporate concealed tie rods.

3. Door Design: Stile and rail width as indicated on Drawings.

   a. Accessible Doors: Smooth surfaced bottom rail for width of door in area within 10 inches above floor or ground plane.

4. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

   a. Provide nonremovable glazing stops on outside of door.

2.5 ENTRANCE DOOR HARDWARE

A. General: Provide entrance door hardware listed in this Section for each entrance door.

1. Entrance Door Hardware Sets: Refer to Division 08 Section "Door Hardware" for furnishing and installing balance of entrance door hardware.

B. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.

C. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

2.6 GLAZING

A. Curtain Wall Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard.

1. Color: Black.

C. Glazing Sealants: Comply with Section 088000 "Glazing."

D. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes into contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.

1. Color: As selected by Architect.

2.7 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

F. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM and prepare surfaces in accordance with applicable SSPC standard.

2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from 300 series stainless steel.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Dead-soft, 0.018-inch-thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.9 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.

3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
7. Components curved to indicated radii.

D. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

E. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.10 ALUMINUM FINISHES

A. Provide one of the following matching existing finish.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

D. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.4 INSTALLATION OF WEATHERSEAL SEALANT

A. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass, as recommended by sealant manufacturer.

B. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

3.5 ERECTION TOLERANCES

A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2-inch-wide, limit offset from true alignment to 1/16 inch.
b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

END OF SECTION 084413

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SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:

    a. Swinging doors.
    b. Gates.

2. Cylinders for door hardware specified in other Sections.
3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
4. Exit Devices
5. Keyways
6. Surface Closers

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Section 064113 "Wood-Veneer-Faced Architectural Cabinets" for cabinet door hardware provided with cabinets.
2. Section 081113 "Hollow Metal Doors and Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided as part of hollow-metal frames.
3. Section 081416 "Flush Wood Doors" for integral intumescent seals provided as part of labeled fire-rated assemblies.
4. Section 083113 "Access Doors and Frames" for access door hardware, except cylinders.
5. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead door assemblies.
6. Section 083326 "Overhead Coiling Grilles" for door hardware provided as part of overhead grille assemblies.
7. Section 084113 "Aluminum-Framed Entrances and Storefronts" for installation of entrance door hardware, including cylinders.
8. Section 102213 "Wire Mesh Partitions" for door hardware for doors in wire mesh partitions, except cylinders.
9. Section 281300 "Access Control" for access control devices installed at door openings and provided as part of a security system.

10. Section 281600 "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion-detection system.
11. Section 283111 "Digital, Addressable Fire-Alarm System" for connections to building fire-alarm system.
12. Section 283112 "Zoned (DC Loop) Fire-Alarm System" for connections to building fire-alarm system.

1.03 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
2. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems

1.04 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:

a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.
b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

    a. Wiring Diagrams: For power, signal, and control wiring and including:
        1) Details of interface of electrified door hardware and building safety and security systems.
        2) Schematic diagram of systems that interface with electrified door hardware.
        3) Point-to-point wiring.
        4) Risers.
        5) Operational Description of electrified door hardware.

3. Door Hardware Schedule:

    a. Submit concurrent with submissions of Product Data and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
    b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
    c. Indicate complete designations of each item required for each opening, include:
        1) Door Index: door number, heading number, and Architect’s hardware set number.
        2) Quantity, type, style, function, size, and finish of each hardware item.
        3) Name and manufacturer of each item.
        4) Fastenings and other pertinent information.
        5) Location of each hardware set cross-referenced to indications on Drawings.
        6) Explanation of all abbreviations, symbols, and codes contained in schedule.
        7) Mounting locations for hardware.
        8) Door and frame sizes and materials.
        9) Degree of door swing and handing.
        10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

4. Key Schedule:

    a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
    b. Use ANSI/BHMA A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
    c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
    d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
    e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
    f. Prepare key schedule by or under supervision of supplier, detailing Owner’s final keying instructions for locks and padlocks.

5. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.

   a. Provide Certificate of manufacturer training acceptable to Owner for each installer performing work of this Section.

2. Provide Product Data:

   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
   b. Include warranties for specified door hardware.

3. Provide Minutes of Preinstallation meetings.
4. Provide Field Quality Control Reports.
5. Provide Special warranties for products specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Factory order acknowledgement numbers (for warranty and service)
   d. Name, address, and phone number of local representative for each manufacturer.
   e. Parts list for each product.
   f. Final approved hardware schedule edited to reflect conditions as installed.
   g. Final keying schedule
   h. Copies of floor plans with keying nomenclature
   i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
   j. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

2. Bitting Schedule: For keying schedule for Project, reflecting decisions made in keying conference and modifications. Submit directly to CMS Locksmith no less than 45 days prior to Substantial Completion. Provide copy of transmittal only to Owner's Representative and to Architect.

1.05 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

   a. Warehousing Facilities: In Project's vicinity.
   b. Scheduling Responsibility: Preparation of door hardware and keying schedules.

c. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies like those indicated for this Project.
d. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
    1) Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

2. Manufacturer's Field Representative: A technical representative of the manufacturer not engaged in the sale of products who is experienced in the specification, installation, and maintenance of the specified products, qualified to perform inspection specified in 'FIELD QUALITY CONTROL' section herein.
3. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
4. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

    a. For door hardware: DHI certified AHC or DHC.
    b. Can provide installation and technical data to Architect and other related subcontractors.
    c. Can inspect and verify components are in working order upon completion of installation.
    d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

5. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:

    a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
    b. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:

    a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
    b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware

    a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:

a. Comply with governing accessibility regulations cited in “REFERENCES” article, herein for door hardware on doors in an accessible route.

C. Pre-Installation Meetings

1. Pre-installation Conference: Conduct conference at Project site. Attendees shall include door hardware supplier, door hardware installer, electrical subcontractor, Architect, Owner, and Owner’s security consultant if applicable.

a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Inspect and discuss preparatory work performed by other trades.
c. Inspect and discuss electrical roughing-in for electrified door hardware.
d. Review sequence of operation for each type of electrified door hardware.
e. Review required testing, inspecting, and certifying procedures.
f. Review questions or concerns related to proper installation and adjustment of door hardware.
g. Coordinate a hardware installation seminar to be conducted on the installation of locksets, exit devices, and door closers with Manufacturer’s representative. Training shall include use of installation manuals, hardware schedule, templates, and physical product samples. Submit minutes of seminar.

2. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Owner, Contractor, Installer, and Architect, conference participants shall also include Supplier's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Requirements for access control.
e. Address for delivery of keys.
f. Submit Minutes of conference.

3. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer’s original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys with key cabinet to Owner by registered mail or overnight package service.

1. Locksmith Department, Charlotte-Mecklenburg Schools, 3301 Stafford Drive, Charlotte, North Carolina 28208

1.07 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant and other applicable security subcontractors.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.08 WARRANTY

1. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

    a. Failures include, but are not limited to, the following:
        1) Structural failures including excessive deflection, cracking or breakage.
        2) Faulty operation of doors and door hardware.
        3) Deterioration of metals, metal finishes, and other material beyond normal weathering and use.

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
3. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer’s published listings.

    a. Mechanical Warranty
        1) Locks
            a) 3 year
        2) Exit Devices
            a) 3 year

3) Closers
   a) 25 year

b. Electrical Warranty
   1) Electric Strikes
      a) 5 year
   2) Exit Devices
      a) 10 year

c. Magnetic Door Holder
   a) 5 years

1.09 MAINTENANCE

A. Provide Door Hardware Allowance for additional attic stock as indicated by Project Type listed:

   1. Renovation & Additions: Coordinate with Owner

B. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approval of manufacturers and/or products other than those listed as “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

B. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fasteners

   1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
   2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
   3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners.
   4. Provide thru-bolts at door closers and exit devices.

5. Install hardware with fasteners provided by hardware manufacturer.

B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.

1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
2. Use materials which match materials of adjacent modified areas.
3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

D. Cable and Connectors: Hardwired Electrified Hardware and Exit Device Trim:

1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with enough and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES – BALL BEARING

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Ives 5BB series
b. Hager BB1191/1279 series
c. McKinney TA/T4A series
d. Stanley FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 48 inches (914 mm) wide:

a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 48 inches (914 mm) wide:

a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
6. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
7. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

    a. Steel Hinges: Steel pins
    b. Non-Ferrous Hinges: Stainless steel pins
    c. Out-Swinging Exterior Doors: Non-removable pins
    d. Out-Swinging Interior Lockable Doors: Non-removable pins
    e. Interior Non-lockable Doors: Non-rising pins

9. Tips: Flat button.
10. Corners: Square

2.04 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:

    a. Von Duprin EPT-10

2. Acceptable Manufacturers and Products:

    a. ABH PT1000
    b. Securitron CEPT-10

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer’s template and UL requirements, unless interference with operation of door or other hardware items.

2.05 FLUSH BOLTS

A. Manufacturers:

1. Acceptable Manufacturers:

    a. Ives
    b. Burns
    c. Rockwood
    d. Trimco

B. Requirements:

1. Provide constant latching and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for

each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 COORDINATORS

A. Manufacturers:

1. Acceptable Manufacturers:

a. Ives
b. Burns
c. Rockwood
d. Trimco

B. Requirements:

1. Where pairs of doors are equipped with constant latching flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.07 MORTISE LOCKS

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Schlage L9000 series x 06A lever
b. Sargent 8200 series x L lever
c. Corbin-Russwin ML2000 series x Newport lever

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

2.08 DEADBOLTS

A. Manufacturers and Products:

1. Acceptable Manufacturer and Products:

a. Schlage B600/B700/B800 Series
b. Corbin-Russwin DL3000 Series
c. Sargent 480 Series

B. Requirements:

1. Provide grade 1 deadbolt series conforming to ANSI/BHMA A156.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide deadbolts with standard 2-3/4 inches (70 mm) backset. Provide 2-3/8 inches (60 mm) where noted or if door or frame detail requires. Provide deadbolt with full 1-inch (25 mm) throw, constructed of steel alloy.
4. Provide manufacturer’s standard strike.

2.09 PADLOCKS:

A. Manufacturers and Products:

1. Acceptable Manufacturer and Products:

a. American Lock 5560 Series
b. Schlage KS Series
c. Sargent 758 Series

B. Requirements:

1. Provide padlocks with 1-inch (25 mm) shackle height, unless noted otherwise, as specified.
2. Cylinders: Contact CMS Locksmith for pinning instructions.

2.10 EXIT DEVICES

A. Manufacturers and Products:

1. Alternate Products: Subject to compliance with requirements, provide: Von Duprin 99/33A series
2. Base Bid Products: Subject to compliance with requirements, provide one of the following:

a. Von Duprin 99/33A series
b. Corbin-Russwin ED5000 series
c. Sargent 19-43-GL-80 series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to “KEYING” article, herein.

3. Provide grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as removable mullion, provide type that can be removed without a cylinder.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Rim Exit Devices: provide devices with non-tapered smart latchbolt with 90° latchbolt to strike engagement under stress and Static Load Resistance of 2000 pounds at exterior doors.
16. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
17. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
18. Provide one (1) hex/allen key for each exit device and removable mullion specified.
19. Provide exit devices with thru-bolt fasteners.

2.11 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Von Duprin 6000 Series.
b. Folger Adam 300 Series
c. HES 1006 Series

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.12 POWER SUPPLIES

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Schlage/Von Duprin PS900 Series
b. Sargent 3500 series
c. Securitron BPS series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:

a. 12/24 VDC Output, field selectable.
b. Class 2 Rated power limited output.
c. Universal 120-240 VAC input.
d. Low voltage DC, regulated and filtered.
e. Polarized connector for distribution boards.
f. Fused primary input.
g. AC input and DC output monitoring circuit w/LED indicators.
h. Cover mounted AC Input indication.
i. Tested and certified to meet UL294.
j. NEMA 1 enclosure.
k. Hinged cover w/lock down screws.
l. High voltage protective cover.

2.13 CYLINDERS

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Schlage Everest C
b. Corbin-Russwin Access 3
c. Sargent XC

B. Requirements:

1. Provide cylinders compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer’s series as indicated. Refer to “KEYING” article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.

a. Grade 1; Type M, mechanical; conventional patented open: cylinder with conventional core with open keyway.

3. Number of pins: Six
4. Permanent Core: Manufacturer’s standard, non-removable. Finish face to match lockset.
5. Type: As required at each device.
6. Patent Protection: Cylinders requiring use patented keys, patent protected.
7. Nickel silver bottom pins.

C. Construction Keying:

1. Temporary Construction Cylinder Keying.

    a. Provide construction cores that permit voiding construction keys without cylinder removal at openings indicated by Owner as hazard areas, furnished in accordance with the following requirements.
        1) Split Key or Lost Ball Construction Keying System.
        2) 10 construction control keys, and extractor tools or keys as required to void construction keying.
        3) 12 construction change (day) keys.

    b. Construction and operating keys shall not be part of the Owner's permanent keying system or furnished on the same keyway as the Owner's permanent keying system.
    c. Owner or Owner’s Representative will void operation of temporary construction keys.

2.14 KEYING

A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Manufacturers and Products:

1. Alternate Products: Subject to compliance with requirements, provide: Schlage C145 keyway
2. Base Bid Products: Subject to compliance with requirements, provide one of the following:

    a. Schlage C145
    b. Corbin-Russwin Access 3
    c. Sargent XC
    d. Grand Master Key System: Cylinders are operated by a change key, a master key, and a grand master key

3. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders involved at no additional cost to Owner.
4. Provide keys with the following features:

    a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
    b. Patent Protection: Keys and blanks protected by one or more utility patent(s).

5. Identification:

    a. Mark permanent cylinders and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
    b. Identification stamping provisions must be approved by the Architect and Owner.
    c. Stamp cylinders and keys with Owner’s unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with “DO NOT DUPLICATE” along with the “PATENTED” or patent number to enforce the patent protection.
    d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.

6. Cutting: Factory-cut keys.
7. Keys to be delivered by registered mail to the Owner. Change Keys to be provided in set up key control system. Construction keys shall be delivered to the Contractor.
8. Quantity: Furnish in the following quantities:

a. Change (Day) Keys: 3 per cylinder.
b. Master Keys: 6.
c. Grand Master Keys: 2.
d. Provide 100 blank keys for use by CMS Lockshop.

9. Keying System Coordination: Before factory order is placed, hardware supplier shall consult with CMS Maintenance Department to secure formal written approval of keying system and function.

    a. After installation of hardware and before acceptance of building, hardware supplier shall check each locked door against key symbol to make certain that correct locks and cylinders are on proper doors. For any incorrectly located cylinders, tag and relocate to proper location.

2.15 KEY CONTROL SYSTEM

A. Manufacturers:

1. Acceptable Manufacturers:

    a. Telkee
    b. Key Control
    c. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.

    a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
    b. Provide hinged-panel type cabinet for wall mounting equipped with pin-tumbler cylinder door lock.

2.16 KEY BOXES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. Knox Box, 3200 Series

B. Requirements:

1. Provide locked key box capable of storing four keys.
2. Provide key box capable of being surface mounted and recessed in exterior masonry.

2.17 DOOR CLOSERS

A. Manufacturers and Products:

1. Alternate Products: Subject to compliance with requirements, provided listed products of LCN 4040XP series
2. Base Bid Products: Subject to compliance with requirements, provide one of the following:

    a. LCN 4040XP series
    b. Corbin-Russwin DC8000 series
    c. Sargent 281 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter with 5/8-inch (16 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
11. Provide extra heavy duty arm when closer is to be installed using parallel arm mounting.
12. Unless otherwise specified, mount all closer parallel arm.
13. Unless specified, do not furnish closers with stop arm closer function.
14. Attach closers using thru-bolts supplied by manufacturer.
15. Provide closers with full metal covers supplied by manufacturer.

2.18 DOOR TRIM

A. Manufacturers:

1. Acceptable Manufacturers:

    a. Ives.
    b. Trimco
    c. Burns
    d. Rockwood

B. Requirements:

1. Provide push plates, pull plates, and pulls with diameter and length as scheduled.
2. Subject to compliance with requirements, provide the products of a single manufacturer.

2.19 PROTECTION PLATES

A. Manufacturers:

1. Acceptable Manufacturers:

a. Ives
b. Burns
c. Trimco
d. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. Provide counter sunk screw holes.
4. At fire rated doors, provide protection plates over 16 inches high with UL label.
5. Provide amor plates for loading dock doors and only as specified. All other applications Consult CMS Design Manager.

2.20 OVERHEAD STOPS

A. Manufacturers:

1. Acceptable Manufacturers:

a. Glynn-Johnson
b. Rixson
c. ABH

B. Requirements:

1. Provide overhead stops only where specified in locations where a wall stop, floor stop, or closer arm cannot be used.

2.21 DOOR STOPS

A. Manufacturers:

1. Acceptable Manufacturers:

a. Ives
b. Hager
c. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal dome type floor stops.

2.22 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Acceptable Manufacturers:

a. Zero International
b. National Guard
c. Reese

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Do not cut weatherstripping to install other hardware.
3. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
4. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency for sound ratings indicated, based on testing according to ASTME 1408. Provide gasketing suitable for installation in kerfed hollow metal frames where applicable.
5. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
6. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.
7. Exterior Doors: Provide rain drip at exterior hollow metal doors where door is not protected by canopy.

2.23 SILENCERS

A. Manufacturers:

1. Acceptable Manufacturers:

a. Ives
b. Burns
c. Rockwood
d. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.24 MAGNETIC HOLDERS

A. Manufacturers:

1. Acceptable Manufacturers:

a. LCN SEM Series
b. Rixson 990 Series

c. ABH 2000 Series

B. Requirements:

1. Provide wall mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.25 DOOR POSITION SWITCHES

A. Manufacturers:

1. Acceptable Manufacturers:

a. Schlage
b. GE-Interlogix
c. Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.26 LATCH PROTECTORS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Trimco
b. Rockwood

B. Provide stainless steel latch protectors of type required to function with specified lock.

2.27 COAT HOOKS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Rockwood

B. Provide coat hooks as specified.

2.28 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
3. Protection Plates: BHMA 630 (US32D)
4. Overhead Stops and Holders: BHMA 630 (US32D)
5. Door Closers: Powder Coat to Match
6. Wall Stops: BHMA 630 (US32D)
7. Latch Protectors: BHMA 630 (US32D)
8. Weatherstripping: Clear Anodized Aluminum
9. Thresholds: Mill Finish Aluminum

2.29 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Wood or Machine Screws: For the following:

a. Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
b. Strike plates to frames.

2. Steel Through Bolts: For the following:

a. Closers to doors and frames.
b. Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

D. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Where on-site modification of doors and frames is required:

1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
2. Field modify and prepare existing doors and frames for new hardware being installed.
3. When modifications are exposed to view, use concealed fasteners, when possible.
4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

    a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
    b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
    c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

H. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28, ELECTRONIC SAFETY AND SECRUTIY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Testing and labeling wires with Architect’s opening number.

I. Lock Cylinders: Install conventional cylinders and use construction key to secure building during construction period.

J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

L. Power Supplies: Power supplies for access control products including electric strikes, electrified exit devices, and card readers to be provided in Division 28 ELECTRONIC SAFETY AND SECURITY.

M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

Q. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

A. Inspection and Testing:

1. Provide functional testing and inspection of fire door assemblies by a qualified person in accordance with NFPA 80.

    a. Schedule fire door assembly inspection within 90 days of Substantial Completion of the Project.
    b. Submit a signed, written final report as specified in Paragraph 1.03.E.1.
    c. Correct all deficiencies and schedule a reinspection of fire door assemblies noted as deficient on the inspection report.
    d. Inspector to reinspect fire door assemblies after repairs are made.

2. Provide inspection of required egress door assemblies by a qualified person in accordance with NFPA 101.

    a. Schedule egress door assembly inspection within 90 days of Substantial Completion of the Project for the required openings.
    b. Submit a signed, written final report as specified in Paragraph 1.03.E.2.
    c. Correct all deficiencies and schedule a reinspection of egress door assemblies noted as deficient on the inspection report.
    d. Inspector to reinspect required egress door assemblies after repairs are made.

3.05 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

    1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
    2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.06 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer’s instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.07 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier’s responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

Building 6600
87753 X-77245 Version 6

Hardware Group No. HWA-01

For use on Door #(s):

1000	1005	1014	1201	1503	1503
1628	2009	2403	2423	2424	

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-02

For use on Door #(s):
1001A

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	9927-EO-LBR-SNB		626	VON
1	EA	PANIC HARDWARE	9927-L-LBR-06-SNB		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
2	EA	SURFACE CLOSER	4040XP EDA MC		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	WALL STOP/HOLDER	WS45/WS45X		626	IVE
2	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-03

For use on Door #(s):

1001B	1011	1101D	1700	1704A	1704B
2002	2003A	2003B	2507B		

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	99-NL-SNB		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-03.1

For use on Door #(s):

1115

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4040XP EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-04

For use on Door #(s):

1006	1017	1200A	1200B	1500	2008
2111	2213	2300	2420	2512	

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP			652	IVE
1	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-NL-CON 24 VDC			626	VON
1	EA	RIM CYLINDER	20-021			626	SCH
1	EA	SURFACE CLOSER	4040XP EDA MC			689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			630	IVE
1	EA	WALL STOP	WS406/407CCV			630	IVE
3	EA	SILENCER	SR64/65 AS REQ			GRY	IVE
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER				
1	EA	WIRE HARNESS	CON X LENGTH AS REQ				VON
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC			LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED				DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RELEASE ELECTRIC STRIKE AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWA-05

For use on Door #(s):

1004A	1018A	2006	2200

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	FIRE EXIT HARDWARE	99-L-BE-F-06-SNB		626	VON
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. HWA-06

For use on Door #(s):
1021

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-NL-CON 24 VDC		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	MOUNTING PLATE	4040XP-18		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30		689	LCN
1	EA	WEATHERSTRIPPING	PROVIDED BY DOOR MANUFACTURER			
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER			
1	EA	DOOR CONTACT	679-05		WHT	SCE
1	EA	WIRE HARNESS	CON X LENGTH AS REQ			VON
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED			DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.

2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL AT READER WILL RETRACT LATCHBOLT. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.

3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWA-07

For use on Door #(s):

1027	1103	1104	1105	1106	1107
1108	1109	1110	1111	1112	1113
1203	1204	1211	1302	1303	1304
1306	1307	1401	1405	1406	1605
1606	1607	1621	1621B	1701	2014
2102	2103	2104	2112	2203	2302
2303	2304	2401	2402	2415	2417
2421	2422	2502	2503	2504	2505
2515	2516	2517			

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	L9070P6 06A		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-08

For use on Door #(s):

1007	1008	1009

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK WITH INDICATOR	L9040 06A 09-544 L283-722		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-09

For use on Door #(s):

1010

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM W/DEADBOLT	L9480P6 06A 09-544 L283-722 (WITH INDICATOR)		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-10

For use on Door #(s):
1002

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. HWA-10.1

For use on Door #(s):
1015 1611

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	FLOOR STOP	FS436		626	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-11

For use on Door #(s):
1012 1013 1024 1025 2011 2012
2418 2419

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-12

For use on Door #(s):
1016 1023 1400 2005 2013

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	ELECTRIC STRIKE	6210 FSE DS CON 12/16/24/28 VAC/VDC		630	VON
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER			
1	EA	WIRE HARNESS	CON X LENGTH AS REQ			VON
1	EA	POWER SUPPLY	PS902 120/240 VAC		LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED			DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RELEASE ELECTRIC STRIKE AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWA-13

For use on Door #(s):
1004B 1018B

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	PANIC HARDWARE	LD-99-NL-SNB		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA (OMIT IF UNDER CANOPY)		AA	ZER
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	DOOR CONTACT	679-05		WHT	SCE

Hardware Group No. HWA-13.1

For use on Door #(s):
1620A

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	PANIC HARDWARE	LD-99-NL-SNB		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	RAIN DRIP	142AA (OMIT IF UNDER CANOPY)		AA	ZER
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

Hardware Group No. HWA-14

For use on Door #(s):
1020

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER	EPT10 CON	✓	689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-NL-CON 24 VDC	✓	626	VON
1	EA	SURFACE CLOSER	4040XP EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER			
1	EA	DOOR CONTACT	679-05	✓	WHT	SCE
1	EA	WIRE HARNESS	CON X LENGTH AS REQ	✓		VON
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC	✓	LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED	✓		DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOORS NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RETRACT LATCHBOLT AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWA-15

For use on Door #(s):
1600

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	REMOVABLE MULLION	4954		689	VON
1	EA	PANIC HARDWARE	LD-99-EO-SNB		626	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-NL-CON 24 VDC		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER			
2	EA	DOOR CONTACT	679-05		WHT	SCE
1	EA	WIRE HARNESS	CON X LENGTH AS REQ			VON
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED			DLR
1	EA		WEATHERSTRIP BY DOOR/FRAME MANUFACTURER			

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.

2. DOOR FUNCTION: DOORS NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RETRACT LATCHBOLT AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.

3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWA-16

For use on Door #(s):
1022A 1022B 1702 2416A 2416B 2501
2519

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	L9070P6 06A		626	SCH
1	EA	FLOOR STOP	FS436		626	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-17

For use on Door #(s):
1212 1600A 2212

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-17.1

For use on Door #(s):
1026

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. HWA-18

For use on Door #(s):
1101A

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP			630	IVE
1	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	REMOVABLE MULLION	4954			689	VON
1	EA	PANIC HARDWARE	99-DT-SNB			626	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-NL-CON 24 VDC			626	VON
1	EA	RIM CYLINDER	20-021			626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH MC			689	LCN
2	EA	MOUNTING PLATE	4040XP-18			689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30			689	LCN
1	EA	MULLION SEAL	8780NBK PSA			BK	ZER
2	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A-223			A	ZER
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER				
1	EA	DOOR CONTACT	679-05			WHT	SCE
1	EA	REMOTE RELEASE	BY SECURITY PROVIDER				
1	EA	WIRE HARNESS	CON X LENGTH AS REQ				VON
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC			LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED				DLR
1	EA		WEATHERSTRIP BY DOOR/FRAME MANUFACTURER				

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.

2. DOOR FUNCTION: DOORS NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RETRACT LATCHBOLT AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS. DOORS MAY BE PROGRAMMED UNLATCHED FOR FREE ENTRY. REMOTE RELEASE AVAILABLE USING INTERCOM SYSTEM.

4. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWA-19

For use on Door #(s):
1101B

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	REMOVABLE MULLION	4954		689	VON
1	EA	PANIC HARDWARE	99-DT-SNB		626	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-NL-CON 24 VDC		626	VON
2	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
2	EA	MOUNTING PLATE	4040XP-18		689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30		689	LCN
2	EA	DOOR CONTACT	679-05		WHT	SCE
1	EA	REMOTE RELEASE	BY SECURITY PROVIDER			
1	EA	WIRE HARNESS	CON X LENGTH AS REQ			VON
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		LGR	SCE

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOORS NORMALLY CLOSED AND LOCKED. DOORS MAY BE DOGGED DURING BUSINESS HOURS. VALID CREDENTIAL AT EXTERIOR READER OR REMOTE RELEASE FROM RECEPTION WILL RETRACT LATCHBOLT AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS. KEY OVERRIDE AVAILABLE.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWA-20

For use on Door #(s):

1205	1206	1207	1208	1402	1602
1603	1604	1608	1609	1703	2105
2106	2107	2108	2109	2110	2202
2205	2206	2207	2406	2407	2408
2410	2411	2412			

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070P6 06A	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	COAT AND HAT HOOK	582	626	IVE
3	EA	SILENCER	SR64/65 AS REQ	GRY	IVE

Hardware Group No. HWA-21

For use on Door #(s):
1610 2209 2509

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	CLASSROOM LOCK	L9070P6 06A		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-22

For use on Door #(s):
2004 2506

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	MANUAL FLUSH BOLT	FB458		626	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
2	EA	WALL STOP	WS406/407CCV		630	IVE
2	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-24

For use on Door #(s):
2010

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	FIRE EXIT HARDWARE	99-NL-F-SNB		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

Hardware Group No. HWA-25

For use on Door #(s):
2201

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	ELECTRIC STRIKE	6210 FSE DS CON 12/16/24/28 VAC/VDC		630	VON
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER			
1	EA	WIRE HARNESS	CON X LENGTH AS REQ			VON
1	EA	POWER SUPPLY	PS902 120/240 VAC		LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED			DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RELEASE ELECTRIC STRIKE AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWA-26

For use on Door #(s):
2210

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	L9070P6 06A		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-27

For use on Door #(s):
2211

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-28

For use on Door #(s):
2507A

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	REMOVABLE MULLION	4954		689	VON
1	EA	PANIC HARDWARE	99-DT-SNB		626	VON
1	EA	PANIC HARDWARE	99-NL-SNB		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-29

For use on Door #(s):
2101B

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	EXIT LOCK	L9025 06A		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWA-30

For use on Door #(s):
E2111 E2204 E2511

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1		DEADBOLT	MS1850		613	ADA
2	EA	MORTISE CYLINDER	AS REQUIRED TO MATCH EXISTING KEY SYSTEM			
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
	EA	EXISTING HARDWARE TO REMAIN	EXISTING			

END OF SECTION

SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:

    a. Swinging doors.
    b. Gates.

2. Cylinders for door hardware specified in other Sections.
3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
4. Exit Devices
5. Keyways
6. Surface Closers

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Section 064113 "Wood-Veneer-Faced Architectural Cabinets" for cabinet door hardware provided with cabinets.
2. Section 081113 "Hollow Metal Doors and Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided as part of hollow-metal frames.
3. Section 081416 "Flush Wood Doors" for integral intumescent seals provided as part of labeled fire-rated assemblies.
4. Section 083113 "Access Doors and Frames" for access door hardware, except cylinders.
5. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead door assemblies.
6. Section 083326 "Overhead Coiling Grilles" for door hardware provided as part of overhead grille assemblies.
7. Section 084113 "Aluminum-Framed Entrances and Storefronts" for installation of entrance door hardware, including cylinders.
8. Section 102213 "Wire Mesh Partitions" for door hardware for doors in wire mesh partitions, except cylinders.
9. Section 281300 "Access Control" for access control devices installed at door openings and provided as part of a security system.

10. Section 281600 "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion-detection system.
11. Section 283111 "Digital, Addressable Fire-Alarm System" for connections to building fire-alarm system.
12. Section 283112 "Zoned (DC Loop) Fire-Alarm System" for connections to building fire-alarm system.

1.03 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
2. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems

1.04 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:

    a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.
    b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
    c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

    a. Wiring Diagrams: For power, signal, and control wiring and including:
        1) Details of interface of electrified door hardware and building safety and security systems.
        2) Schematic diagram of systems that interface with electrified door hardware.
        3) Point-to-point wiring.
        4) Risers.
        5) Operational Description of electrified door hardware.

3. Door Hardware Schedule:

    a. Submit concurrent with submissions of Product Data and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
    b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
    c. Indicate complete designations of each item required for each opening, include:
        1) Door Index: door number, heading number, and Architect’s hardware set number.
        2) Quantity, type, style, function, size, and finish of each hardware item.
        3) Name and manufacturer of each item.
        4) Fastenings and other pertinent information.
        5) Location of each hardware set cross-referenced to indications on Drawings.
        6) Explanation of all abbreviations, symbols, and codes contained in schedule.
        7) Mounting locations for hardware.
        8) Door and frame sizes and materials.
        9) Degree of door swing and handing.
        10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

4. Key Schedule:

    a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
    b. Use ANSI/BHMA A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
    c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
    d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
    e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
    f. Prepare key schedule by or under supervision of supplier, detailing Owner’s final keying instructions for locks and padlocks.

5. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.

   a. Provide Certificate of manufacturer training acceptable to Owner for each installer performing work of this Section.

2. Provide Product Data:

   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
   b. Include warranties for specified door hardware.

3. Provide Minutes of Preinstallation meetings.
4. Provide Field Quality Control Reports.
5. Provide Special warranties for products specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Factory order acknowledgement numbers (for warranty and service)
   d. Name, address, and phone number of local representative for each manufacturer.
   e. Parts list for each product.
   f. Final approved hardware schedule edited to reflect conditions as installed.
   g. Final keying schedule
   h. Copies of floor plans with keying nomenclature
   i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
   j. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

2. Bitting Schedule: For keying schedule for Project, reflecting decisions made in keying conference and modifications. Submit directly to CMS Locksmith no less than 45 days prior to Substantial Completion. Provide copy of transmittal only to Owner's Representative and to Architect.

1.05 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

   a. Warehousing Facilities: In Project's vicinity.
   b. Scheduling Responsibility: Preparation of door hardware and keying schedules.

c. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies like those indicated for this Project.
d. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
    1) Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

2. Manufacturer's Field Representative: A technical representative of the manufacturer not engaged in the sale of products who is experienced in the specification, installation, and maintenance of the specified products, qualified to perform inspection specified in 'FIELD QUALITY CONTROL' section herein.
3. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
4. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

    a. For door hardware: DHI certified AHC or DHC.
    b. Can provide installation and technical data to Architect and other related subcontractors.
    c. Can inspect and verify components are in working order upon completion of installation.
    d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

5. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:

    a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
    b. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:

    a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
    b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware

    a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:

a. Comply with governing accessibility regulations cited in “REFERENCES” article, herein for door hardware on doors in an accessible route.

C. Pre-Installation Meetings

1. Pre-installation Conference: Conduct conference at Project site. Attendees shall include door hardware supplier, door hardware installer, electrical subcontractor, Architect, Owner, and Owner’s security consultant if applicable.

a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Inspect and discuss preparatory work performed by other trades.
c. Inspect and discuss electrical roughing-in for electrified door hardware.
d. Review sequence of operation for each type of electrified door hardware.
e. Review required testing, inspecting, and certifying procedures.
f. Review questions or concerns related to proper installation and adjustment of door hardware.
g. Coordinate a hardware installation seminar to be conducted on the installation of locksets, exit devices, and door closers with Manufacturer’s representative. Training shall include use of installation manuals, hardware schedule, templates, and physical product samples. Submit minutes of seminar.

2. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Owner, Contractor, Installer, and Architect, conference participants shall also include Supplier's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Requirements for access control.
e. Address for delivery of keys.
f. Submit Minutes of conference.

3. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer’s original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys with key cabinet to Owner by registered mail or overnight package service.

1. Locksmith Department, Charlotte-Mecklenburg Schools, 3301 Stafford Drive, Charlotte, North Carolina 28208

1.07 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant and other applicable security subcontractors.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.08 WARRANTY

1. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

    a. Failures include, but are not limited to, the following:
        1) Structural failures including excessive deflection, cracking or breakage.
        2) Faulty operation of doors and door hardware.
        3) Deterioration of metals, metal finishes, and other material beyond normal weathering and use.

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
3. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer’s published listings.

    a. Mechanical Warranty
        1) Locks
            a) 3 year
        2) Exit Devices
            a) 3 year

3) Closers
   a) 25 year

b. Electrical Warranty
   1) Electric Strikes
      a) 5 year
   2) Exit Devices
      a) 10 year

c. Magnetic Door Holder
   a) 5 years

1.09 MAINTENANCE

A. Provide Door Hardware Allowance for additional attic stock as indicated by Project Type listed:

   1. Renovation & Additions: Coordinate with Owner

B. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approval of manufacturers and/or products other than those listed as “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

B. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fasteners

   1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
   2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
   3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners.
   4. Provide thru-bolts at door closers and exit devices.

5. Install hardware with fasteners provided by hardware manufacturer.

B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.

1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
2. Use materials which match materials of adjacent modified areas.
3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

D. Cable and Connectors: Hardwired Electrified Hardware and Exit Device Trim:

1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with enough and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES – BALL BEARING

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Ives 5BB series
b. Hager BB1191/1279 series
c. McKinney TA/T4A series
d. Stanley FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 48 inches (914 mm) wide:

a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 48 inches (914 mm) wide:

a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
6. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
7. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

    a. Steel Hinges: Steel pins
    b. Non-Ferrous Hinges: Stainless steel pins
    c. Out-Swinging Exterior Doors: Non-removable pins
    d. Out-Swinging Interior Lockable Doors: Non-removable pins
    e. Interior Non-lockable Doors: Non-rising pins

9. Tips: Flat button.
10. Corners: Square

2.04 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:

    a. Von Duprin EPT-10

2. Acceptable Manufacturers and Products:

    a. ABH PT1000
    b. Securitron CEPT-10

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer’s template and UL requirements, unless interference with operation of door or other hardware items.

2.05 FLUSH BOLTS

A. Manufacturers:

1. Acceptable Manufacturers:

    a. Ives
    b. Burns
    c. Rockwood
    d. Trimco

B. Requirements:

1. Provide constant latching and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for

each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 COORDINATORS

A. Manufacturers:

1. Acceptable Manufacturers:

a. Ives
b. Burns
c. Rockwood
d. Trimco

B. Requirements:

1. Where pairs of doors are equipped with constant latching flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.07 MORTISE LOCKS

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Schlage L9000 series x 06A lever
b. Sargent 8200 series x L lever
c. Corbin-Russwin ML2000 series x Newport lever

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

2.08 DEADBOLTS

A. Manufacturers and Products:

1. Acceptable Manufacturer and Products:

a. Schlage B600/B700/B800 Series
b. Corbin-Russwin DL3000 Series
c. Sargent 480 Series

B. Requirements:

1. Provide grade 1 deadbolt series conforming to ANSI/BHMA A156.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide deadbolts with standard 2-3/4 inches (70 mm) backset. Provide 2-3/8 inches (60 mm) where noted or if door or frame detail requires. Provide deadbolt with full 1-inch (25 mm) throw, constructed of steel alloy.
4. Provide manufacturer’s standard strike.

2.09 PADLOCKS:

A. Manufacturers and Products:

1. Acceptable Manufacturer and Products:

a. American Lock 5560 Series
b. Schlage KS Series
c. Sargent 758 Series

B. Requirements:

1. Provide padlocks with 1-inch (25 mm) shackle height, unless noted otherwise, as specified.
2. Cylinders: Contact CMS Locksmith for pinning instructions.

2.10 EXIT DEVICES

A. Manufacturers and Products:

1. Alternate Products: Subject to compliance with requirements, provide: Von Duprin 99/33A series
2. Base Bid Products: Subject to compliance with requirements, provide one of the following:

a. Von Duprin 99/33A series
b. Corbin-Russwin ED5000 series
c. Sargent 19-43-GL-80 series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to “KEYING” article, herein.

3. Provide grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as removable mullion, provide type that can be removed without a cylinder.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Rim Exit Devices: provide devices with non-tapered smart latchbolt with 90° latchbolt to strike engagement under stress and Static Load Resistance of 2000 pounds at exterior doors.
16. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
17. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
18. Provide one (1) hex/allen key for each exit device and removable mullion specified.
19. Provide exit devices with thru-bolt fasteners.

2.11 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Von Duprin 6000 Series.
b. Folger Adam 300 Series
c. HES 1006 Series

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.12 POWER SUPPLIES

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Schlage/Von Duprin PS900 Series
b. Sargent 3500 series
c. Securitron BPS series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:

a. 12/24 VDC Output, field selectable.
b. Class 2 Rated power limited output.
c. Universal 120-240 VAC input.
d. Low voltage DC, regulated and filtered.
e. Polarized connector for distribution boards.
f. Fused primary input.
g. AC input and DC output monitoring circuit w/LED indicators.
h. Cover mounted AC Input indication.
i. Tested and certified to meet UL294.
j. NEMA 1 enclosure.
k. Hinged cover w/lock down screws.
l. High voltage protective cover.

2.13 CYLINDERS

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Schlage Everest C
b. Corbin-Russwin Access 3
c. Sargent XC

B. Requirements:

1. Provide cylinders compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer’s series as indicated. Refer to “KEYING” article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.

a. Grade 1; Type M, mechanical; conventional patented open: cylinder with conventional core with open keyway.

3. Number of pins: Six
4. Permanent Core: Manufacturer’s standard, non-removable. Finish face to match lockset.
5. Type: As required at each device.
6. Patent Protection: Cylinders requiring use patented keys, patent protected.
7. Nickel silver bottom pins.

C. Construction Keying:

1. Temporary Construction Cylinder Keying.

    a. Provide construction cores that permit voiding construction keys without cylinder removal at openings indicated by Owner as hazard areas, furnished in accordance with the following requirements.
        1) Split Key or Lost Ball Construction Keying System.
        2) 10 construction control keys, and extractor tools or keys as required to void construction keying.
        3) 12 construction change (day) keys.

    b. Construction and operating keys shall not be part of the Owner's permanent keying system or furnished on the same keyway as the Owner's permanent keying system.
    c. Owner or Owner’s Representative will void operation of temporary construction keys.

2.14 KEYING

A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Manufacturers and Products:

1. Alternate Products: Subject to compliance with requirements, provide: Schlage C145 keyway
2. Base Bid Products: Subject to compliance with requirements, provide one of the following:

    a. Schlage C145
    b. Corbin-Russwin Access 3
    c. Sargent XC
    d. Grand Master Key System: Cylinders are operated by a change key, a master key, and a grand master key

3. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders involved at no additional cost to Owner.
4. Provide keys with the following features:

    a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
    b. Patent Protection: Keys and blanks protected by one or more utility patent(s).

5. Identification:

    a. Mark permanent cylinders and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
    b. Identification stamping provisions must be approved by the Architect and Owner.
    c. Stamp cylinders and keys with Owner’s unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with “DO NOT DUPLICATE” along with the “PATENTED” or patent number to enforce the patent protection.
    d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.

6. Cutting: Factory-cut keys.
7. Keys to be delivered by registered mail to the Owner. Change Keys to be provided in set up key control system. Construction keys shall be delivered to the Contractor.
8. Quantity: Furnish in the following quantities:

a. Change (Day) Keys: 3 per cylinder.
b. Master Keys: 6.
c. Grand Master Keys: 2.
d. Provide 100 blank keys for use by CMS Lockshop.

9. Keying System Coordination: Before factory order is placed, hardware supplier shall consult with CMS Maintenance Department to secure formal written approval of keying system and function.

    a. After installation of hardware and before acceptance of building, hardware supplier shall check each locked door against key symbol to make certain that correct locks and cylinders are on proper doors. For any incorrectly located cylinders, tag and relocate to proper location.

2.15 KEY CONTROL SYSTEM

A. Manufacturers:

1. Acceptable Manufacturers:

    a. Telkee
    b. Key Control
    c. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.

    a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
    b. Provide hinged-panel type cabinet for wall mounting equipped with pin-tumbler cylinder door lock.

2.16 KEY BOXES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. Knox Box, 3200 Series

B. Requirements:

1. Provide locked key box capable of storing four keys.
2. Provide key box capable of being surface mounted and recessed in exterior masonry.

2.17 DOOR CLOSERS

A. Manufacturers and Products:

1. Alternate Products: Subject to compliance with requirements, provided listed products of LCN 4040XP series
2. Base Bid Products: Subject to compliance with requirements, provide one of the following:

    a. LCN 4040XP series
    b. Corbin-Russwin DC8000 series
    c. Sargent 281 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter with 5/8-inch (16 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
11. Provide extra heavy duty arm when closer is to be installed using parallel arm mounting.
12. Unless otherwise specified, mount all closer parallel arm.
13. Unless specified, do not furnish closers with stop arm closer function.
14. Attach closers using thru-bolts supplied by manufacturer.
15. Provide closers with full metal covers supplied by manufacturer.

2.18 DOOR TRIM

A. Manufacturers:

1. Acceptable Manufacturers:

    a. Ives.
    b. Trimco
    c. Burns
    d. Rockwood

B. Requirements:

1. Provide push plates, pull plates, and pulls with diameter and length as scheduled.
2. Subject to compliance with requirements, provide the products of a single manufacturer.

2.19 PROTECTION PLATES

A. Manufacturers:

1. Acceptable Manufacturers:

a. Ives
b. Burns
c. Trimco
d. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. Provide counter sunk screw holes.
4. At fire rated doors, provide protection plates over 16 inches high with UL label.
5. Provide amor plates for loading dock doors and only as specified. All other applications Consult CMS Design Manager.

2.20 OVERHEAD STOPS

A. Manufacturers:

1. Acceptable Manufacturers:

a. Glynn-Johnson
b. Rixson
c. ABH

B. Requirements:

1. Provide overhead stops only where specified in locations where a wall stop, floor stop, or closer arm cannot be used.

2.21 DOOR STOPS

A. Manufacturers:

1. Acceptable Manufacturers:

a. Ives
b. Hager
c. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal dome type floor stops.

2.22 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Acceptable Manufacturers:

a. Zero International
b. National Guard
c. Reese

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Do not cut weatherstripping to install other hardware.
3. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
4. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency for sound ratings indicated, based on testing according to ASTME 1408. Provide gasketing suitable for installation in kerfed hollow metal frames where applicable.
5. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
6. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.
7. Exterior Doors: Provide rain drip at exterior hollow metal doors where door is not protected by canopy.

2.23 SILENCERS

A. Manufacturers:

1. Acceptable Manufacturers:

a. Ives
b. Burns
c. Rockwood
d. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.24 MAGNETIC HOLDERS

A. Manufacturers:

1. Acceptable Manufacturers:

a. LCN SEM Series
b. Rixson 990 Series

c. ABH 2000 Series

B. Requirements:

1. Provide wall mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.25 DOOR POSITION SWITCHES

A. Manufacturers:

1. Acceptable Manufacturers:

a. Schlage
b. GE-Interlogix
c. Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.26 LATCH PROTECTORS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Trimco
b. Rockwood

B. Provide stainless steel latch protectors of type required to function with specified lock.

2.27 COAT HOOKS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Rockwood

B. Provide coat hooks as specified.

2.28 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
3. Protection Plates: BHMA 630 (US32D)
4. Overhead Stops and Holders: BHMA 630 (US32D)
5. Door Closers: Powder Coat to Match
6. Wall Stops: BHMA 630 (US32D)
7. Latch Protectors: BHMA 630 (US32D)
8. Weatherstripping: Clear Anodized Aluminum
9. Thresholds: Mill Finish Aluminum

2.29 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Wood or Machine Screws: For the following:

a. Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
b. Strike plates to frames.

2. Steel Through Bolts: For the following:

a. Closers to doors and frames.
b. Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

D. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Where on-site modification of doors and frames is required:

1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
2. Field modify and prepare existing doors and frames for new hardware being installed.
3. When modifications are exposed to view, use concealed fasteners, when possible.
4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

    a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
    b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
    c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

H. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28, ELECTRONIC SAFETY AND SECRUTIY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Testing and labeling wires with Architect’s opening number.

I. Lock Cylinders: Install conventional cylinders and use construction key to secure building during construction period.

J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

L. Power Supplies: Power supplies for access control products including electric strikes, electrified exit devices, and card readers to be provided in Division 28 ELECTRONIC SAFETY AND SECURITY.

M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

Q. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

A. Inspection and Testing:

1. Provide functional testing and inspection of fire door assemblies by a qualified person in accordance with NFPA 80.

    a. Schedule fire door assembly inspection within 90 days of Substantial Completion of the Project.
    b. Submit a signed, written final report as specified in Paragraph 1.03.E.1.
    c. Correct all deficiencies and schedule a reinspection of fire door assemblies noted as deficient on the inspection report.
    d. Inspector to reinspect fire door assemblies after repairs are made.

2. Provide inspection of required egress door assemblies by a qualified person in accordance with NFPA 101.

    a. Schedule egress door assembly inspection within 90 days of Substantial Completion of the Project for the required openings.
    b. Submit a signed, written final report as specified in Paragraph 1.03.E.2.
    c. Correct all deficiencies and schedule a reinspection of egress door assemblies noted as deficient on the inspection report.
    d. Inspector to reinspect required egress door assemblies after repairs are made.

3.05 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

    1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
    2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.06 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer’s instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.07 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier’s responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

Building 6623
87742 X-77234 Version 3

Hardware Group No. HWB-01

For use on Door #(s):
1001A 1110 1304

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-NL-CON 24 VDC		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	MOUNTING PLATE	4040XP-18		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30		689	LCN
1	EA	WEATHERSTRIPPING	PROVIDED BY DOOR MANUFACTURER			
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER			
1	EA	DOOR CONTACT	679-05		WHT	SCE
1	EA	WIRE HARNESS	CON X LENGTH AS REQ			VON
1	EA	POWER SUPPLY	PS902 120/240 VAC		LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED			DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.

2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL AT READER WILL RETRACT LATCHBOLT. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.

3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWB-02

For use on Door #(s):
1002 1006

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	CLASSROOM LOCK	L9070P6 06A		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWB-03

For use on Door #(s):

1003A	1003B	1004	1005	1012	1015
1016	1017	1018	1100A	1106	1201A
1201B	1201C	1204	1208	1210	1301
1303	1307				

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	L9070P6 06A		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWB-03.1

For use on Door #(s):
1001B

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	99-NL-SNB		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWB-04

For use on Door #(s):
1008 1009

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK WITH INDICATOR	L9040 06A 09-544 L283-722		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWB-05

For use on Door #(s):
1010 1101 1104 1306

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWB-06

For use on Door #(s):
1011

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWB-07

For use on Door #(s):
1019 1207 1305

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	L9070P6 06A		626	SCH
1	EA	FLOOR STOP	FS436		626	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWB-08

For use on Door #(s):
1100B

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	MANUAL FLUSH BOLT	FB458		626	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
2	EA	WALL STOP	WS406/407CCV		630	IVE
2	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWB-09

For use on Door #(s):
1102 1103

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK WITH INDICATOR	L9040 06A 09-544 L283-722		626	SCH
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWB-10

For use on Door #(s):
1105

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK WITH INDICATOR	L9040 06A 09-544 L283-722		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWB-11

For use on Door #(s):
1107A 1107B

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	99-NL-SNB		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWB-12

For use on Door #(s):
1118.A

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	RAIN DRIP	142AA (OMIT IF UNDER CANOPY)		AA	ZER
1	EA	WEATHERSTRIPPING	PROVIDED BY DOOR MANUFACTURER			
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

Hardware Group No. HWB-13

For use on Door #(s):
1202 1203 1205

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	L9070P6 06A		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	COAT AND HAT HOOK	582		626	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWB-14

For use on Door #(s):
1212

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	ELECTRIC STRIKE	6210 FSE CON 12/16/24/28 VAC/VDC		630	VON
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER			
1	EA	WIRE HARNESS	CON X LENGTH AS REQ			VON
1	EA	POWER SUPPLY	PS902 120/240 VAC		LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED			DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RELEASE ELECTRIC STRIKE AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWB-15

For use on Door #(s):
E1309

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND80P6D RHO		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

EXISTING DOOR AND FRAME TO REMAIN. REPLACE HARDWARE. CLEAN, PATCH AND REPAIR EXISTING DOORS OF ALL HOLES AN PREPS.

Hardware Group No. HWB-16

For use on Door #(s):
E1310 E1311

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

EXISTING DOOR AND FRAME TO REMAIN. REPLACE HARDWARE. CLEAN, PATCH AND REPAIR EXISTING DOORS OF ALL HOLES AND PREPS.

Hardware Group No. HWB-17

For use on Door #(s):
E1312 E1313

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	PANIC HARDWARE	99-NL-SNB		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	MOUNTING PLATE	4040XP-18		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30		689	LCN
1	EA	RAIN DRIP	142AA (OMIT IF UNDER CANOPY)		AA	ZER
1	EA	WEATHERSTRIPPING	PROVIDED BY DOOR MANUFACTURER			
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

EXISTING FRAME TO REMAIN. REPLACE HARDWARE. CLEAN, PATCH AND REPAIR EXISTING PREP FOR NEW DOOR.

Hardware Group No. HWB-18

For use on Door #(s):
EG1 EG2 EG3 EG4

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PANIC HARDWARE	99-NL-OP-110MD-WH-SNB		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
	EA	BALANCE OF HARDWARE	GATE SUPPLIER			

Hardware Group No. HWB-19

For use on Door #(s):
1021

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

END OF SECTION

SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:

    a. Swinging doors.
    b. Gates.

2. Cylinders for door hardware specified in other Sections.
3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
4. Exit Devices
5. Keyways
6. Surface Closers

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Section 064113 "Wood-Veneer-Faced Architectural Cabinets" for cabinet door hardware provided with cabinets.
2. Section 081113 "Hollow Metal Doors and Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided as part of hollow-metal frames.
3. Section 081416 "Flush Wood Doors" for integral intumescent seals provided as part of labeled fire-rated assemblies.
4. Section 083113 "Access Doors and Frames" for access door hardware, except cylinders.
5. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead door assemblies.
6. Section 083326 "Overhead Coiling Grilles" for door hardware provided as part of overhead grille assemblies.
7. Section 084113 "Aluminum-Framed Entrances and Storefronts" for installation of entrance door hardware, including cylinders.
8. Section 102213 "Wire Mesh Partitions" for door hardware for doors in wire mesh partitions, except cylinders.
9. Section 281300 "Access Control" for access control devices installed at door openings and provided as part of a security system.

10. Section 281600 "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion-detection system.
11. Section 283111 "Digital, Addressable Fire-Alarm System" for connections to building fire-alarm system.
12. Section 283112 "Zoned (DC Loop) Fire-Alarm System" for connections to building fire-alarm system.

1.03 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
2. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems

1.04 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:

    a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.
    b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
    c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

    a. Wiring Diagrams: For power, signal, and control wiring and including:
        1) Details of interface of electrified door hardware and building safety and security systems.
        2) Schematic diagram of systems that interface with electrified door hardware.
        3) Point-to-point wiring.
        4) Risers.
        5) Operational Description of electrified door hardware.

3. Door Hardware Schedule:

    a. Submit concurrent with submissions of Product Data and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
    b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
    c. Indicate complete designations of each item required for each opening, include:
        1) Door Index: door number, heading number, and Architect’s hardware set number.
        2) Quantity, type, style, function, size, and finish of each hardware item.
        3) Name and manufacturer of each item.
        4) Fastenings and other pertinent information.
        5) Location of each hardware set cross-referenced to indications on Drawings.
        6) Explanation of all abbreviations, symbols, and codes contained in schedule.
        7) Mounting locations for hardware.
        8) Door and frame sizes and materials.
        9) Degree of door swing and handing.
        10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

4. Key Schedule:

    a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
    b. Use ANSI/BHMA A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
    c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
    d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
    e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
    f. Prepare key schedule by or under supervision of supplier, detailing Owner’s final keying instructions for locks and padlocks.

5. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.

   a. Provide Certificate of manufacturer training acceptable to Owner for each installer performing work of this Section.

2. Provide Product Data:

   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
   b. Include warranties for specified door hardware.

3. Provide Minutes of Preinstallation meetings.
4. Provide Field Quality Control Reports.
5. Provide Special warranties for products specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Factory order acknowledgement numbers (for warranty and service)
   d. Name, address, and phone number of local representative for each manufacturer.
   e. Parts list for each product.
   f. Final approved hardware schedule edited to reflect conditions as installed.
   g. Final keying schedule
   h. Copies of floor plans with keying nomenclature
   i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
   j. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

2. Bitting Schedule: For keying schedule for Project, reflecting decisions made in keying conference and modifications. Submit directly to CMS Locksmith no less than 45 days prior to Substantial Completion. Provide copy of transmittal only to Owner's Representative and to Architect.

1.05 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

   a. Warehousing Facilities: In Project's vicinity.
   b. Scheduling Responsibility: Preparation of door hardware and keying schedules.

c. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies like those indicated for this Project.
d. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
    1) Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

2. Manufacturer's Field Representative: A technical representative of the manufacturer not engaged in the sale of products who is experienced in the specification, installation, and maintenance of the specified products, qualified to perform inspection specified in 'FIELD QUALITY CONTROL' section herein.
3. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
4. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

    a. For door hardware: DHI certified AHC or DHC.
    b. Can provide installation and technical data to Architect and other related subcontractors.
    c. Can inspect and verify components are in working order upon completion of installation.
    d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

5. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:

    a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
    b. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:

    a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
    b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware

    a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:

a. Comply with governing accessibility regulations cited in “REFERENCES” article, herein for door hardware on doors in an accessible route.

C. Pre-Installation Meetings

1. Pre-installation Conference: Conduct conference at Project site. Attendees shall include door hardware supplier, door hardware installer, electrical subcontractor, Architect, Owner, and Owner’s security consultant if applicable.

a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Inspect and discuss preparatory work performed by other trades.
c. Inspect and discuss electrical roughing-in for electrified door hardware.
d. Review sequence of operation for each type of electrified door hardware.
e. Review required testing, inspecting, and certifying procedures.
f. Review questions or concerns related to proper installation and adjustment of door hardware.
g. Coordinate a hardware installation seminar to be conducted on the installation of locksets, exit devices, and door closers with Manufacturer’s representative. Training shall include use of installation manuals, hardware schedule, templates, and physical product samples. Submit minutes of seminar.

2. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Owner, Contractor, Installer, and Architect, conference participants shall also include Supplier's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Requirements for access control.
e. Address for delivery of keys.
f. Submit Minutes of conference.

3. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer’s original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys with key cabinet to Owner by registered mail or overnight package service.

1. Locksmith Department, Charlotte-Mecklenburg Schools, 3301 Stafford Drive, Charlotte, North Carolina 28208

1.07 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant and other applicable security subcontractors.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.08 WARRANTY

1. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

    a. Failures include, but are not limited to, the following:
        1) Structural failures including excessive deflection, cracking or breakage.
        2) Faulty operation of doors and door hardware.
        3) Deterioration of metals, metal finishes, and other material beyond normal weathering and use.

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
3. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer’s published listings.

    a. Mechanical Warranty
        1) Locks
            a) 3 year
        2) Exit Devices
            a) 3 year

3) Closers
   a) 25 year

b. Electrical Warranty
   1) Electric Strikes
      a) 5 year
   2) Exit Devices
      a) 10 year

c. Magnetic Door Holder
   a) 5 years

1.09 MAINTENANCE

A. Provide Door Hardware Allowance for additional attic stock as indicated by Project Type listed:

   1. Renovation & Additions: Coordinate with Owner

B. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approval of manufacturers and/or products other than those listed as “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

B. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fasteners

   1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
   2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
   3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners.
   4. Provide thru-bolts at door closers and exit devices.

5. Install hardware with fasteners provided by hardware manufacturer.

B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.

1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
2. Use materials which match materials of adjacent modified areas.
3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

D. Cable and Connectors: Hardwired Electrified Hardware and Exit Device Trim:

1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with enough and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES – BALL BEARING

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Ives 5BB series
b. Hager BB1191/1279 series
c. McKinney TA/T4A series
d. Stanley FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 48 inches (914 mm) wide:

a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 48 inches (914 mm) wide:

a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
6. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
7. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

    a. Steel Hinges: Steel pins
    b. Non-Ferrous Hinges: Stainless steel pins
    c. Out-Swinging Exterior Doors: Non-removable pins
    d. Out-Swinging Interior Lockable Doors: Non-removable pins
    e. Interior Non-lockable Doors: Non-rising pins

9. Tips: Flat button.
10. Corners: Square

2.04 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:

    a. Von Duprin EPT-10

2. Acceptable Manufacturers and Products:

    a. ABH PT1000
    b. Securitron CEPT-10

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer’s template and UL requirements, unless interference with operation of door or other hardware items.

2.05 FLUSH BOLTS

A. Manufacturers:

1. Acceptable Manufacturers:

    a. Ives
    b. Burns
    c. Rockwood
    d. Trimco

B. Requirements:

1. Provide constant latching and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for

each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 COORDINATORS

A. Manufacturers:

1. Acceptable Manufacturers:

a. Ives
b. Burns
c. Rockwood
d. Trimco

B. Requirements:

1. Where pairs of doors are equipped with constant latching flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.07 MORTISE LOCKS

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Schlage L9000 series x 06A lever
b. Sargent 8200 series x L lever
c. Corbin-Russwin ML2000 series x Newport lever

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

2.08 DEADBOLTS

A. Manufacturers and Products:

1. Acceptable Manufacturer and Products:

a. Schlage B600/B700/B800 Series
b. Corbin-Russwin DL3000 Series
c. Sargent 480 Series

B. Requirements:

1. Provide grade 1 deadbolt series conforming to ANSI/BHMA A156.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide deadbolts with standard 2-3/4 inches (70 mm) backset. Provide 2-3/8 inches (60 mm) where noted or if door or frame detail requires. Provide deadbolt with full 1-inch (25 mm) throw, constructed of steel alloy.
4. Provide manufacturer’s standard strike.

2.09 PADLOCKS:

A. Manufacturers and Products:

1. Acceptable Manufacturer and Products:

a. American Lock 5560 Series
b. Schlage KS Series
c. Sargent 758 Series

B. Requirements:

1. Provide padlocks with 1-inch (25 mm) shackle height, unless noted otherwise, as specified.
2. Cylinders: Contact CMS Locksmith for pinning instructions.

2.10 EXIT DEVICES

A. Manufacturers and Products:

1. Alternate Products: Subject to compliance with requirements, provide: Von Duprin 99/33A series
2. Base Bid Products: Subject to compliance with requirements, provide one of the following:

a. Von Duprin 99/33A series
b. Corbin-Russwin ED5000 series
c. Sargent 19-43-GL-80 series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to “KEYING” article, herein.

3. Provide grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as removable mullion, provide type that can be removed without a cylinder.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Rim Exit Devices: provide devices with non-tapered smart latchbolt with 90° latchbolt to strike engagement under stress and Static Load Resistance of 2000 pounds at exterior doors.
16. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
17. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
18. Provide one (1) hex/allen key for each exit device and removable mullion specified.
19. Provide exit devices with thru-bolt fasteners.

2.11 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Von Duprin 6000 Series.
b. Folger Adam 300 Series
c. HES 1006 Series

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.12 POWER SUPPLIES

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Schlage/Von Duprin PS900 Series
b. Sargent 3500 series
c. Securitron BPS series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:

a. 12/24 VDC Output, field selectable.
b. Class 2 Rated power limited output.
c. Universal 120-240 VAC input.
d. Low voltage DC, regulated and filtered.
e. Polarized connector for distribution boards.
f. Fused primary input.
g. AC input and DC output monitoring circuit w/LED indicators.
h. Cover mounted AC Input indication.
i. Tested and certified to meet UL294.
j. NEMA 1 enclosure.
k. Hinged cover w/lock down screws.
l. High voltage protective cover.

2.13 CYLINDERS

A. Manufacturers and Products:

1. Acceptable Manufacturers and Products:

a. Schlage Everest C
b. Corbin-Russwin Access 3
c. Sargent XC

B. Requirements:

1. Provide cylinders compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer’s series as indicated. Refer to “KEYING” article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.

a. Grade 1; Type M, mechanical; conventional patented open: cylinder with conventional core with open keyway.

3. Number of pins: Six
4. Permanent Core: Manufacturer’s standard, non-removable. Finish face to match lockset.
5. Type: As required at each device.
6. Patent Protection: Cylinders requiring use patented keys, patent protected.
7. Nickel silver bottom pins.

C. Construction Keying:

1. Temporary Construction Cylinder Keying.

    a. Provide construction cores that permit voiding construction keys without cylinder removal at openings indicated by Owner as hazard areas, furnished in accordance with the following requirements.
        1) Split Key or Lost Ball Construction Keying System.
        2) 10 construction control keys, and extractor tools or keys as required to void construction keying.
        3) 12 construction change (day) keys.

    b. Construction and operating keys shall not be part of the Owner's permanent keying system or furnished on the same keyway as the Owner's permanent keying system.
    c. Owner or Owner’s Representative will void operation of temporary construction keys.

2.14 KEYING

A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Manufacturers and Products:

1. Alternate Products: Subject to compliance with requirements, provide: Schlage C145 keyway
2. Base Bid Products: Subject to compliance with requirements, provide one of the following:

    a. Schlage C145
    b. Corbin-Russwin Access 3
    c. Sargent XC
    d. Grand Master Key System: Cylinders are operated by a change key, a master key, and a grand master key

3. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders involved at no additional cost to Owner.
4. Provide keys with the following features:

    a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
    b. Patent Protection: Keys and blanks protected by one or more utility patent(s).

5. Identification:

    a. Mark permanent cylinders and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
    b. Identification stamping provisions must be approved by the Architect and Owner.
    c. Stamp cylinders and keys with Owner’s unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with “DO NOT DUPLICATE” along with the “PATENTED” or patent number to enforce the patent protection.
    d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.

6. Cutting: Factory-cut keys.
7. Keys to be delivered by registered mail to the Owner. Change Keys to be provided in set up key control system. Construction keys shall be delivered to the Contractor.
8. Quantity: Furnish in the following quantities:

a. Change (Day) Keys: 3 per cylinder.
b. Master Keys: 6.
c. Grand Master Keys: 2.
d. Provide 100 blank keys for use by CMS Lockshop.

9. Keying System Coordination: Before factory order is placed, hardware supplier shall consult with CMS Maintenance Department to secure formal written approval of keying system and function.

    a. After installation of hardware and before acceptance of building, hardware supplier shall check each locked door against key symbol to make certain that correct locks and cylinders are on proper doors. For any incorrectly located cylinders, tag and relocate to proper location.

2.15 KEY CONTROL SYSTEM

A. Manufacturers:

1. Acceptable Manufacturers:

    a. Telkee
    b. Key Control
    c. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.

    a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
    b. Provide hinged-panel type cabinet for wall mounting equipped with pin-tumbler cylinder door lock.

2.16 KEY BOXES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. Knox Box, 3200 Series

B. Requirements:

1. Provide locked key box capable of storing four keys.
2. Provide key box capable of being surface mounted and recessed in exterior masonry.

2.17 DOOR CLOSERS

A. Manufacturers and Products:

1. Alternate Products: Subject to compliance with requirements, provided listed products of LCN 4040XP series
2. Base Bid Products: Subject to compliance with requirements, provide one of the following:

    a. LCN 4040XP series
    b. Corbin-Russwin DC8000 series
    c. Sargent 281 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter with 5/8-inch (16 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
11. Provide extra heavy duty arm when closer is to be installed using parallel arm mounting.
12. Unless otherwise specified, mount all closer parallel arm.
13. Unless specified, do not furnish closers with stop arm closer function.
14. Attach closers using thru-bolts supplied by manufacturer.
15. Provide closers with full metal covers supplied by manufacturer.

2.18 DOOR TRIM

A. Manufacturers:

1. Acceptable Manufacturers:

    a. Ives.
    b. Trimco
    c. Burns
    d. Rockwood

B. Requirements:

1. Provide push plates, pull plates, and pulls with diameter and length as scheduled.
2. Subject to compliance with requirements, provide the products of a single manufacturer.

2.19 PROTECTION PLATES

A. Manufacturers:

1. Acceptable Manufacturers:

a. Ives
b. Burns
c. Trimco
d. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. Provide counter sunk screw holes.
4. At fire rated doors, provide protection plates over 16 inches high with UL label.
5. Provide amor plates for loading dock doors and only as specified. All other applications Consult CMS Design Manager.

2.20 OVERHEAD STOPS

A. Manufacturers:

1. Acceptable Manufacturers:

a. Glynn-Johnson
b. Rixson
c. ABH

B. Requirements:

1. Provide overhead stops only where specified in locations where a wall stop, floor stop, or closer arm cannot be used.

2.21 DOOR STOPS

A. Manufacturers:

1. Acceptable Manufacturers:

a. Ives
b. Hager
c. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal dome type floor stops.

2.22 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Acceptable Manufacturers:

a. Zero International
b. National Guard
c. Reese

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Do not cut weatherstripping to install other hardware.
3. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
4. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency for sound ratings indicated, based on testing according to ASTME 1408. Provide gasketing suitable for installation in kerfed hollow metal frames where applicable.
5. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
6. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.
7. Exterior Doors: Provide rain drip at exterior hollow metal doors where door is not protected by canopy.

2.23 SILENCERS

A. Manufacturers:

1. Acceptable Manufacturers:

a. Ives
b. Burns
c. Rockwood
d. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.24 MAGNETIC HOLDERS

A. Manufacturers:

1. Acceptable Manufacturers:

a. LCN SEM Series
b. Rixson 990 Series

c. ABH 2000 Series

B. Requirements:

1. Provide wall mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.25 DOOR POSITION SWITCHES

A. Manufacturers:

1. Acceptable Manufacturers:

a. Schlage
b. GE-Interlogix
c. Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.26 LATCH PROTECTORS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Trimco
b. Rockwood

B. Provide stainless steel latch protectors of type required to function with specified lock.

2.27 COAT HOOKS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Rockwood

B. Provide coat hooks as specified.

2.28 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
3. Protection Plates: BHMA 630 (US32D)
4. Overhead Stops and Holders: BHMA 630 (US32D)
5. Door Closers: Powder Coat to Match
6. Wall Stops: BHMA 630 (US32D)
7. Latch Protectors: BHMA 630 (US32D)
8. Weatherstripping: Clear Anodized Aluminum
9. Thresholds: Mill Finish Aluminum

2.29 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Wood or Machine Screws: For the following:

a. Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
b. Strike plates to frames.

2. Steel Through Bolts: For the following:

a. Closers to doors and frames.
b. Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

D. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Where on-site modification of doors and frames is required:

1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
2. Field modify and prepare existing doors and frames for new hardware being installed.
3. When modifications are exposed to view, use concealed fasteners, when possible.
4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

    a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
    b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
    c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

H. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28, ELECTRONIC SAFETY AND SECRUTIY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Testing and labeling wires with Architect’s opening number.

I. Lock Cylinders: Install conventional cylinders and use construction key to secure building during construction period.

J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

L. Power Supplies: Power supplies for access control products including electric strikes, electrified exit devices, and card readers to be provided in Division 28 ELECTRONIC SAFETY AND SECURITY.

M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

Q. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

A. Inspection and Testing:

1. Provide functional testing and inspection of fire door assemblies by a qualified person in accordance with NFPA 80.

    a. Schedule fire door assembly inspection within 90 days of Substantial Completion of the Project.
    b. Submit a signed, written final report as specified in Paragraph 1.03.E.1.
    c. Correct all deficiencies and schedule a reinspection of fire door assemblies noted as deficient on the inspection report.
    d. Inspector to reinspect fire door assemblies after repairs are made.

2. Provide inspection of required egress door assemblies by a qualified person in accordance with NFPA 101.

    a. Schedule egress door assembly inspection within 90 days of Substantial Completion of the Project for the required openings.
    b. Submit a signed, written final report as specified in Paragraph 1.03.E.2.
    c. Correct all deficiencies and schedule a reinspection of egress door assemblies noted as deficient on the inspection report.
    d. Inspector to reinspect required egress door assemblies after repairs are made.

3.05 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

    1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
    2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.06 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer’s instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.07 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier’s responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

Building 6635
87754 X-77246 Version 4

Hardware Group No. HWC-01

For use on Door #(s):
32A E1314

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	PANIC HARDWARE	99-NL-SNB		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	RAIN DRIP	142AA (OMIT IF UNDER CANOPY)		AA	ZER
1	EA	WEATHERSTRIPPING	PROVIDED BY DOOR MANUFACTURER			
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER

Hardware Group No. HWC-02

For use on Door #(s):
1001

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	REMOVABLE MULLION	4954		689	VON
1	EA	PANIC HARDWARE	99-DT-SNB		626	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-NL-CON 24 VDC		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER			
1	EA	DOOR CONTACT	679-05		WHT	SCE
1	EA	REMOTE RELEASE	BY SECURITY PROVIDER			
1	EA	WIRE HARNESS	CON X LENGTH AS REQ			VON
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED			DLR
1	EA		WEATHERSTRIP BY DOOR/FRAME MANUFACTURER			

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.

2. DOOR FUNCTION: DOORS NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RETRACT LATCHBOLT AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS. DOORS MAY BE DOGGED FOR FREE ENTRY. REMOTE RELEASE AVAILABLE USING INTERCOM SYSTEM.

3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWC-03

For use on Door #(s):
1002

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	L9070P6 06A		626	SCH
1	EA	FLOOR STOP	FS436		626	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWC-04

For use on Door #(s):

1003	1009	1103	1104	1107	1110
1111	1201	1202	1204	1205	1207
1208A	1208B	1210	1211	1213	1214
1216	1217	1219	1222	1223	

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	L9070P6 06A		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWC-05

For use on Door #(s):

1004	1007	1008

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM W/DEADBOLT	L9480P6 06A 09-544 L283-722 (WITH INDICATOR)		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWC-06

For use on Door #(s):

1005	1006

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK WITH INDICATOR	L9040 06A 09-544 L283-722		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWC-07

For use on Door #(s):
1010 1011

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS436		626	IVE

Hardware Group No. HWC-08

For use on Door #(s):
1012 1013 1100 1101

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWC-09

For use on Door #(s):
1014

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	FLOOR STOP	FS436		626	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWC-10

For use on Door #(s):
1105 1106

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
2	EA	MANUAL FLUSH BOLT	FB458		626	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
2	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWC-11

For use on Door #(s):
1114

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	L9070P6 06A		626	SCH
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS436		626	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

Hardware Group No. HWC-12

For use on Door #(s):
1206

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-99-NL-CON 24 VDC		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC		689	LCN
1	EA	MOUNTING PLATE	4040XP-18		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30		689	LCN
1	EA	WEATHERSTRIPPING	PROVIDED BY DOOR MANUFACTURER			
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A-223		A	ZER
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER			
1	EA	DOOR CONTACT	679-05		WHT	SCE
1	EA	WIRE HARNESS	CON X LENGTH AS REQ			VON
1	EA	POWER SUPPLY	PS902 900-2RS 120/240 VAC		LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED			DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.

2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. VALID CREDENTIAL AT READER WILL RETRACT LATCHBOLT. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.

3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWC-13

For use on Door #(s):
1209

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080P6 06A		626	SCH
1	EA	ELECTRIC STRIKE	6210 FSE DS CON 12/16/24/28 VAC/VDC		630	VON
1	EA	SURFACE CLOSER	4040XP MC		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER			
1	EA	WIRE HARNESS	CON X LENGTH AS REQ			VON
1	EA	POWER SUPPLY	PS902 120/240 VAC		LGR	SCE
1	EA	WIRING DIAGRAM	AS REQUIRED			DLR

1. THE HARDWARE SUPPLIER SHALL COORDINATE THE ELECTRIFIED HARDWARE WITH ALL RELATED TRADES.
2. DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RELEASE ELECTRIC STRIKE AND ALLOW FOR ENTRY. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.
3. CREDENTIALS, READER, AND CONNECTIONS TO THE OWNER'S NETWORK PROVIDED BY ACCESS CONTROL PROVIDER. ALL OTHER WORK PROVIDED BY ELECTRICAL CONTRACTOR.

Hardware Group No. HWC-14

For use on Door #(s):
E1113A

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	MORTISE CYLINDER	AS REQ'D TO MATCH EXISTING		
1	EA	CREDENTIAL READER	BY SECURITY PROVIDER		
	EA	EXISTING HARDWARE TO REMAIN	EXISTING		

EXISTING DOOR AND HARDWARE TO REMAIN. PATCH AND REPAIR HOLES AND EXISTING PREPS. VERIFY DOOR FUNCTION AND APPLICATION PRIOR TO ORDERING HARDWARE. VERIFY EXISTING POWER AND LOW VOLTAGE FOR EXISTING ELECTRIC STRIKE.

DOOR FUNCTION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING VALID CREDENTIAL AT READER WILL RELEASE ELECTRIC STRIKE AND ALLOW FOR ENTRY. KEY OVERRIDE AVAILABLE. DOOR ALWAYS AVAILABLE FOR FREE EGRESS.

Hardware Group No. HWC-15

For use on Door #(s):
E1113B

Provide each door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1		HARDWARE BY MANUFACTURER		

Hardware Group No. HWC-16

For use on Door #(s):
E1313

Provide each door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	99-NL-SNB		626	VON
1	EA	RIM CYLINDER	20-021		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/65 AS REQ		GRY	IVE

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Glass for doors, interior borrowed lites, and curtainwall framing.
2. Interior applied window film.
3. Glazing sealants and accessories.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples for Selection: For each type of glass product; 12 inches square.

1. Architect will select from full array of insulating glass units that unit that most closely matches existing adjacent glazing units.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For glass.

1.5 QUALITY ASSURANCE

A. Manufacturer/Fabricator Qualifications: A qualified firm certified by the primary glass manufacturer employing technicians for this Project who are currently certified under the National Glass Association's Certified Glass Installer Program.

B. Installer Qualifications: Fabricator of glazing units, or qualified firm acceptable to fabricator employing technicians for this Project who are currently certified under the National Glass Association's Certified Glass Installer Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.8 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

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

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

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

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.

1. Design Wind Pressures: As indicated on Drawings.
2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.

    a. Wind Design Data: As indicated on Drawings.

3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.

C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

E. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

G. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.

H. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.3 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2. Roll Wave Maximum Distortion Tolerance: 0.003-inch target with 0.005-inch maximum peak to valley measurement.
3. Bow and Warp Maximum Tolerance: 50 percent of the maximum allowed in ASTM C 1048.

C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. Roll Wave Maximum Distortion Tolerance: 0.003-inch target with .005-inch maximum peak to valley measurement.
3. Bow and Warp Maximum Tolerance: 50 percent of the maximum allowed in ASTM C 1048

2.4 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral or ionomeric polymer interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer at Security Glazing: Type as required to meet performance requirements; refer to Glass Schedules in Part 3.
4. Interlayer Color: Clear unless otherwise indicated.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
2. Spacer: Thermally broken aluminum or stainless steel, painted black.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.
4. Edge Deletion: Delete low-E coating prior to fabrication of insulating units according to coated glass manufacturer’s instructions.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Low-Emitting Materials: Sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and

Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing, silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Dow Corning Corporation; 795 or 995
   b. GE Advanced Materials -Silicones; SilPruf NB SCS9000 or SilPruf SCS2000
   c. Pecora Corporation; 864 or 890.
   d. Tremco Incorporated; Spectrem 2

2. Applications: General applications in glazing installation subject to high movement including perimeter; use non-staining formula at absorbent perimeter applications.

C. Glazing Sealant: Neutral-curing, non-staining silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Dow Corning Corporation; 790
   b. GE AdvancedMaterials-Silicones; UltraGlaze SSG4000 or UltraGlaze SSG4000AC
   c. Tremco Incorporated; Proglaze SSG or Tremsil 600

2. Applications: General low movement applications in glazing installation including perimeter.

D. Glazing Sealant: One-part non-acidic moisture curing neutral-curing silicone glazing sealant complying with ASTM C 920 Class A, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Dow Corning Corporation; 790
   b. GE Advanced Materials - Silicones; SilPruf LM SCS2700
   c. Pecora Corporation; 890
   d. Tremco Incorporated; Spectrem 1

2. Applications: High movement joints at metal-to metal and glass to metal.

E. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.

1. Color: As selected by Architect from manufacturer's full range of colors.
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Dow Corning Corporation; 995 Silicone Structural Sealant.
   b. Pecora Corporation; 896.
   c. Tremco Incorporated; Proglaze II.

3. Applications: Locations utilizing full structural glazing or two-sided structural glazing. Refer to glazing framing section for requirements.

2.7 INTERIOR BUTT GLAZING PREFORMED SEALANT

A. Clear Copolymer Strip: For 180 deg. Glass to glass joints for 1/2-inch-thick glazing units.

1. Product: CRL, Clear Copolymer Strip #EZCC12.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 GLAZING FILMS

A. Transparent clear polyester film with solvent-based polyacrylate adhesive backing and removable protective sheet backing made for permanent application to interior side of exterior insulating glass units.

1. Product: 3M FASARA Glass Finishes.
2. Finish and Color: As scheduled.

2.11 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 FILM INSTALLATION

A. Install in accordance with manufacturer's instructions.

1. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
2. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
3. Apply film to glass and lightly spray film with slip solution.
4. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
5. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.

B. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.8 CLEANING AND PROTECTION

A. Immediately after installation remove non-permanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.9 MONOLITHIC GLASS SCHEDULE

A. **Glass Type MG#1**: Clear fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing label required.
3. Application: Glazing openings not requiring insulating glass.

B. **Glass Type MG#2**: Clear fully tempered float glass at butt-glazed applications.

1. Minimum Thickness: 12 mm.
2. Safety glazing label required.
3. Application: Where butt-glazed glass is indicated at interior openings.

3.10 LAMINATED GLASS SCHEDULE

A. **Glass Type LG#1**: Clear laminated acoustical glass, with two plies of fully tempered float glass.

	Unit thickness	Glass ply	Interlayer	STC
1.	1/2" nominal	1/4"	.030" PVB	38

3.11 INSULATING GLASS SCHEDULE

A. Insulating Glass Units, General: Provide visual match to existing adjacent glazing units.

B. **Glass Type IG#1**: Clear insulating glass.

1. Overall Unit Thickness: 1 inch.
2. Outdoor Lite: Clear annealed float glass, except heat-strengthened float glass where required, and fully tempered float glass where safety glass is indicated.

a. Minimum Thickness of Outdoor Glass Lite: 6 mm.

3. Interspace Content: Air.

4. Indoor Lite: Clear annealed float glass, except heat-strengthened float glass where required, and fully tempered float glass where safety glass is indicated.

    a. Minimum Thickness of Indoor Glass Lite: 6 mm.

5. Winter Nighttime U-Value: 0.47
6. Visible Light Transmittance: 80 percent minimum.
7. Solar Heat Gain Coefficient: 0.73 maximum.
8. Outdoor Visible Light Reflectance: 15 percent maximum
9. Safety glazing label where required.

C. **Glass Type IG#2**: Low-E-coated, clear insulating glass.

1. Overall Unit Thickness: 1 inch.
2. Outdoor Lite: Clear annealed float glass, except heat-strengthened float glass where required, and fully tempered float glass where safety glass is indicated.

    a. Minimum Thickness of Outdoor Glass Lite: 6 mm.
    b. Low-E Coating: Sputtered on second surface.
    c. Basis of Design Product: Guardian Industries, Inc., SunGuard SN 68 on Clear.

        1) Comparable Product: Vitro Architectural Glazing (formerly PPG), Solarban 60.
        2) Comparable Product: Viracon, VE1-2M.

3. Interspace Content: Air.
4. Indoor Lite: Clear annealed float glass, except heat-strengthened float glass where required, and fully tempered float glass where safety glass is indicated.

    a. Minimum Thickness of Indoor Glass Lite: 6 mm.

5. Winter Nighttime U-Value: 0.29
6. Visible Light Transmittance: 68 percent minimum.
7. Solar Heat Gain Coefficient: 0.38 maximum.
8. Outdoor Visible Light Reflectance: 11 percent maximum
9. Safety glazing label where required.

END OF SECTION 088000

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SECTION 090171 – REHABILITATION OF CEMENT PLASTER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes rehabilitation of exterior cement plaster work including:

1. Metal lath.
2. Base-coat cement plaster.
3. Cement plaster finish coats.
4. Accessories.

B. Related Information:

1. Section 024119 "Selective Demolition."
2. Section 099213 "Exterior Painting" for painting cement plaster.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

C. Samples for Verification: For each type of factory-prepared finish coat and for each color and texture specified, 12 by 12 inches, and prepared on rigid backing.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.5 FIELD CONDITIONS

A. Comply with ASTM C926 requirements.

B. Exterior Plasterwork:

1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
2. Apply plaster when ambient temperature is greater than 40 deg F.
3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain plaster materials from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E119 by a qualified testing agency.

2.3 METAL LATH

A. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.

1. Diamond-Mesh Lath: Flat and Self-furring, 3.4 lb./sq. yd.

2.4 BASE-COAT CEMENT PLASTER

A. General: Comply with ASTM C926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. of cementitious materials.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

2.5 CEMENT PLASTER FINISH COATS

A. Job-Mixed Finish-Coat Mixes:

2.6 ACCESSORIES

A. General: Comply with ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Cornerite: Fabricated from metal lath with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
2. External- (Outside-) Corner Reinforcement: Fabricated from metal lath with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
3. Cornerbeads: Fabricated from zinc zinc-coated (galvanized) steel or anodized aluminum.

a. Smallnose cornerbead with expanded flanges; use unless otherwise indicated.
b. Smallnose cornerbead with perforated flanges; use on curved corners.
c. Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
d. Bullnose cornerbead, radius 3/4 inch minimum, with expanded flanges; use at locations indicated on Drawings.

4. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
5. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.

2.7 PLASTER MATERIALS

A. Portland Cement: ASTM C150/C150M, Type II.

1. Color for Finish Coats: White.

B. Lime: ASTM C206, Type S; or ASTM C207, Type S.

C. Sand Aggregate: ASTM C897.

1. Color for Job-Mixed Finish Coats: White.

2.8 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch long, free of contaminants, manufactured for use in cement plaster.

C. Bonding Compound: ASTM C932.

D. Fasteners for Attaching Metal Lath to Substrates: ASTM C1063.

E. Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Inspect existing plaster to determine plaster is adequately bonded to substrate. Mark unsound areas for replacement.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare smooth, solid substrates for plaster according to ASTM C926.

C. Remove plaster that is found to not be adequately bonded to substrate.

3.3 INSTALLATION OF METAL LATH

A. Metal Lath: Install according to ASTM C1063.

1. On Solid Surfaces, Not Otherwise Furred: Install self-furring, diamond-mesh lath.

3.4 INSTALLATION OF ACCESSORIES

A. Install according to ASTM C1063 and at locations indicated on Drawings.

B. Reinforcement for External (Outside) Corners:

1. Install lath-type, external-corner reinforcement at exterior locations.
2. Install cornerbead at interior locations.

C. Control Joints: Locate as approved by Architect for visual effect and as follows:

1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:

a. Size panels to match existing spacing of control joints.

2. At distances between control joints of not greater than 18 feet o.c.
3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
4. Where control joints occur in surface of construction directly behind plaster.
5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.5 APPLICATION OF BASE-COAT CEMENT PLASTER

A. General: Comply with ASTM C926.

1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces when measured by a 10-foot straightedge placed on surface.
2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Apply on substrates where plaster is to be direct applied due to inability to properly attach metal lath.

C. Walls: Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork with 3/4-inch total thickness, as follows:

1. Portland cement mixes.

D. Walls: Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having 1/2-inch thickness on masonry and 3/8-inch thickness on concrete, as follows:

1. Portland cement mix.

E. Walls: Overall thickness of plaster application including finish coats to match existing.

3.6 APPLICATION OF CEMENT PLASTER FINISH COATS

A. Plaster Finish Coats: Apply to provide float finish to match Architect's sample.

3.7 REPAIR

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.8 CLEANING

A. Remove temporary protection and enclosure of other work after plastering is complete.

B. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered.

C. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 090171

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SECTION 092116 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gypsum board shaft wall assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements in accordance with Section 018113.

1.3 DELIVERY, STORAGE, AND HANDLING

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

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.

B. Do not install finish panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E90 and classified according to ASTM E413 by a testing and inspecting agency.

2.2 SUSTAINABLE DESIGN REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection as indicated in Section 018113, including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Insulation.

2.3 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Fire-Resistance Rating: As indicated on Drawings.

B. STC Rating: As indicated on Drawings.

C. Gypsum Shaftliner Board:

1. Moisture- and Mold-Resistant Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D3273 mold-resistance score of 10 as rated according to ASTM D3274, 1 inch thick, and with double beveled long edges.

D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.

1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A653/A653M, G40 unless otherwise indicated.

E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:

1. Depth: As indicated.
2. Minimum Base-Metal Thickness: 0.030 inch.

F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.

1. Minimum Base-Metal Thickness: Matching steel studs.

G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

H. Finish Panels: Gypsum board as specified in Section 092900 "Gypsum Board," or Cementitious backer units as specified in Section 092900 "Gypsum Board" where applicable.

I. Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board."

2.4 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.
2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E1190 conducted by a qualified testing agency.

E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch minimum thickness of base metal (uncoated).

F. Acoustical Sealant: Section 079219 "Acoustical Joint Sealants."

G. Gypsum Board Cants:

1. Gypsum Board Panels: As specified in Section 092900 "Gypsum Board," Type X, 1/2- or 5/8-inch panels.
2. Adhesive: Laminating adhesive as specified in Section 092900 "Gypsum Board."
3. Non-Load-Bearing Steel Framing: As specified in Section 092216 "Non-Structural Metal Framing."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fire Protection."

B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.

B. Do not bridge building expansion joints with shaft wall assemblies, frame both sides of expansion joints with furring and other support.

C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

1. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.

D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.

F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

G. Control Joints: Install control joints at locations indicated on Drawings, or if not indicated, locate according to ASTM C840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.

I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet, or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092116

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."

B. Manufacturer Stud Height and Deflection Limitation Charts: Manufacturer's standard charts with applicable selected studs indicated, consistent with minimum requirements in Part 2.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For embossed steel studs and runners and firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

B. Evaluation Reports: For firestop tracks, post-installed anchors, and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association, or the Supreme Steel Framing System Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.

D. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. minimum as required by building code.

E. Horizontal Deflection Limits: L/240, except L/360 for partitions faced with tile.

F. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with AISI S220 for conditions indicated.

1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated.

2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.

a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.

B. Studs and Track: AISI S220.

1. Steel Studs and Tracks:

a. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection, but not less than 0.0296.

b. Minimum Base-Steel Thickness: At framing to receive cementitious tile backer units or impact-resistant gypsum board: 0.0329 inch.
c. Depth: As indicated on Drawings.

C. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C645 steel studs and tracks.

1. Minimum Base-Steel Thickness: As required by horizontal deflection performance requirements.

2. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection, but not less than 0.0190.
3. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. 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) ClarkDietrich Building Systems.
2) Fire Trak Corp.
3) MarinoWARE.
4) Steel Construction Systems.

E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ClarkDietrich Building Systems.
b. Fire Trak Corp.
c. MarinoWARE.
d. Steel Construction Systems.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0329 inch.

G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.

1. Depth: 1-1/2 inches unless otherwise indicated on Drawings.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.0179 inch.
2. Depth: 7/8 inch unless otherwise indicated on Drawings.

I. Resilient Furring Channels: Steel sheet members designed to reduce sound transmission.

1. Product: ClarkDietrich, RC Deluxe (RCSD).
2. Configuration: Single leg.

J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: 3/4 inch.
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

B. Hanger Attachments to Concrete:

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.

1. Depth: 1-1/2 inches.

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
2. Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.0269 inch.
b. Depth: 3-5/8 inches unless otherwise indicated on Drawings.

3. Embossed Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.0190 inch.
b. Depth: 3-5/8 inches unless otherwise indicated on Drawings.

4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

a. Minimum Base-Metal Thickness: 0.0179 inch.

5. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical or hat shaped.

G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

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

a. Armstrong World Industries, Inc.
b. Rockfon (Rockwool International).
c. USG Corporation.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

C. Outlet Box Isolation Pad: Resilient acoustical and fire-resistant wall opening protective material for isolation and sealing of electrical outlets in wall construction, UL-classified.

1. Basis of Design Product: Kinetics Noise Control, Inc., Isobacker Acoustical Outlet Backer Putty Pad www.kineticsnoise.com/arch/isobacker.html.

D. Partial Wall Framing Connection to Floor: Configured to support out-of-plane loading of cantilevered partial wall systems that are unsupported at the top track:

1. Basis of Design Product: Pony Wall, by ClarkDietrich.
2. Web Depth: 3-5/8 inches.
3. Anchor Plate: 2-3/8 b 5-1/2 by 3/8 inches.
4. Height: Use tallest manufactured item that will fit application.

E. Hand-Formable Track:

1. Basis of Design Product: Hand-Formable Ready-Track, by Radius Track Corporation.
2. Web Depth: 3-5/8 inches.
3. Flange Height: 1-1/4 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, wall-mounted door stops, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
2. Multilayer Application: 24 inches o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

6. Curved Partitions:

   a. Bend hand-formable track to uniform curve and locate straight lengths so they are tangent to arcs.

E. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Outlet Box Isolation Pad Installation: At sound rated partitions and walls, following installation of electrical wiring, remove release paper and cover back and exposed sides of outlet box in accordance with outlet box manufacturer's installation instructions.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 24 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.

6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
2. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

1.3 DELIVERY, STORAGE AND HANDLING

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

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Where schedules require installation of panels prior to weathertight enclosure, use mold and moisture resistant products at exterior walls and in other areas subject to potential wetting.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Composite Wood or Agrifiber Products.
3. Low-Emitting Materials: Insulation.

2.3 GYPSUM BOARD, GENERAL

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

2.4 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

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

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

C. Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.

1. Basis-of-Design Product: Subject to compliance with requirements, provide National Gypsum Company; Hi-Abuse Brand XP Fire-Shield Wallboard or a comparable product by one of the following:

a. CertainTeed Corporation.
b. Georgia-Pacific Gypsum LLC.
c. USG Corporation.

2. Core: 5/8 inch (15.9 mm), Type X.
3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.

5. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
6. Long Edges: Tapered.
7. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

D. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Basis-of-Design Product: Subject to compliance with requirements, provide National Gypsum Company; Gold Bond Brand XP Wallboard or a comparable product by one of the following:

   a. CertainTeed Corporation.
   b. Georgia-Pacific Gypsum LLC.
   c. USG Corporation.

2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

   a. Cornerbead.
   b. Bullnose bead.
   c. LC-Bead: J-shaped; exposed long flange receives joint compound.
   d. L-Bead: L-shaped; exposed long flange receives joint compound.
   e. Expansion (control) joint.

B. General: Comply with ASTM C 475/C 475M.

C. Joint Tape:

1. Interior Gypsum Board: Paper.

D. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.

E. Joint Compound for Mold-Resistant Gypsum Board Products: Use product recommended by gypsum board panel manufacturer for application.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Low-Emitting Materials: Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

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

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Vertical surfaces unless otherwise indicated.
2. Ceiling Type: Ceiling surfaces.
3. Abuse-Resistant and Mold-Resistant Type: Vertical surfaces to 8 feet AFF in the following:

a. Janitor closets.
b. Group Toilet Rooms.
c. Mechanical rooms.
d. Areas indicated to receive epoxy paint.
e. As additionally indicated on Drawings.

4. Mold-Resistant Type: Areas finished prior to building enclosure and as indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings, or if not indicated, according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. Bullnose Bead: Use where indicated.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
3. Level 5: At wall mounted graphics indicated on Drawings.

3.6 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

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SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Stone thresholds.
3. Tile backing panels.
4. Waterproof membrane for thinset applications.
5. Crack isolation membrane.
6. Metal edge strips.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.2 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Stone thresholds in 6-inch lengths.
4. Metal edge strips in 6-inch lengths.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

D. Installation Schedule: Provide written description of installation methods and procedures to be used at each type of installation required. Cross reference to Installation Types Schedule in Part 3. Include copies of TCNA Installation Methods cited.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to one full package or container installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Experienced installer employing workers trained by manufacturer of installation materials, with record of successful performance on similar projects.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.9 COORDINATION

A. Coordinate locations and depth required for slab depressions for installation of ceramic tile.

1. Provide minimum 2 inch deep slab depression at quarry tile.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient and substrate temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Installation Materials: Obtain surface preparation materials and setting and grouting materials from single listed manufacturer.

1. Provide waterproof membrane and crack isolation membrane manufactured by or approved by manufacturer of installation materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single listed manufacturer:

1. Stone thresholds.
2. Cementitious backer units.
3. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.3 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials: Adhesives and Sealants.

2.4 TILE PRODUCTS

A. Tile Type **CTP**: Unglazed paver tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated schedules or comparable product by one of the following:

a. American Olean; Division of Dal-Tile International Inc.
b. Crossville, Inc.
c. Daltile; Division of Dal-Tile International Inc.
d. Florida Tile Industries, Inc.
e. United States Ceramic Tile Company.

2. Composition: Porcelain.
3. Face Size: Nominal 6 by 6 inches, unless otherwise scheduled.
4. Thickness: [**3/8 inch**] [**1/2 inch**].
5. Face: Plain with cushion edges.
6. Tile Color and Pattern: As selected by Architect from manufacturer's full range of through-color unglazed paver tiles consisting of:

a. Color Group 1, Color Group 2, Color Group 3.

7. Grout Color: As selected by Architect from manufacturer's full range.

2.5 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of [**10**] [**12**] per ASTM C 1353 or ASTM C 241 and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.6 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, with manufacturer's standard edges.

1. Thickness: 5/8 inch.
2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.7 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following, which complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Low-Emitting Materials: Membrane shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Bonsal American, an Oldcastle company; B 6000 Waterproof-Crack Isolation Membrane.
b. Laticrete International, Inc.; Laticrete Hydro Barrier.
c. MAPEI Corporation; Mapelastic AquaDefense.
d. TEC; H.B. Fuller Construction Products Inc.; HydraFlex - Waterproofing Crack Insolation Membrane.

2.8 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following, which complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Low-Emitting Materials: Membrane shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Bonsal American, an Oldcastle company; B 6000 Waterproof-Crack Isolation Membrane.
b. Laticrete International, Inc.; Latricete Hydro Ban.
c. MAPEI Corporation; Mapelastic AquaDefense.
d. TEC; H.B. Fuller Construction Products Inc.; HydraFlex - Waterproofing Crack Insolation Membrane.

D. Fabric-Reinforced, Modified-Bituminous Sheet: Where required for relocating control joints: Self-adhering, modified-bituminous sheet with fabric reinforcement facing; 0.040-inch (1-mm) nominal thickness.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Boiardi Products Corporation; a QEP company; Elastiment 340 Sound Control Sheet Membrane Waterproofing and Anti-Fracture/Crack Suppression System.
b. Custom Building Products; Crack Buster Pro-Crack Prevention Mat Underlayment.
c. MAPEI Corporation; Mapeguard™ 2.
d. National Applied Construction Products, Inc.; ECB Anti-Fracture Membrane.

2.9 SETTING MATERIALS

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

1. Bonsal American, an Oldcastle company.
2. Laticrete International, Inc.
3. MAPEI Corporation.
4. TEC; H.B. Fuller Construction Products Inc.

B. Latex-Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.
2. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

C. High-Performance Latex-Portland Cement Mortar (Thinset): ANSI A118.15.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.15.

D. High-Performance Medium-Bed, Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.15. Provide product that is approved by manufacturer for application thickness of 3/4 inch.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

2.10 GROUT MATERIALS

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

1. Bonsal American, an Oldcastle company.
2. Laticrete International, Inc.
3. MAPEI Corporation.
4. TEC; H.B. Fuller Construction Products Inc.

B. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.11 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; half-hard brass or white zinc alloy exposed-edge material as selected by Architect.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

D. Joint Sealant: Silicone, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, Shore A hardness not less than 35, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Uses T and NT.

2.12 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Tile floors in wet areas.
    b. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Quarry Tile: 1/4 inch.
2. Glazed Wall Tile: 1/16 inch.
3. Porcelain Tile: 1/4 inch.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where expansion and isolation joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Where saw-cut crack control joints occur in slabs on ground, relocate joint to nearest tile grout joint using fabric-reinforced, modified-bituminous sheet crack isolation membrane per TCNA F125 Partial.

J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thinset).
2. Do not extend cleavage membrane waterproofing or crack isolation membrane under thresholds set in latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane waterproofing or crack isolation membrane with elastomeric sealant.

K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated, and at locations indicated.

3.4 TILE BACKING PANEL INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.6 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

C. Fabric-Reinforced, Modified-Bituminous Sheet: Use where required to bridge existing cracks and to relocate crack control joints to coordinate with nearest tile grout joint: Install in accordance with manufacturer's instructions. Clean and prime concrete surface and allow primer to dry. Set self-adhering sheet in place, remove release sheet, and roll sheet to ensure full contact with substrate.

3.7 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.8 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.9 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations:

1. Ceramic Tile Installation CTF#4: TCNA F122; medium-bed mortar on full waterproofing membrane.

a. Ceramic Tile Type: Unglazed porcelain pavers.
b. Mortar: Medium-bed, latex- portland cement mortar.
c. Grout: Water-cleanable epoxy grout ANSI 108.6.
d. Fluid-applied waterproofing membrane.
e. Application: Toilet rooms on above-ground slab without slope to drain. Extend waterproofing membrane to drain flanges and flashed up perimeter walls and in-field interruptions including columns, chases, and wing walls to form watertight installation.

B. Interior Wall Installations, Metal Studs or Furring:

1. Ceramic Tile Installation CTW#2: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units.

a. Ceramic Tile Type: Unglazed porcelain pavers.
b. Thinset Mortar: Latex- portland cement mortar.
c. Grout: Water-cleanable epoxy grout.

END OF SECTION 093013

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SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which suspension systems will be attached.
3. Size and location of initial access modules for acoustical panels.
4. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Communication and security devices.
    e. Sprinklers.
    f. Access panels.

5. Perimeter moldings.

1.5 CLOSEOUT SUBMITTALS

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

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: The greater of 1 percent or two full boxes of each type, color, pattern or size installed.

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical ceiling area as shown on Drawings.
2. Coordinate with separate trades in include all ceiling-mounted items indicated on Reflected Ceiling Plans or Coordination Drawings.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.9 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
2. Smoke-Developed Index: 50 or less.

C. Ceiling products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 ACOUSTICAL PANELS, GENERAL

A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.

B. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance's unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

E. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

F. Low-Emitting Materials: Acoustical panel products shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 ACOUSTICAL PANELS

A. Water-Felted, Mineral-Base Acoustical Panels for Acoustical Panel Ceiling **APC#1.**

1. Approved Products:

a. Armstrong, Fine Fissured 1728.
b. USG, Radar ClimaPlus 2210.
c. CertainTeed Fine Fissured HHF-157.

2. Color: White.
3. LR: Not less than 0.80.
4. NRC: Not less than 0.55.
5. CAC: Not less than 30.
6. Edge Detail: Square.
7. Thickness: 5/8 inch.
8. Size: 24 by 24 inches.
9. Sag resistant.
10. Formaldehyde: Less than 13.5 ppb per ASHRAE Standard 62.
11. Application: All applications unless otherwise indicated.

B. Water-Felted, Mineral-Base Acoustical Panels for Acoustical Panel Ceiling **APC#2.**

1. Approved Products:

a. Armstrong, Fine Fissured High NRC 1713.
b. USG, Radar ClimaPlus 22111 (FC).
c. CertainTeed Fine Fissured High NRC HHF-457-DP.

2. Color: White.
3. LR: Not less than 0.85.
4. NRC: Not less than 0.70.

5. CAC: Not less than 35.
6. Edge Detail: Square.
7. Thickness: 3/4 inch.
8. Size: 24 by 24 inches.
9. Sag resistant.
10. Formaldehyde: Less than 13.5 ppb per ASHRAE Standard 62.
11. Application: Instructional areas except where indicated.

C. Glass-Fiber-Base Acoustical Panels with Membrane-Faced Overlay for Acoustical Panel Ceiling **APC#3.**

1. Products:

   a. Armstrong, Optima 3150.
   b. USG Halcyon ClimaPlus 97221.
   c. CertainTeed Symphony f 1322-OVT-1.

2. Color: White.
3. LR: Not less than 0.85.
4. NRC: Not less than 0.85.
5. AC: Not less than 180.
6. Edge Detail: Square.
7. Thickness: 3/4 inch.
8. Size: 24 by 24 inches.
9. Sag resistant.
10. Formaldehyde: Less than 13.5 ppb per ASHRAE Standard 62.
11. Application: Music rehearsal spaces, Multipurpose Rooms, and as indicated.

D. High-Density, Wet-Formed Mineral Fiber Acoustical Panels With Scrubbable Finish For Acoustical Panel Ceiling **APC#5**:

1. Products:

   a. Armstrong, Armatuff Medium Texture 861.
   b. USG, Rock Face ClimaPlus 56335.

2. Color: White.
3. LR: Not less than 0.85.
4. NRC: Not less than 0.50.
5. CAC: Not less than 35.
6. Edge Detail: Square.
7. Thickness: ¾ inch.
8. Modular Size: 24 by 24 inches.
9. Sag resistant.
10. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.
11. Formaldehyde: Less than 13.5 ppb per ASHRAE Standard 62.
12. Application: Wet or humid areas.

2.4 SUSPENDED SPECIALTY ACOUSTIC PANELS

A. Fabric acoustic partition consisting of PET felt board, 9 mm thick, NRC 0.50, ASTM E84 Class A, suspended in horizontal orientation from overhead using panel manufacturer's standard suspension components.

1. Product: Turf, Static Wall.
2. Pattern and Color: As selected by Architect from manufacturer's full line.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

    a. Type: Postinstalled expansion anchors.
    b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: In wet locations: ASTM A 580/A 580M, Type 304, nonmagnetic.
3. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire, except use 0.135-inch-diameter wire in locker room, shower, and swimming pool areas.

2.6 METAL SUSPENSION SYSTEMS FOR ACOUSTICAL PANEL CEILING

A. Wide-Face, Capped, Double-Web, Steel Suspension System **SUS#1**: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16-inch-wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system, except heavy-duty where indicated.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Steel cold-rolled sheet.
5. Cap Finish: Painted white.
6. Application: General use unless otherwise indicated.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design

requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
2. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

A. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated. Extend insulation 48 inches (1219 mm) up either side of partitions. Refer to Division 09 Section "Gypsum Board" for material requirements.

3.5 CLEANING

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

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base.
2. Rubber stair accessories on monumental stairs.
3. Resilient molding accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Samples for Initial Selection: For each type of product indicated.

D. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

E. Product Schedule: For resilient base and accessory products.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.4 COORDINATION

A. For concrete pan stairs to receive resilient stair accessories, coordinate finishing requirements for concrete in accordance with stair accessory and adhesive manufacturer's written recommendations.

1.5 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Low-Emitting Materials: Resilient base and accessories shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 THERMOSET-RUBBER BASE

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

1. Burke Mercer Flooring Products, Division of Burke Industries Inc.
2. Flexco.
3. Roppe Corporation, USA.

B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:

a. Style A, Straight: Provide in areas with carpet.
b. Style B, Cove: Provide in areas with resilient flooring and exposed concrete.

C. Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors: As selected by Architect from manufacturer's full line.

2.3 RUBBER STAIR ACCESSORIES

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following if providing acceptable match to scheduled products:

1. Armstrong World Industries, Inc.
2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
3. Flexco.

4. Johnsonite; a Tarkett company.

C. Stair Treads: ASTM F2169.

1. Type: TS (rubber, vulcanized thermoset).
2. Class: 2 (pattern; embossed, grooved, or ribbed).
3. Group: 1 (embedded abrasive strips) 2 (with contrasting color for the visually impaired).
4. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
5. Nosing Height: 1-1/2 inches.
6. Thickness: 1/4 inch and tapered to back edge.
7. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, in equal-length units.

D. Separate Risers: Smooth, flat; in height that fully covers substrate; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

1. Style: Coved toe, 7 inches high by length matching treads.
2. Thickness: Manufacturer's standard.

E. Landing Tile: Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

F. Locations: Provide rubber stair accessories in areas indicated.

G. Colors and Patterns: As indicated by manufacturer's designations.

2.4 RUBBER MOLDING ACCESSORIES

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

1. Roppe Corporation, USA.
2. VPI Corporation.

B. Description: Rubber carpet edge for glue-down applications; nosing for carpet; nosing for resilient flooring; reducer strip for resilient flooring; joiner for tile, and carpet transition strips.

C. Profile and Dimensions: As required by applications.

D. Colors and Patterns: As selected by Architect from full range of industry colors for each application.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Low-Emitting Materials: Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and

Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Adhesive, Rubber Stair Treads and Risers: Two-part epoxy adhesive formulated for use in applying rubber stair treads to concrete-filled metal pan stairs.

1. Available Product: R.C. Musson, No. 775 Epoxy Adhesive.

D. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 6 inches in length.

    a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 6 inches in length.

    a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

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SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid vinyl floor tile (LVT).

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Shop Drawings: For each type of resilient floor tile.

1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

E. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

B. Mockups: Build in-place mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.

a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Flooring.
3. Certified Flooring Products - SCS Floorscore.

2.3 MANUFACTURERS

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 Flooring, Inc.
2. Mannington Commercial.
3. Patcraft; a division of Shaw Industries, Inc.
4. Shaw Contract Group.
5. Tarkett North America.

2.4 SOLID VINYL FLOOR TILE (LVT)

A. Tile Standard: ASTM F1700.

1. Class: Class III, Printed Film Vinyl Tile.
2. Type: B, Embossed Surface.

B. Thickness: 0.125 inch.

C. Size: As indicated on Drawings.

D. Colors and Patterns: As scheduled on Drawings.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

C. Adhesives, High Moisture: Water-resistant high-moisture type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions.

1. Use adhesives approved by tile flooring manufacturer for installation on floor slabs with up to 7 lb. of vapor pressure, relative humidity of up to 90 percent, and pH up to 10.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING OF NEW RESILIENT TILE

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

END OF SECTION 096519

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SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes modular carpet tile.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.
d. Review protection of installed carpeting.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For flooring products, indicating compliance with requirements for testing and product requirements of CRI's "Green Label Plus" testing program.
5. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.
6. Carpet Reclamation Plan: Submit written plan indicating carpet manufacturer's reclamation plan details for new carpet specified in this Section and for recycling of carpet indicated to be removed.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

1. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

C. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.

8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and Project name.

1. Carpet Tile: The greater of 5 percent or 10 square yards of each type, color and pattern installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer with a record of successful projects of similar type and scope, approved by manufacturer to install specified product.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI's "CRI Carpet Installation Standard."

1.9 FIELD CONDITIONS

A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 10 percent edge raveling, snags, and runs.
b. Dimensional instability.
c. Excess static discharge.
d. Loss of tuft-bind strength.
e. Loss of face fiber.
f. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Carpet Reclamation Program Requirement: Provide carpet covered under manufacturer's carpet reclamation program comparable to California Carpet Stewardship program. Submit reclamation plan and certification.

2.2 CARPET TILE

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the listed manufacturers approved by Architect prior to submittal of bid. Comparable product to be determined by Architect as equal to Basis of Design product in design, pattern, color, texture, construction and sustainability components:

1. Interface, LLC.
2. Mohawk Group (The); Mohawk Carpet, LLC.
3. Shaw Contract Group; a Berkshire Hathaway company.
4. Tandus; a Tarkett company.

B. Fiber and Pile:

1. Fiber Content: Premium branded nylon, yarn or solution dyed.
2. Pile Characteristic: Level-loop or multi-level loop pile to match scheduled product.
3. Face Weight: 17 oz. /sy minimum and not less than scheduled product.
4. Density: 6,000 oz. /sy minimum and not less than scheduled product.

C. Backing:

1. Primary: Reinforced synthetic with high performance precoat.
2. Secondary: Closed cell thermoplastic compound (non-PVC).

D. Size: As selected from manufacturer's standard sizes.

E. Performance Characteristics:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D 2646.
4. Tuft Bind: Not less than 6 lbf according to ASTM D 1335.
5. Delamination: Not less than 3.5 lbf/in. according to ASTM D 3936.
6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
8. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
9. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
10. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum relative humidity level measurement acceptable to adhesive manufacturer.
    b. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable cementitious leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

E. Water Vapor Barrier Preparation: Use where floor slab moisture levels exceed requirements. Refer to Section 090561 "Moisture Control Preparation for Flooring."

3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye-lot integrity. Do not mix dye lots in same area accept where manufacturer indicates that products are produced from mergeable dye lots.

D. Maintain pile-direction patterns indicated on Drawings, or if not indicated, as shown on approved shop drawings or directed by Architect.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 096900 - ACCESS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Patching, repairing, and extending existing access floor system including matching existing accessories and flooring.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For access flooring:

1. Include layout of access flooring and relationship to adjoining Work based on field-verified dimensions.
2. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.

C. Samples: For each type of exposed finish.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Match profiles and materials in existing flooring.

2.2 ACCESSORIES

A. Adhesives: Manufacturer's standard adhesive for bonding pedestal bases to subfloor.

B. Post-Installed Anchors: For anchoring pedestal bases to subfloor, provide post-installed expansion anchors made from carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5 (5 microns) for Class SC 1 (Mild), with the capability to sustain, without failure, a load equal to 1.5 times the loads imposed by pedestal-overturning moment on fasteners, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

C. Service Outlets: As indicated on Drawings.

D. Cavity Dividers: Provide manufacturer's standard metal dividers located where indicated to divide underfloor cavities.

E. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, with raised-disc or textured rubber or vinyl-tile floor coverings, and of same materials, performance, and construction requirements as access flooring.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine substrates, with Installer and manufacturer's authorized representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Lay out floor panel installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than 6 inches.

C. Locate each pedestal, complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

3.2 INSTALLATION

A. Install access flooring and accessories under supervision of access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.

B. Mechanical Attachment of Pedestals: Attach pedestals to subfloor with post-installed mechanical anchors.

C. Adjust pedestals so installed panels are flat, level, and at the proper height.

D. Stringer Systems: Secure stringers to pedestal heads according to access-flooring manufacturer's written instructions.

E. Install flooring panels securely in place, leaving them properly seated with panel edges flush. Do not force panels into place.

F. Scribe perimeter panels to provide a close fit, with adjoining construction having no voids greater than 1/8 inch where panels abut vertical surfaces.

1. To prevent dusting, seal cut edges of steel-encapsulated, wood-core panels with sealer recommended in writing by panel manufacturer.

G. Cut and trim access flooring and perform other dirt-or-debris-producing activities at a remote location or as required to prevent contamination of subfloor under installed access flooring.

H. Grounded Access Flooring: Ground access flooring as recommended by manufacturer and as needed to comply with performance requirements for electrical resistance of floor coverings.

1. Panel-to-Understructure Resistance: Not more than 10 ohms as measured without floor coverings.

I. Underfloor Dividers: Scribe and install underfloor-cavity dividers to closely fit against subfloor surfaces, and seal with mastic.

J. Closures: Scribe closures to closely fit against subfloor and adjacent finished-floor surfaces. Set in mastic and seal to maintain plenum effect within underfloor cavity.

K. Clean dust, dirt, and construction debris caused by floor installation, and vacuum subfloor area as installation of floor panels proceeds.

L. Seal underfloor air cavities at construction seams, penetrations, and perimeter to control air leakage, according to manufacturer's written instructions.

M. Install access flooring without change in elevation between adjacent panels and within the following tolerances:

1. Plus or minus 1/16 inch in any 10-foot distance.
2. Plus or minus 1/8 inch from a level plane over entire access flooring area.

END OF SECTION 096900

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SECTION 098433 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:

1. Sound-absorbing wall panels.

1.2 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

B. SAA: Sound Absorption Average.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include fabric facing, panel edge, core material, and mounting indicated.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Shop Drawings: For unit assembly and installation.

1. Include plans, elevations, sections, and mounting devices and details.
2. Include details at panel head, base, joints, and corners, and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
3. Include details at cutouts and penetrations for other work.
4. Include direction of fabric weave and pattern matching.

D. Samples for Verification: For the following products:

1. Fabric on Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Electrical outlets, switches, and thermostats.
2. Items penetrating or covered by units including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Alarms.
e. Sprinklers.
f. Access panels.

3. Show operation of hinged and sliding components covered by or adjacent to units.

B. Product Certificates: For each type of unit.

C. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.8 FIELD CONDITIONS

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

B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.

C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication and indicate them on Shop Drawings.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to the following:

a. Acoustical performance.
b. Fabric sagging, distorting, or releasing from panel edge.
c. Warping of core.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall units specified in this Section from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Low-Emitting Materials: Wall units shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.3 SOUND-ABSORBING WALL UNITS

A. Sound-Absorbing Wall Panel AWP#1: Manufacturer's standard panel construction consisting of facing material stretched over front face of edge-framed core and bonded or attached to edges and back of frame.

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

a. Armstrong World Industries, Inc.

b. AVL Systems, Inc.
c. Conwed Designscape; an Owens Corning company.
d. Decoustics Limited; a Saint Gobain company.
e. Perdue Acoustics, Inc.

2. Mounting: Back mounted with manufacturer's standard metal clips or bar hangers, secured to substrate.
3. Core: Glass-fiber board.
4. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
5. Edge Profile: Square.
6. Corner Detail in Elevation: Square with continuous edge profile indicated.
7. Reveals between Panels: Reveals as indicated on Drawings.
8. Facing Material: As selected from manufacturer's full range.

9. Nominal Core Thickness and System NRC: 1-1/2 inches and not less than NRC 0.85, according to ASTM C 423 for Type A mounting according to ASTM E 795, unless otherwise indicated on Drawings.
10. Panel Width: As indicated on Drawings.
11. Panel Height: As indicated on Drawings.

2.4 MATERIALS

A. Core Materials:

1. Glass-Fiber Board: ASTM C 612; of type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft., unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

B. Facing Material: Fabric from same dye lot; color and pattern as indicated by manufacturer's designations.

1. Fiber Content: As scheduled on Drawings.
2. Applied Treatments: Stain resistance and flame retardant.

C. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, consistent with mounting type used to establish unit acoustic performance, and as follows:

1. Metal Clips or Bar Hangers: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.

2.5 FABRICATION

A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

B. Edge Hardening: For glass-fiber board cores, chemically harden core edges and areas of core where mounting devices are attached.

C. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.

D. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.

1. Square Corners: Tailor corners.

E. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.
5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

C. Align fabric pattern and grain with adjacent units.

3.3 INSTALLATION TOLERANCES

A. Variation from Plumb and Level: Plus or minus 1/16 inch in 48 inches, noncumulative.

B. Variation of Joint Width: Not more than 1/16-inch variation from hairline in 48 inches, noncumulative.

3.4 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 098433

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SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on exterior substrates.

B. Related Requirements:

1. Section 099600 "High-Performance Coatings" for epoxy or polyurethane coatings for scheduled items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and Project name.

1. Paint: 1 gal. of each material and color applied.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); scheduled products, or comparable products by one of the following:

1. Benjamin Moore & Co.
2. PPG Architectural Coatings.
3. Pratt & Lambert

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

C. Colors: As indicated in a color schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMUs): 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 3.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Water-Based Light Industrial Coating System:

a. First Coat: Latex, exterior, matching topcoat.

b. Topcoat: Light industrial coating, exterior, water based, semi-gloss: S-W Pro Industrial Multi-Surface Acrylic Semi-Gloss Coating, B66-1550 Series, at 3.75 to 5.0 mils wet, 1.5 to 2.0 mils dry, per coat.

B. CMU Substrates:

1. Water-Based Light Industrial Coating System:

a. Block Filler: Block filler, latex, interior/exterior: S-W PrepRite Block Filler, B25W25, at 75 to 125 sq. ft. per gal.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Light industrial coating, exterior, water based, semi-gloss: S-W Pro Industrial Multi-Surface Acrylic Semi-Gloss Coating, B66-1550 Series, at 3.75 to 5.0 mils wet, 1.5 to 2.0 mils dry, per coat.

C. Steel Substrates:

1. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer, alkyd based, anti-corrosive for metal: S-W Kem Kromik Universal Metal Primer, B50AZ6 Series. Field re-prime factory-primed hollow metal doors and frames.
b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
c. Topcoat: Light industrial coating, exterior, water based, semi-gloss: S-W Pro Industrial Multi-Surface Acrylic Semi-Gloss Coating, B66-1550 Series, at 3.75 to 5.0 mils wet, 1.5 to 2.0 mils dry, per coat.
d. Application: Interior and exterior surfaces of hollow metal doors and frames, and miscellaneous items requiring paint protection.

2. High-Performance Coating System: See Section 099600 "High-Performance Coatings" for scheduled items.

END OF SECTION 099113

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SECTION 099125 - INTERIOR PAINTING AND REPAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on new and previously painted interior substrates.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
3. Section 099600 "High-Performance Coatings" for coating of scheduled items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and Project name.

1. Paint: 1 gal. of each material and color applied, except do not provide extra material for CMS standard interior wall paint color.

1.4 QUALITY ASSURANCE

A. Mockups: Apply in-place mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.

b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following manufacturers comparable to scheduled products.

B. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company scheduled products, or comparable products by one of the following:

1. Benjamin Moore & Co.
2. PPG Architectural Coatings.
3. Sherwin-Williams Company (The)

2.2 SUSTABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials: Field applied interior paints and coatings.

2.3 PAINT, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Colors: As indicated in a color schedule.

C. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

2.4 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F.

C. Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent that contains no ammonia, 5 quarts of 5 percent sodium hypochlorite bleach, and 15 quarts of warm water for every 5 gal. of solution required.

D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup of household detergent that contains no ammonia, 1 quart of 5 percent sodium hypochlorite bleach, and 3 quarts of warm water.

E. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.5 PATCHING MATERIALS

A. Cementitious Patching Compounds: Cementitious patching compounds and repair materials specifically manufactured for filling cementitious substrates and for sanding or tooling prior to repainting; formulation as recommended in writing by manufacturer for type of cementitious substrate indicated, exposure to weather and traffic, the detail of work, and site conditions.

B. Gypsum-Plaster Patching Compound: Finish coat plaster and bonding compound according to ASTM C842 and manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMUs): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical solutions being used unless the solutions will not damage adjacent surfaces. Use protective materials that are UV resistant and waterproof. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Do not apply chemical solutions during winds of sufficient force to spread them to unprotected surfaces.
3. Neutralize and collect alkaline and acid wastes before disposal.
4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.3 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 3.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Wood Substrates:

1. Scrape and clean knots; and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view; and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

G. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.4 MAINTENANCE REPAINTING, GENERAL

A. Maintenance Repainting Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from building interior at 5 feet away from painted surface away from painted surface.

B. Execution of the Work: In repainting surfaces, disturb them as minimally as possible and as follows:

1. Remove failed coatings and corrosion and repaint.
2. Verify that substrate surface conditions are suitable for repainting.
3. Allow other trades to repair items in place before repainting.

C. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use gentle methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail.

D. Heat Processes: Do not use torches, heat guns, or heat plates.

3.5 PREPARATORY CLEANING OF EXISTING SUBSTRATES

A. General: Use the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.

B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used, and that surface remains wet. Rinse with water applied by clean rags or sponges.

C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.

D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.

3.6 SUBSTRATE REPAIR

A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes.

B. Gypsum-Plaster and Gypsum-Board Substrates:

1. Repair defects including dents and chips more than 1/8 inch in size and all holes and cracks by filling with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.
2. Rout out surface cracks to remove loose, unsound material, fill with patching compound and sand smooth.

C. Metal Substrate:

1. Preparation: Treat repair locations by wire-brushing and solvent cleaning. Use chemical or mechanical rust removal method to clean off rust.
2. Defects in Metal Surfaces: Repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than 1/16-inch-deep or 1/2 inch across and all holes and cracks by filling with metal-patching compound and sanding smooth. Remove burrs and protruding fasteners.
3. Priming: Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners, crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that are inaccessible after completion of the Work.

3.7 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

a. Tanks and other equipment that do not have factory-applied final finishes.

2. Paint the following work where exposed in occupied spaces:

a. Equipment, including panelboards and switchgear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.8 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.9 INTERIOR PAINTING AND REPAINTING SCHEDULE

A. Primer Application: Apply at new work, and as recommended by manufacturer at existing surface repainting.

B. Intermediate Coat: Apply at new work, and as required to achieve uniform cover at existing surface repainting.

C. Concrete Substrates, Nontraffic Surfaces:

1. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer sealer, latex, interior: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Multi-Surface Acrylic Semi-Gloss Coating, B66-1550 Series, at 3.75 to 5.0 mils wet, 1.5 to 2.0 mils dry, per coat.
d. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

D. Concrete Substrates, Traffic Surfaces: See Section 099600 "High-Performance Coatings" for sealed concrete.

E. CMU Substrates:

1. Water-Based Light Industrial Coating System:

a. Block Filler: Block filler, latex, interior/exterior: S-W PrepRite Block Filler, B25W25, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).
b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Multi-Surface Acrylic Semi-Gloss Coating, B66-1550 Series, at 3.75 to 5.0 mils wet, 1.5 to 2.0 mils dry, per coat.
d. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

F. Steel Substrates:

1. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer, alkyd based, anti-corrosive for metal: S-W Kem Kromik Universal Metal Primer, B50AZ6 Series.
b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Multi-Surface Acrylic Semi-Gloss Coating, B66-1550 Series, at 3.75 to 5.0 mils wet, 1.5 to 2.0 mils dry, per coat.
d. Application: Interior and exterior surfaces of hollow metal doors and frames, and miscellaneous items requiring paint protection.

2. Water-Based Dry-Fall System:

a. Prime Coat: Where required: Primer, alkyd based, anti-corrosive for metal: S-W Kem Kromik Universal Metal Primer, B50AZ6 Series.
b. Top Coat: Dry-fall latex, flat: S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-80 Series, at 6.0 mils wet, 1.7 mils dry.

3. High-Performance Coating System: See Section 099600 "High-Performance Coatings" for scheduled items.

G. Gypsum Board Substrates:

1. Latex System:

a. Prime Coat: Primer sealer, latex, interior: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
b. Intermediate Coat: Latex, interior, water based, matching topcoat.
c. Topcoat: At ceilings and soffits: Latex, interior, flat: S-W ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
d. Topcoat: At walls: Latex, interior, semi-gloss: S-W ProMar 200 Zero VOC Interior Latex Semi-gloss, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

2. Water-Based Light Industrial Coating Systems:

a. Prime Coat: Primer sealer, latex, interior: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: At walls indicated as epoxy: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy Semi-gloss, K46-115 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

3. High-Performance Coating System: See Section 099600 "High-Performance Coatings" for scheduled items

H. Cotton or Canvas and ASJ Insulation-Covering Substrates: Including pipe and duct coverings.

1. Latex System:

a. Prime Coat: Primer sealer, latex, interior.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Match topcoat of adjacent wall or ceiling surfaces.

END OF SECTION 099125

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SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of high-performance coating systems.

B. Related Requirements:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 09 painting Sections for special-use coatings and general field painting.

1.2 DEFINITIONS

A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

1.4 COORDINATION

A. Coordinate selection of topcoats applied over intumescent fireproofing with Work of Section 078123 "Intumescent Fireproofing."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Field applied interior paints and coatings.

2.2 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide scheduled products or a comparable product by one of the following:

1. Corotech Coatings; Benjamin Moore & Co. (BM).
2. Sherwin-Williams Company (The) (S-W).
3. Tnemec Company, Inc. (TN).

2.3 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

B. Colors: As indicated in color schedule.

2.4 BLOCK FILLERS

A. Latex Block Filler: Water-based, pigmented, emulsion coating with minimum of 50 percent solids by volume; formulated to bridge and fill porous surfaces of CMUs in preparation for specified intermediate and topcoat coatings:

2.5 METAL PRIMERS

A. Zinc-Rich Inorganic Primer: Corrosion-resistant, inorganic-based, zinc-rich primer; formulated for use on prepared steel that will be exposed to severe industrial or marine environments.

B. Epoxy Zinc-Rich Primer: Solvent-based, multi-component, epoxy-type anti-corrosive primer; formulated for use on cleaned ferrous metal surfaces that will be exposed to moderate industrial or marine environments.

C. Water-Based, Rust-Inhibitive Primer: Corrosion-resistant, water-based-emulsion primer; formulated for resistance to flash rusting when applied to cleaned, ferrous metals that will be exposed to mildly corrosive environments.

D. Epoxy, Anti-Corrosive Primer: Solvent-based, two-component, epoxy, anti-corrosive primer; formulated for use on ferrous and galvanized metal surfaces.

E. Vinyl Wash Primer: Two-component, vinyl butyral/phosphoric acid-wash primer; for use over cleaned metal surfaces and zinc rich primers as a tie coat for subsequent priming with corrosion-resistant primers or intermediate and topcoat coatings.

2.6 EPOXY COATINGS

A. Epoxy, Semigloss: Solvent-based, two-component, epoxy coating; formulated for resistance to incidental splash and spillage of dilute (5 percent) sulfuric acid, (15 percent) hydrochloric acid, (20 percent) sodium hydroxide, gasoline, and heavy-duty cleaners and detergents; for use on wall and floor surfaces in moderate to heavy traffic commercial and moderate industrial environments.

1. Gloss Level: Manufacturer's standard semigloss finish.

B. High-Build Epoxy, Low Gloss: Two-component epoxy, high-solids, low-gloss coating for use on interior or exterior concrete, masonry, and primed metal surfaces.

1. Gloss Level: Manufacturer's standard semigloss finish.

2.7 POLYURETHANE COATINGS

A. Polyurethane, Two-Component, Pigmented, Semigloss: Solvent-based, two-component polyurethane, pigmented coating with a semigloss finish formulated for resistance to abrasion, weathering, chemical and solvent exposure, for use on interior or exterior brick, block, concrete, plaster, wood, and metal surfaces, where is required.

1. Gloss Level: Manufacturer's standard semigloss finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMUs): 12 percent.
3. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations for repainting in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Preparation of Existing Surfaces Scheduled for Recoating with High Performance Coatings: Refer to Section 099125 "Interior Painting and Repainting" or Section 099125 "Exterior Painting and Repainting."

C. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

D. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

E. Concrete Substrates: 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.

1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches.
2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4.
3. Prepare horizontal traffic surfaces in accordance with coating manufacturer's written instructions.

F. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 to 12 inches.

G. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 7/NACE No. 4, unless otherwise indicated.
2. SSPC-SP 10/NACE No. 3, for handrails and guardrails.

H. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

I. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Apply coatings at manufacturer's recommended thicknesses; obtain manufacturer technical representative written recommendations for substrates that vary from normal application conditions.
3. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
4. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
5. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel and Galvanized Steel Substrates:

1. Pigmented Polyurethane System:

a. Application: Exposed exterior steel framing and metal fabrication items including dumpster gates, and where epoxy paint or high-performance coating is indicated.

b. Prime Coat: Shop applied: Alkyd, anti-corrosive, for metal:

1) BM: Corotech Universal Metal Primer V131.
2) S-W: Kem Kromik Univeral Metal Primer

c. Prime Coat: For non-galvanized substrates: Zinc rich epoxy:
1) S-W Corothane I GalvaPac 2K.

d. Intermediate Coat: Polyurethane, two-component, pigmented, matching topcoat.
e. Topcoat: Polyurethane, two-component, pigmented, semi-gloss:

1) BM: Corotech Aliphatic Acrylic Urethane V510.
2) S-W Acrolon 218 HS Acrylic Polyurethane.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. For water-based precatalyzed epoxy coatings and other light industrial coating systems, see Section 099123 "Interior Painting."

B. Concrete Substrates, Traffic Surfaces.

1. Epoxy System: Water-based two-component polyamine epoxy coating system, LEED v4.1 Emissions compliant:

a. Application: Where "sealed concrete" is indicated.
b. Prime Coat: Reduced topcoat.
c. Intermediate Coat: Epoxy floor enamel, matching topcoat.
d. Topcoat: Epoxy Floor Coating, clear, semi-gloss:

1) S-W Armorseal 8100 Series.

e. Paint manufacturer's slip resistant additive:

1) S-W H&C SharkGrip.

C. Steel Substrates:

1. Epoxy System: Water-based Catalyzed Epoxy, LEED v4.1 Emissions compliant:

a. Application:

1) Interior stair components and railing components indicated as painted.

b. Prime Coat: Primer, rust-inhibitive, water based:

1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series.

c. Intermediate Coat: Epoxy, two-component polyamine, pigmented, matching topcoat.

d. Topcoat: Epoxy, two-component polyamine, semi-gloss:

1) S-W Pro Industrial Water Based Catalyzed Epoxy, B73-300 Series.

D. Gypsum Board Systems: See Section 099123 "Interior Painting."

END OF SECTION 099600

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SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Visual display board assemblies.
2. Tackboard sheet goods.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.
2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
3. Include sections of typical trim members.

D. Samples for Verification: For each type of visual display unit indicated.

1. Visual Display Panel: Not less than 8-1/2 by 11 inches, with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.
2. Sheet Goods: Not less than 8-1/2 by 11 inches.
3. Trim: 6-inch-long sections of each trim profile.
4. Accessories: Full-size Sample of each type of accessory.

E. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display units to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockup of typical visual display unit and of typical sheet goods application as shown on Drawings. Include accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Surfaces lose original writing and erasing qualities.
b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: Life of the building.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

2.3 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Composite Wood or Agrifiber Products.

2.4 VISUAL DISPLAY BOARD ASSEMBLY

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

1. ADP Lemco.
2. Best-Rite; MooreCo, Inc.
3. Claridge Products and Equipment, Inc.
4. Marsh Industries, Inc.
5. Platinum Visual Systems.

B. Visual Display Board Assembly: Factory fabricated.

1. Assembly: Markerboard and tackboard.
2. Corners: Square.
3. Width: As indicated on Drawings.
4. Height: As indicated on Drawings.
5. Mounting Method: Direct to wall.

C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.

1. Color: White.

D. Tackboard Panel: Plastic-impregnated-cork tackboard panel on core indicated.

1. Color and Pattern: As scheduled.

E. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape.

1. Aluminum Finish: Clear anodic finish.

F. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.

G. Combination Assemblies: Provide manufacturer's standard exposed trim between abutting sections of visual display panels.

H. Chalktray: Manufacturer's standard; continuous.

1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.

2.5 MARKERBOARD PANELS

A. Porcelain-Enamel Markerboard Panels, Magnetic: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of galvanized steel sheet backing, core material, and porcelain-enamel face sheet with high-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

1. Particleboard Core: 1/2-inch thick; 0.013-inch-thick, galvanized-steel sheet backing.
2. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.6 TACKBOARD PANELS

A. Plastic-Impregnated-Cork Tackboard: 1/4-inch-thick, plastic-impregnated cork sheet factory laminated to 1/4-inch-thick hardboard backing.

1. Basis-of-Design Product: Subject to compliance with requirements, provide scheduled product; or a comparable product approved by Architect.

2.7 TACKBOARD ROLL GOODS

A. Plastic-Impregnated-Cork Tackboard: 1/4-inch-thick, plastic-impregnated cork sheet.

1. Basis-of-Design Product: Subject to compliance with requirements, provide scheduled product; or a comparable product approved by Architect.

a. Color: As scheduled.
b. Mounting: Adhere to wall surface.
c. Aluminum Edge Trim: On bottom and top, continuously: As indicated on Drawings.

2.8 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

B. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.

C. Hardboard: ANSI A135.4, tempered.

D. Particleboard: ANSI A208.1, Grade M-1.

E. Extruded Aluminum: ASTM B 221, Alloy 6063.

F. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application as recommended in writing by visual display unit manufacturer.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper preparation and backing for visual display units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

D. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

3.3 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.

C. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings.

3.4 CLEANING AND PROTECTION

A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 101100

SECTION 101416 - PLAQUES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plaques.

B. Related Information

1. Allowances: Refer to Division 01 Section "Allowances" for lump sum allowance for purchase and installation of a dedication plaque. Plaque content, fabrication, and installation will be coordinated by the Owner's Representative.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For plaques.

1. Include fabrication and installation details and attachments to other work.
2. Show plaque mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each plaque at least half size.

C. Samples for Verification: For each type of plaque showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Plaque Casting: 6 inches square including border.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For plaques to include in maintenance manuals.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 PLAQUES

A. Cast Plaque: Plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Basis-of-Design Product: Subject to compliance with requirements, provide A.R.K. Ramos; Cast Plaques or a comparable product by one of the following:

a. Gemini Incorporated.
b. Matthews International Corporation; Bronze Division.
c. Metal Arts.
d. Southwell Company (The).

2. Plaque Material: Cast bronze.
3. Plaque Thickness: 0.50 inch.
4. Finishes:

a. Integral Metal Finish: Satin bronze raised surface with dark oxidized background.
b. Overcoat: Manufacturer's standard baked-on clear coating.

5. Background Texture: Leatherette.
6. Integrally Cast Border Style: #504.
7. Mounting: Concealed studs.
8. Text and Typeface: Text as directed by Owner's Representative; typeface Times New Roman

2.3 MATERIALS

A. Bronze Castings: ASTM B 584, alloy recommended by manufacturer and finisher for finish indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. Plaque Mounting Fasteners:

a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque, unless otherwise indicated.

2.5 FABRICATION

A. General: Provide manufacturer's standard plaques according to requirements indicated.

1. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of plaque work.

B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.

1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as plaques are installed.

C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

3.4 PLAQUE SCHEDULE:

1. Plaque Type **PLQ-1**:

   a. Plaque Size: 24 inch wide by 18 inches high.
   b. Character Size and Text/Message: As provided by Owner within 30 days of Substantial Completion.
   c. Location: As directed.

END OF SECTION 101416

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cutout dimensional characters.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For dimensional letter signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign.

C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Dimensional Characters: Half-size Sample of each type of dimensional character.
2. Exposed Accessories: Full-size Sample of each accessory type.

D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

PART 2 - PRODUCTS

2.1 DIMENSIONAL CHARACTERS

A. Cutout Characters:

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

a. ASI Sign Systems, Inc.
b. Gemini Incorporated.
c. Metal Arts.
d. Southwell Company (The).

2. Character Material: Plate aluminum.
3. Character Height: As indicated.
4. Thickness: 0.25 inch.
5. Finishes:

a. Integral Aluminum Finish: Clear anodized.

6. Mounting: Projecting studs.
7. Typeface: As indicated on Drawings.

2.2 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.3 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

4. Sign Mounting Fasteners:

a. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

2.4 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate and install washers and nuts on stud ends projecting through opposite side of surface and tighten.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

3.4 DIMENSIONAL CHARACTER SIGN SCHEDULE:

A. Sign Type **DCS-1**:

1. Sign Size: As indicated.
2. Character Size: As indicated.
3. Text/Message: As provided by Owner within 30 days of Substantial Completion.
4. Location: As indicated.

END OF SECTION 101419

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Panel signs and room-identification signs.
2. Field-applied, vinyl-character signs.
3. Door and room identification tags.

B. Related Requirements:

1. Section 101416 "Plaques."
2. Section 101419 "Dimensional Letter Signage" for cutout building exterior sign.
3. Section 101426 "Post and Panel/Pylon Signage" for freestanding signs.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Panel Signs: Full-size Sample.
2. Room-Identification Signs: Full-size Sample.
3. Field-Applied, Vinyl-Character Signs: Full-size Sample of characters on glass.
4. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
5. Exposed Accessories: Full-size Sample of each accessory type.

E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 SIGNS

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. ASI Sign Systems, Inc.
2. Best Sign Systems, Inc.
3. InPro Corporation (IPC).
4. Mohawk Sign Systems.
5. Nelson-Harkins Industries.

B. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Laminated-Sheet Signs and Room Identification Signs: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet at interior and fiberglass sheet at exterior, to produce composite sheet.

a. Composite-Sheet Thickness: 0.25 inch.
b. Surface-Applied Graphics: Applied paint.

2. Sign-Panel Perimeter: Finish edges smooth.

a. Edge Condition, Vertical Edges, Horizontal Edges: Square cut.
b. Corner Condition in Elevation: Square.

3. Mounting:

a. Surface mounted to wall with countersunk tamper-resistant flathead through fasteners.
b. Projecting from wall with aluminum bracket with tamper-resistant fasteners, where indicated.

4. Surface Finish and Applied Graphics:

a. Integral Aluminum Finish: Clear anodized.
b. Integral Acrylic and Fiberglass Sheet Colors: As selected by Architect from full range of industry colors.
c. Painted Finish and Graphics: Manufacturer's standard, factory-applied acrylic polyurethane, in color as selected by Architect from manufacturer's full range.
d. Overcoat: Manufacturer's standard baked-on clear coating.

5. Text and Typeface: Accessible raised characters and Braille typeface as indicated on Drawings and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.

6. Type, Size, and Layout: As scheduled.

C. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.

D. Changeable Message Inserts: Where Scheduled: Fabricate signs to allow insertion of changeable messages in the form of transparent covers with paper inserts printed by Owner.

1. Furnish insert material and software for creating text and symbols for PC-Windows computers for Owner production of paper inserts.
2. Furnish insert material cut-to-size for changeable message insert.
3. Solid-Sheet Sign: Aluminum sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph and as follows:

a. Thickness: Manufacturer's standard for size of sign but not less than 0.080 inch.
b. Surface-Applied, Flat Graphics: Applied paint.

2.3 FIELD-APPLIED, VINYL-CHARACTER SIGNS

A. Field-Applied, Vinyl-Character Sign: Prespaced characters die cut from 3- to 3.5-mil thick, weather-resistant vinyl film with release liner on the back and carrier film on the front for on-site alignment and application.

1. Size: As indicated or as scheduled.
2. Substrate: Glass.
3. Text and Font: As indicated or as scheduled.
4. Special Sign Requirements:

a. Fire Department Building Identification Signage:

1) Letter Material: High-intensity reflective vinyl sheeting, exterior grade.
2) Panel Material: Sheet aluminum, 1/8 inch thick.
3) Mounting: Wall with face-mounted tamper-resistant screws.
4) Color: As scheduled.

b. Exit Door Identification: Self-adhesive, vinyl die-cut letters: "EXIT", where required to be applied to a glass surface, with a blank opposite side; include braille characters. Configure sign per ADA requirements.

2.4 DOOR AND ROOM IDENTIFICATION TAGS

A. Door Edge Tags: Provide brass I.D. tag, 1-1/8 by 2-3/4 by 0.83 inch, flushed mounted on the edge of each door above the top hinge. Provide two identical tags at paired doors. Mount to wood and hollow metal doors using No. 8 by 3/4-inch screws. Mark tags with 1/2-inch-high engraved building designation and 1/4-inch-high engraved door designation. Verify Owner's final room numbering prior to fabricating and installing tags.

2.5 PANEL-SIGN MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

C. Fiberglass Sheet: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.

D. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated and suitable for exterior applications.

E. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.6 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
b. Fastener Heads: For nonstructural connections, use flathead screws and bolts with tamper-resistant spanner-head slots unless otherwise indicated.

4. Sign Mounting Fasteners:

a. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

5. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.

2.7 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.

B. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:

1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Furnish two blank inserts for each sign for Owner's use.

C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets as indicated.

2.8 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that anchor inserts are correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated in this Section and according to manufacturer's written instructions.

1. Use mechanical attachment for signs unless otherwise indicated.
2. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
3. Install signs so they do not protrude or obstruct according to the accessibility standard.
4. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
5. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated.

C. Mounting Methods:

1. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
2. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.

D. Field-Applied, Vinyl-Character Signs: Clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages and apply and firmly press characters into final position. Press from the middle outward to obtain good bond without blisters or fishmouths. Remove carrier film without disturbing applied vinyl film.

E. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

F. Door and Room Tags: Mount as indicated in material description in Part 2.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

3.4 SIGNAGE SCHEDULE

A. Special Panel Sign Requirements: Signage required by authorities having jurisdiction, whether or not indicated. Below are examples only; refer to Drawings and verify code requirements with Architect:

B. Changeable Message Insert Signs:

1. Fire Evacuation Route.
2. Assembly space capacities.

C. Special Panel Sign Requirements: Signage required by authorities having jurisdiction, whether or not indicated. Below are examples only; verify code requirements with Architect:

D. Special Panel Sign Requirements:

1. Fire Evacuation Route Signage: At all occupied spaces: Polymer sign with non-changeable insert graphic sheet and clear polycarbonate sheet overlay, face-fastened with tamper-resistant fasteners. Graphic content coordinated by Owner's Representative.
2. Fire Sprinkler Riser Room.
3. Main Electrical Room.
4. Roof Access.
5. First Responder exterior door identification.

6. Elevator corridor signage.
7. Stairwell signage.
8. Roof Access Sign: On corridor side of room containing roof access ladder.
9. FACP (Fire Alarm Control Panel) Sign: On corridor side of room where FACP is located.
10. Wayfinding Letters or Numbers: Above fire doors in corridors; four-inch-high letters, content as directed by Owner's Representative.

E. Exterior Fire Department Connection Sign: Size, font, and substrate as required by authorities having jurisdiction.

END OF SECTION 101423

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SECTION 101426 – BOX FRAME EXTERIOR SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single sided box frame monument sign.
2. Building-mounted box frame signs.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete foundations and base slab for post and panel signs.

1.2 COORDINATION

A. Furnish templates and tolerance information for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.3 QUALITY ASSURANCE

A. Manufacturer/Installer: Experienced fabricator with minimum 5-year record of successful installations of similar type and scope.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For monument signage.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.

C. Samples for Verification: For each type of sign assembly, showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Box Frame Signs: Not less than 12 inches square, including corner.
2. Variable Component Materials: 8-inch Sample of each base material, character or graphic element, in each exposed color and finish not included in other Samples.
3. Exposed Accessories: Full-size Sample of each accessory type.

D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

E. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Permits: Secure and submit copy of permit issued by authorities having jurisdiction indicated approval of design and installation of signage.

B. Qualification Data: For manufacturer/Installer.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

B. Failures include, but are not limited to, the following:

1. Deterioration of finishes beyond normal weathering.
2. Separation or delamination of sheet materials and components.
3. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of post-and-panel sign type(s) according to structural performance requirements.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

1. Uniform Wind Load: As indicated on Drawings.

C. Code Compliance: Provide illuminated signage in compliance with requirements of authorities having jurisdiction.

D. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 POST AND PANEL SIGNS

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. Allen Industries Architectural Signage.
2. APCO Graphics, Inc.
3. ASI Sign Systems, Inc.
4. Charleston Industries, Inc.
5. Nelson-Harkins Industries.

B. Hollow-Box Sign Frame: Entire perimeter framed with formed-steel sheet hollow-box-type frame with vertical edges attached to supports with steel fittings. Close top and bottom edges of panels with manufacturer's standard welded seams or extrusions.

a. Size: As indicated on Drawings.
b. Finish and Color: As indicated on Drawings.

2. Sign-Frame Mounting: Direct to cast in place concrete base.
3. Sign-Panel-Face Finish:

a. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
b. Overcoat: Manufacturer's standard baked-on clear coating.

4. Text and Typeface: Typeface matching Architect's sample.

5. Electrical Requirements: Not applicable.

2.3 STEEL AND IRON

A. Tubing: ASTM A500/A500M (cold formed) or ASTM A513, Type 5 (mandrel drawn).

B. Plates, Shapes, and Bars: ASTM A36/A36M.

C. Steel Sheet, Cold Rolled: ASTM A1008/A1008M, either commercial steel or structural steel, exposed.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
b. Fastener Heads: For nonstructural connections, use flathead screws and bolts with tamper-resistant, spanner-head slots unless otherwise indicated.

4. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

C. Anchoring Materials:

1. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
2. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

    a. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in locations concealed from view after final assembly.
2. Mill joints to tight, hairline fit. Form joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.
4. Conceal fasteners and anchors unless indicated to be exposed; locate exposed fasteners where they will be inconspicuous.
5. Internally brace signs for stability and for securing fasteners.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize products made from rolled, pressed, and forged steel shapes, castings, plates, bars, and strips indicated to be galvanized to comply with ASTM A123/A123M.

1. Hot-dip galvanize steel and iron hardware indicated to be galvanized to comply with ASTM A153/A153M.
2. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

3. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. Preparing Galvanized Items for Shop Priming: After galvanizing, thoroughly clean decorative metal of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

C. Primer Application: Apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

D. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color: Match Architect's sample.

E. Powder-Coat Finish, Galvanized: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:

1. Prepare galvanized metal by thoroughly removing grease, dirt, oil, flux, and other foreign matter.
2. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs.

C. Verify that anchor inserts are correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using installation methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to accessibility standard.

3. Before installation, verify that sign components are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101426

SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

B. Related Requirements:

1. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Shop Drawings: For toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of centerlines of toilet fixtures.
3. Show locations of floor drains.

D. Samples for Initial Selection: For each type of toilet compartment material indicated.

1. Include Samples of hardware and accessories involving material and color selection.

E. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
2. Each type of hardware and accessory.

F. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of manufacturer's warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.6 WARRANTY

A. Special Warranty for Toilet Panels: Manufacturer's form in which manufacturer agrees to furnish replacement toilet compartment panels that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Surfaces exhibiting chipping, breakage, corrosion, delamination and defects in workmanship.
b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: 25 years from date of Substantial Completion.

B. Special Warranty for Toilet Compartment Hardware: Manufacturer's form in which manufacturer agrees to furnish replacement toilet compartment cast stainless steel hardware and full height aluminum brackets that fail in materials or workmanship within specified warranty period.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 75 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Composite Wood or Agrifiber Products.

2.3 PHENOLIC-CORE TOILET COMPARMENTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Partition Systems International of South Carolina; **Series #54000** or a comparable product by one of the following:

1. Atlanta Sunbelt Products.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.
4. General Partitions Mfg. Corp.
5. Global Partitions Corp., an ASI Group Company.
6. Scranton Products.

B. Toilet-Enclosure Style: Floor supported, overhead braced.

C. Urinal-Screen Style: Floor supported, overhead braced.

D. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch-thick doors and pilasters and minimum 3/4-inch-thick panels.

E. Pilaster Shoes: Formed from stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

F. Urinal-Screen: Manufacturer's standard post design of 1-3/4-inch-square, aluminum tube with satin finish; with shoe matching that on the panel pilasters, and overhead brace.

G. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

H. Phenolic-Panel Finish:

1. **Color and Pattern: Plastic laminate selection as scheduled in Drawings**.

2.4 HARDWARE AND ACCESSORIES

A. Heavy-Duty Hardware and Accessories: Manufacturer's optional heavy-duty operating hardware and accessories consisting of not less than the following:

1. Hinges: 14 gauge by 3-inch-wide stainless steel, heavy duty continuous self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, with 0.250 inch diameter 304 stainless steel pivot pin. Provide emergency access by lifting door. Mount with through-bolts.
2. Latch and Keeper: Cast stainless steel, minimum 0.15-inch thick, satin finish, heavy duty surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Latch shall be equipped with internal buffering spring to prevent damage due to slamming. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be handicapped accessible.
3. Coat Hook: Heavy duty stainless steel, through-bolted combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
4. Door Bumper at PH stall: Wall-mounted.
5. Door Pull: Heavy-duty stainless-steel unit, through-bolted, at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be handicapped accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.5 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221.

C. Stainless-Steel Castings: ASTM A 743/A 743M.

2.6 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at bottoms of posts. Provide shoes at posts to conceal anchorage.

D. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide in-swinging doors for standard toilet compartments and 36-inch-wide out-swinging doors with a minimum 32-inch-wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch.

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

    a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

    a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113.17

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SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Surface-mounted plastic cover corner guards.
2. Metal corner guards.

1.2 ACTION SUBMITTALS

A. Samples for Verification: For each type of exposed finish required.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain wall protection units from single source from single manufacturer.

PART 2 - PRODUCTS

2.1 CORNER GUARDS

A. Surface-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard, PVC-free assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties, Inc., Acrovyn Corner Guards SSM-20N/SSM-25N, or a comparable products by one of the following:

    a. Inpro Corporation.
    b. Korogard Wall Protection Systems; a division of RJF International Corporation.
    c. Nystrom.

2. Cover: Extruded rigid plastic, minimum 0.078-inch wall thickness as follows:

    a. Profile: Nominal 2-inch-long leg and 1/4-inch corner radius.
    b. Color and Texture: As scheduled, or if not scheduled, as selected by Architect from manufacturer's full range.

3. Continuous Retainer: Minimum 0.060-inch-thick, one-piece, extruded aluminum.
4. Retainer Clips: Manufacturer's standard impact-absorbing clips.
5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
6. Application: Provide where indicated on Drawings.
7. Mounting: At top of resilient wall base and extend to height of tops of adjacent door frames, approximately 7-foot 2 inch.

B. Surface-Mounted, Metal Corner Guards: Fabricated from one-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties, Inc., Heavy Duty Corner Guards CO-8, or a comparable products by one of the following:

    a. Inpro Corporation.
    b. Korogard Wall Protection Systems; a division of RJF International Corporation.
    c. Nystrom.

2. Material: Stainless steel, Type 304.

    a. Thickness: Minimum 0.0625 inch.
    b. Finish: Directional satin, No. 4.

3. Wing Size: Nominal 2-1/2 by 2-1/2 inches.
4. Wing Size: At Partition End: Nominal 2-1/2 by 2-1/2 inches by partition width.
5. Corner Radius: 1/8 inch.
6. Mounting: Adhesive.
7. Application: Provide where indicated on Drawings.
8. Mounting: At top of resilient wall base and extend to height of tops of adjacent door frames, approximately 7-foot 2 inch.

2.2 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required; thickness as indicated.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

C. Adhesive Tape: Product: 3M Adhesive Transfer Tape 9473PC, unless other product is recommended by protection product manufacturer.

2.3 FABRICATION

A. Fabricate components with tight seams and joints with exposed edges eased. Provide surfaces and edges free of wrinkles, chips, dents, uneven coloration, burrs, sharp edges, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install wall protection units' level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Install wall protection units in locations and at mounting heights indicated on Drawings or, if not indicated, as indicated below:
2. Provide splices, adhesive tapes, mounting hardware, anchors, and other accessories required for a complete installation.

a. Provide anchoring devices to withstand imposed loads.

B. Installation of Metal Corner Guards: Install at locations indicated on Drawings, or if not indicated, at outside corners of gypsum board.

1. Install using specified adhesive mounting tape.

3.4 CLEANING

A. Immediately after completion of installation, wall protection units using a standard, ammonia-based, household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

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SECTION 102800 – TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Childcare accessories.
3. **Adult changing stations**.
4. Underlavatory guards.
5. Custodial accessories.

1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

B. Keys: Provide keys and tools required for access to and maintenance of toilet accessories.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

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

1. AJW Architectural Products.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. Other manufacturers as listed below.

B. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer, except where indicated below as "Required Product."

C. Toilet Tissue Jumbo Roll Dispenser **TTJ**:

1. Mounting: Surface mounted, at required clearance above grab bar.
2. Application: Where indicated.
3. Required Product: Bay West, #88800, or San Jamar, R2000TBK.

D. Toilet Tissue Roll Dispenser **TTR**:

1. Double roll dispenser.
2. Cast aluminum with polymer spindles.
3. Control delivery, except non-control delivery at accessible water closets.
4. Mounting: Surface mounted, at required clearance below grab bar.
5. Application: In locations that do not show jumbo dispensers TTJ and in locations where jumbo dispenser conflict with grab bar.
6. Basis of Design Product: Bobrick #27460, or comparable product of listed manufacturer.

E. Paper Towel (Roll) Dispenser **PTR**:

1. Lever-actuated delivery.
2. 8 inch by 800 foot roll capacity.
3. Mounting: Surface mounted.
4. Application: All toilet rooms.
5. Required Product: Georgia Pacific Vista Push Paddle #54338.

F. Paper Towel (Folded) Dispenser **PTF**:

1. 400 single-fold towel minimum capacity.
2. Mounting: Surface mounted.
3. Application: Lavatories and sinks at Kitchen and Food Services
4. Basis of Design Product: A & J Washroom Accessories #U190 or comparable product of listed manufacturer.

G. Liquid-Soap Dispenser, Child **SDC**:

1. Description: Designed for dispensing soap in liquid form from cartridges.
2. Mounting: Vertically oriented, surface mounted.
3. Application: All lavatories and sinks, 1 per single or pair. Locate over portion of lavatory below that does not include hardware.
4. Required Product: GOJO Plack Chruome FMX-20.

H. Liquid-Soap Dispenser, Adult **SD**:

1. Basis-of-Design: Bradley Corporation; Model 6563.
2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Wall mounted; surface mounted, vertical.
4. Capacity: 40 oz.
5. Materials:

    a. Body: Chrome-plated plastic.
    b. Valve: ABS plastic.
    c. Reservoir: Reusable bottle, 27 oz.

I. Trash Receptacle **TRSR:**
1. Description: Removable waste receptacle.
2. Mounting: Semi-recessed.
3. Minimum Waste-Receptacle Capacity: 21 gal.
4. Material and Finish: Stainless steel, No. 4 finish (satin).
5. Liner: Reusable vinyl liner.
6. Lockset: Tumbler type for waste receptacle.

J. Grab Bar **GB18**, **GB36**, **GB42**:

1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inch thick.
3. Length as designated.
4. Outside Diameter: 1-1/2 inches.
5. Basis of Design Product for 1-1/2 inch: Bradley #8120 series or comparable product of listed manufacturer.
6. Swing-Up Unit: **GBSU**.

K. Sanitary Product Disposal Unit **SDU**:

1. Mounting: Surface mounted.
2. Receptacle: Removable.
3. Basis of Design Product: American Specialties #0852 or comparable product of listed manufacturer.

L. Mirror Unit **MG**:

1. Frame: Stainless-steel angle or channel, mitered and welded, with tamper- and theft-resistant installation.
2. Glazing: Full tempered clear float glass, 1/4 inch thick.
3. Size and Location: 20 by 30 inches, locate above lavatories at single occupancy toilet rooms and staff toilets.
4. Size and Location: 24 by 72 inches, locate at wall adjacent to toilet room door at group toilets.
5. Basis of Design Product: Bradley #780 series or comparable product of listed manufacturer.

2.3 CHILDCARE ACCESSORIES

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

1. American Specialties, Inc.
2. GAMCO Specialty Accessories; a division of Bobrick.
3. Koala Kare Products.

B. Diaper-Changing Station, **DS**:

1. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.

   a. Engineered to support a minimum of 250-lb static load when opened.
   b. Adjustable height range from 12 to 41 inches AFF.
   c. ADA accessible controls.

2. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
3. Operation: By pneumatic shock-absorbing mechanism.
4. Material and Finish: HDPE in manufacturer's standard color.
5. Liner Dispenser: Built in.
6. Basis of Design Product: Koala Kare KB3000-AHL, or comparable product of listed manufacturer.
7. Application: At public restrooms adjacent to assembly spaces such as an auditorium or stadium.

C. Surface-Mounted Adjustable Height Adult Changing Station ADS: Where indicated:

1. Basis of Design: Model KB3000-AHL as manufactured by Koala Kare Products, a Division of Bobrick.
2. Power: Switched 110-V grounded supply for hard wiring required.
3. Powered-Height Adjustability: Changing surface shall electronically adjust from 12 to to 41 inches AFF.
4. Two sets of built-in electronic controls for height adjustment: face of wall cover and front of changing surface.
5. Weight Capacity: 500 lbs. static load.
6. Changing Surface: Polyethylene meets IK10 standard for resistance to high impact and sharp objects.

a. Minimum 75-1/4 inches long, and 31-1/2 inches wide, and can be opened and closed with one-hand.
b. Safety rail with a curved dip in the center for easier patient changing by caregiver. Safety rail rotates and locks under changing bed when in closed position.

7. Unit Framing: 2 inch powder coated steel tubing.
8. Back-Up Battery: Allowing for continuous operation in the event of a power interruption.
9. Emergency Stop: Wall-mounted emergency stop to break power to actuator.
10. Unit shall withstand significant exposure to water without damage to electrical components.

a. Grounded power cord.
b. Splash-proof control system.

11. ISO 60601-1 and -2 whole product certification.
12. **Durability: Cycle tested through range of motion 28,000 times at 500lbs. Stress tested to 100,000 cycles with 500lbs. bounce load test**.

2.4 UNDERLAVATORY GUARDS

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

1. Plumberex Specialty Products, Inc.
2. Truebro by IPS Corporation.

B. Underlavatory Guard **UG**:

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.5 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder **MOP**:

1. Description: 36 inch, 3-hook stainless steel unit with shelf, hooks, holders, and rod suspended beneath shelf, and 4 Mop/Broom Holders.
2. Basis of Design Product: Bradley #9984 or comparable product of listed manufacturer.

B. Mop Sink Wall Protection: Stainless steel sheet, minimum 30 inches high by width and depth of sink, with hemmed edges. Adhere to wall.

2.6 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

C. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

2.7 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using mechanical fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguishers.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

B. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches square.

C. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINETS

A. Cabinet Type: Suitable for fire extinguisher.

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. JL Industries, Inc.; a division of the Activar Construction Products Group.
    b. Larsens Manufacturing Company.
    c. Nystrom, Inc.
    d. Potter Roemer LLC.

B. Cabinet Construction: Nonrated and fire rated as indicated by wall/partition assembly type.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Cold-rolled steel sheet.

D. Semirecessed Cabinet FEC#2: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

E. Cabinet Trim Material: Aluminum.

F. Door Material: Aluminum.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide recessed door pull and rolling friction latch.
2. Provide manufacturer's standard hinge permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.

    a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

        1) Location: Applied to cabinet glazing.
        2) Application Process: Etched.
        3) Lettering Color: Red.
        4) Orientation: Vertical.

K. Materials:

1. Aluminum: ASTM B221 (ASTM B221M) for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.

   a. Finish: Clear anodic.

2. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

   a. Finish: Baked enamel or powder coat.
   b. Color: As selected by Architect from full range of industry colors and color densities.

3. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide surface-mounted fire-protection cabinets at concrete walls.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in the manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. JL Industries, Inc.; a division of the Activar Construction Products Group.
b. Larsens Manufacturing Company.

c. Nystrom, Inc.
d. Potter Roemer LLC.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Steel Container PFE: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

1. Application: At all locations unless otherwise indicated.

C. Clean-Agent Type in Steel Container PFEC: UL-rated 1-A:10-B:C, 10-lb nominal capacity, with HFC blend agent and inert material in enameled-steel container; with pressure-indicating gage.

1. Application: Computer network equipment locations.

2.3 MOUNTING BRACKETS PFEB

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 113100 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cooking appliances.
2. Refrigeration appliances.
3. Icemaker.
4. Cleaning appliances.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Product Data: For indicated products, indicating compliance with requirements for ENERGY STAR product labeling.

B. Product Schedule: For appliances. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of appliance.

B. Field quality-control reports.

C. Sample Warranties: For manufacturers' special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.5 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

B. Microwave Oven: Limited warranty including parts and labor for first year and parts thereafter for on-site service on the magnetron tube.

1. Warranty Period: One year from date of Substantial Completion.

C. Refrigerator/Freezer, Freezer, Icemaker, Sealed System: Limited warranty including parts and labor for first year and parts thereafter for on-site service on the product.

1. Warranty Period for Sealed Refrigeration System: Two years from date of Substantial Completion.
2. Warranty Period for Other Components: One year from date of Substantial Completion.

D. Dishwasher: Limited warranty including parts and labor for first year and parts thereafter for on-site service on the product.

1. Warranty Period for Deterioration of Tub and Metal Door Liner: Two years from date of Substantial Completion.
2. Warranty Period for Other Components: One year from date of Substantial Completion.

E. Clothes Washer: Limited warranty including parts and labor for first year and parts thereafter for on-site service on the product.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain residential appliances from single source and each type of residential appliance from single manufacturer.

B. Finishes: Match finishes of appliances located within room or within view of adjacent appliances.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and ICC A117.1.

2.3 MICROWAVE OVENS

A. Microwave Oven MO#1:

1. Basis of Design: Provide product scheduled on Drawings or comparable product by one of the following:

a. LG Electronics.
b. Samsung.
c. Whirlpool Corporation.

2. Mounting: Countertop.
3. Type: Conventional.
4. Capacity: 2.0 cu. ft.
5. Oven Door: Door with observation window and push-button latch release.

6. Microwave Power Rating: Manufacturer's standard.
7. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.
8. Controls: Digital panel controls and timer display.
9. Other Features: Turntable.
10. Material: Stainless steel.

2.4 REFRIGERATOR/FREEZERS

A. Refrigerator/Freezer **RF#1**: Two-door refrigerator/freezer with freezer on top and ice maker and complying with AHAM HRF-1.

1. Basis of Design: Provide product scheduled on Drawings or comparable product by one of the following:

   a. LG.
   b. Samsung.
   c. Whirlpool Corporation.

2. Type: Freestanding.
3. Storage Capacity:

   a. Refrigeration Compartment Volume: 15.25 cu. ft.
   b. Freezer Volume: 6.68 cu. ft.

4. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
5. Material: Stainless steel.

B. Refrigerator/Freezer **RF#2**: Two-door refrigerator/freezer with freezer on top and complying with AHAM HRF-1.

1. Basis of Design: Provide product scheduled on Drawings or comparable product by one of the following:

   a. LG.
   b. Samsung.
   c. Whirlpool Corporation.

2. Type: Freestanding.
3. Storage Capacity:

   a. Refrigeration Compartment Volume: 15.25 cu. ft.
   b. Freezer Volume: 6.68 cu. ft.

4. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
5. Material: Stainless steel.

C. Refrigerator/Freezer **RF#3**: Compact Refrigerator.

1. Basis of Design: Provide product scheduled on Drawings or comparable product by one of the following:

a. LG.
b. Samsung.
c. Whirlpool Corporation.

2. Type: Freestanding under counter.
3. Storage Capacity:

a. Refrigeration Compartment Volume: 5.63 cu. ft.

4. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
5. Material: Stainless steel.

2.5 ICEMAKERS

A. Icemaker IC#1:

1. Basis of Design: Provide product scheduled on Drawings or comparable product by one of the following:

a. Manitowoc Ice.
b. Avantco Ice Machines.

2. Ice Capacity:

a. Production: 250 lb. per day.

3. Material: Stainless steel.

a. Color/Finish: Stainless steel.

4. Include stand.

2.6 DISHWASHERS

A. Dishwasher DW#1: Complying with AHAM DW-1.

1. Basis of Design: Provide product scheduled on Drawings or comparable product by one of the following:

a. Maytag; a division of Whirlpool Corporation.
b. Whirlpool Corporation.

2. Type: Built-in undercounter.
3. Dimensions:

a. Width: 24 inches.
b. Depth: 23 inches.
c. Height: 34-1/2 inches.

4. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
5. Material: Stainless steel.

a. Color/Finish: Stainless steel.

2.7 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install appliances according to manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After installation, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 113100

SECTION 115223 – AUDIO-VISUAL EQUIPMENT SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Mounting hardware for television monitors.
2. Support requirements for television monitors.
3. Installation requirements for television monitors furnished by Owner.

B. Related Sections include:

1. Division 09 Section "Non-Structural Metal Framing" for miscellaneous framing and support members for TV equipment brackets.

1.2 SUBMITTALS

A. Product Data: For television mounting bracket, indicating mounting plates, fasteners, extension hardware, required framing and blocking, and method of attachment to structure.

B. Verify Owner's selected television unit sizes prior to ordering.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain television mounting brackets through one source from a single manufacturer.

1.4 COORDINATION

A. Confirm final Owner equipment selection and select specific support model based upon manufacturer's recommendation for compatibility.

B. Provide additional framing and blocking required to secure units to structure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide basis of design product or products by one of the following manufacturers comparable to the basis of design product indicated:

1. Da-Lite Screen Co., Inc.
2. Lucasey Mounting Systems.
3. Peerless Industries, Inc.

2.2 TELEVISION WALL MOUNTING BRACKET

A. Basis of Design: Milestone AV Technologies/Chief, LVSXU ConnexSys™ Video Wall Landscape Mounting System without Rails.
1. Verify compatibility with Owner-furnished equipment prior to ordering.

B. Bracket: Open wall plate mounting to metal stud-framed gypsum board wall:

1. Load capacity: 200 lbs.
2. Fixed wall mount.
3. Accommodates monitor size approximately 42 inch to 70 inch.

C. Accessories

1. Security fastener kit.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide framing and blocking required for secure support of television monitors.

3.2 INSTALLATION

A. Install television mounting hardware where indicated. Secure to structure in accordance with manufacturer's written instructions.

3.3 PROTECTING AND CLEANING

A. Protect equipment after installation from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION 115223

SECTION 122113 – HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Replacement horizontal louver blinds with aluminum slats to match existing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For horizontal louver blinds, include fabrication and installation details.

C. Samples for Initial Selection: For each type and color of horizontal louver blind.

1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type and color of horizontal louver blind indicated.

1. Slat: Not less than 12 inches long.

E. Product Schedule: For horizontal louver blinds. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For horizontal louver blinds with polymer slats that have been tested for compliance with NFPA 701, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver horizontal louver blinds in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet-work and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed

units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.

2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Hunter Douglas Contract; Model CD60 or a comparable product by one of the following:

1. Levolor Contract; a Newell Rubbermaid company.
2. Springs Window Fashions; SWFcontract.

B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.

1. Width, Thickness, and Spacing: Match existing.
1. Finish: Ionized antistatic, dust-repellent, baked polyester finish, with reflective finish on outside-facing surface of slat to enhance reflection of solar energy.

C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides.

1. Capacity: One blind(s) per headrail unless otherwise indicated.
2. Ends: Capped or plugged.
3. Manual Lift Mechanism:

    a. Lift-Cord Lock: Variable; stops lift cord at user-selected position within blind full operating range.
    b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.

4. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.

    a. Tilt: Full.
    b. Operator: Clear-plastic wand.
    c. Over-Rotation Protection: Manufacturer's detachable operator or slip clutch to prevent over rotation of gear.

5. Manual Lift-Operator and Tilt-Operator Lengths: Full length of blind when blind is fully closed.
6. Manual Lift-Operator and Tilt-Operator Locations: Manufacturer's standard unless otherwise indicated.
7. Integrated Headrail/Valance: Curved face.

D. Bottom Rail: Formed-steel or extruded-aluminum tube that secures and protects ends of ladders and lift cords and has plastic- or metal-capped ends.

1. Type: Manufacturer's standard.

E. Lift Cords: Manufacturer's standard braided cord.

F. Ladders: Evenly spaced across headrail at spacing that prevents long-term slat sag.

1. Type: Reinforced vinyl tape , manufacturer's standard width.

G. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.

1. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.

H. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.

I. Colors, Textures, Patterns, and Gloss: Match existing.

2.3 HORIZONTAL LOUVER BLIND FABRICATION

A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings, measured at 74 deg F, to match existing installation type.

C. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.

D. Mounting and Intermediate Brackets: Designed for removal and reinstallation of blind without damaging blind and adjacent surfaces, for supporting blind components, and for bracket positions and blind placement indicated.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.

F. Color-Coated Finish:

1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.

1. Locate so exterior slat edges are not closer than 2 inches from interior faces of glass and not closer than 1-1/2 inch from interior faces of glazing frames through full operating ranges of blinds.
2. Install mounting and intermediate brackets to prevent deflection of headrails.
3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.

3.3 ADJUSTING

A. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

A. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.

B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.

C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

END OF SECTION 122113

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations. Indicate required blocking.

C. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

E. Roller-Shade Schedule: Use same designations indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products of SWF; or comparable products by one of the following:

1. Draper Inc.
2. Hunter Douglas Contract.
3. Lutron Electronics Co., Inc.
4. Mechoshade.

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Manufacturer's standard meeting WCMA A 100.1.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Chain tensioner, jamb mounted.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.

a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

2.3 SHADEBAND MATERIAL

A. Shadeband Material: Light-filtering fabric fabric.

1. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As selected by Architect from manufacturer's full range.

B. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches.

2. Endcap Covers.
3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.4 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Basis of Design: Mechoshade, Ecoveil Sheer.
2. Type: PVC- and flame-retardant- free polyester.
3. Weave: Basketweave.
4. Openness Factor: 3 percent.
5. Color: As selected by Architect from manufacturer's full range.

C. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

D. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

E. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

SECTION 123623 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

1. Section includes plastic-laminate countertops and countertop support brackets.
2. Related Information:
    a. Section 012300 "Alternates" for alternate affecting work of this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products high-pressure decorative laminate adhesive for bonding plastic laminate.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

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

1. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in plastic-laminate countertops.
2. Apply AWI Quality Certification Program label to Shop Drawings.

D. Samples for Initial Selection:

1. Plastic laminates.

E. Samples for Verification:

1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For the following:

1. Composite wood and agrifiber products.
2. High-pressure decorative laminate.
3. Adhesives.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Same as installer of casework or cabinetwork bases.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.

B. Grade: Custom.

C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.

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

a. Formica Corporation.
b. Nevamar; a Panolam Industries International, Inc. brand.
c. Wilsonart.

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

1. As indicated by manufacturer's designations.

E. Edge Treatment: 3-mm PVC edging.

F. Core Material: Particleboard.

G. Core Material at Sinks: Exterior-grade plywood.

H. Core Thickness: 3/4 inch.

1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

I. Paper Backing: Provide paper backing on underside of countertop substrate.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

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

1. Composite Wood Products: Products shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
2. Particleboard: ANSI A208.1, Grade M-2.
3. Softwood Plywood: DOC PS 1.

2.3 ACCESSORIES

A. Countertop Support Bracket: Surface-mounted support bracket configured to support countertop directly off wall, with 12 inch vertical flange, of length required for application indicated on Drawings.

1. Product: Rakks, EH-Surface Mount Counter Support Bracket.

B. Grommets for Cable Passage through Countertops: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage, in color selected by Architect from manufacturer's full range.

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

a. Doug Mockett & Company, Inc.

2.4 MISCELLANEOUS MATERIALS

A. Adhesive for Bonding Plastic Laminate: Water-based contact adhesive, low-VOC.

1. Adhesive for Bonding Edges: Hot-melt adhesive.
2. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Installation Adhesive:

1. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.5 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets.

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.
2. Seal edges of cutouts by saturating with varnish.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

E. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

F. Countertop Support Brackets: Fasten securely to concealed blocking in accordance with bracket manufacturer's written instructions.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
3. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 123623

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SECTION 123661 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Countertop support brackets.
3. Related Information:

a. Section 012300 "Alternates" for alternate affecting work of this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.
B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops and windowsills by field measurements before window sill fabrication is complete.

1.6 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops and windowsills or backsplashes.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Composite Wood or Agrifiber Products.

2.2 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Basis-of-Design Product: Subject to compliance with requirements, provide E. I. du Pont de Nemours and Company; Corian, or a comparable product by one of the following:

a. Avonite Surfaces.
b. Formica Corporation.

2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Colors and Patterns: As indicated by manufacturer's designations.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

C. Countertop Support Bracket: Surface-mounted support bracket configured to support countertop directly off wall, with 12-inch vertical flange, of length required for application indicated on Drawings.

1. Product: Rakks, Concealed EH Counter Support Bracket.
2. Depth dimension: As required by application.
3. Color: Mill.

2.3 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium.

B. Configuration:

1. Front: Straight, slightly eased at top with separate apron, 6 inches high, recessed 1/4-inch behind front edge.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops: 1/2-inch-thick, solid surface material with front edge built up with same material.

D. Backsplashes: 1/2-inch-thick, solid surface material.

E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

F. Joints: Fabricate countertops without joints.

1. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.4 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Windowsills: Comply with applicable requirements in Section 07 9200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material windowsills and conditions under which windowsills will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of windowsills.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Countertop Support Brackets: Install countertop support brackets in accordance with manufacturer's written instructions and approved shop drawings.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

D. Bond joints with adhesive and draw tight as windowsills are set. Mask areas of windowsills adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in window sill edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.

E. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

END OF SECTION 123661

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SECTION 126413 – UPHOLSTERED BANQUETTES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes upholstered banquette seating.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of components, and finishes for upholstered banquettes.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment details.
2. Seating Layout: Show seating layout.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Wood and Plywood Materials and Finishes: Manufacturer's standard-size unit, not less than 3 inches square.
2. Upholstery Fabric: Full width by 36-inch- long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of upholstered banquettes.

B. Material Certificates: For each type of flame-retardant treatment of upholstery fabric.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For upholstered banquettes to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Methods for maintaining upholstery fabric.

b. Precautions for cleaning materials and methods that could be detrimental to seating finishes.

1.6 QUALITY ASSURANCE

A. Quality Standard: Exposed woodwork, including, but not limited to, material, finishes, and veneer matching, shall comply with AWI Custom Grade.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install upholstered banquettes until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of upholstered banquettes that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including standards, beams, and pedestals.
b. Wear and deterioration of fabric and stitching beyond normal use.

2. Warranty Periods: 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of seating required, including accessories and mounting components, from single source from single manufacturer.

1. Upholstery Fabric: Obtain fabric of a single dye lot for each color and pattern of fabric required.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics of Upholstered Banquettes:

1. Fabric and Padding:

a. Fabric: Class 1 according to DOC CS 191 or 16 CFR 1610, tested according to California Technical Bulletin 117-2000.
b. Padding: Comply with California Technical Bulletin 117-2000.

2. Upholstery Assembly: Assembly shall comply with component-testing requirements of California Technical Bulletin 117-2013.
3. Strength and Durability Performance: Upholstered banquettes shall pass applicable testing requirements according to BIFMA X5.4.

2.3 UPHOLSTERED BANQUETTES

A. Description: Fixed seating with upholstered seat and back, in configuration indicated on Drawings.

B. Framework: Hardwood lumber or welded steel at manufacturer's option.

C. Exposed Finish: Hardwood Lumber Veneer.

D. Padding: High resiliency polyurethane foam with two layers of dacron.

E. Upholstered Back: Padding and fabric covering.

F. Upholstered Insert (seat): Padding and fabric covering over no-sag springs

2.4 MATERIALS AND FINISHES

A. MDF (Medium-Density Fiberboard): ANSI A208.2, Grade MD.

B. Concealed Plywood: HPVA HP-1 hardwood plywood or DOC PS 1 softwood plywood as standard with manufacturer.

C. Exposed Plywood: HPVA HP-1, Face Grade A, hardwood-veneer core with color-matched hardwood-veneer faces.

D. Hardwood Lumber and Veneer Faces: Clear white oak.

1. Stain and Finish: Match Architect's sample.

E. Fabric: As indicated on Finish Legend

1. Color and Pattern: As indicated by manufacturer's designations.

F. Upholstery Padding: HR-40. High resiliency polyurethane foam.

1. Density: 3.2lb./cu. Ft. per ASTM D 3574.
2. Pounding-Fatigue Performance: Grade AP (heavy-duty use) for seats and Grade BP (normal duty use) for backs; according to ASTM D3453.

G. Batting: Dacron polyester.

H. Springs: -9 gauge no-sag (zig-zag) springs with clips.

2.5 FABRICATION

A. Upholstery: Fabricate fabric-covered cushions with molded padding beneath fabric and with fabric covering free of welts, creases, stretch lines, and wrinkles. For each upholstered component, install pile and pattern run in a consistent direction.

B. Lay out fabric to minimize seams. Reinforce seams and terminate runs of fabric out of normal view.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine floors, risers, and other adjacent work and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install upholstered banquettes in locations indicated and fasten to substrates according to manufacturer's written installation instructions. Install banquettes level and plumb.

1. Install banquettes in such a manner that installation shall comply with performance requirements.

3.3 ADJUSTING

A. Repair minor abrasions and imperfections in finishes with coating that matches factory-applied finish.

B. Replace upholstery fabric damaged during installation or work of other trades.

END OF SECTION 126413

SECTION 210500 – COMMON WORK RESULTS FOR FIRE SUPPRESSION (DESIGN-BUILD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 21 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 21 specifications contain statements more definitive or more restrictive.

1.2 SCOPE

A. Design, fabricate, install, and secure required approvals for a complete fire protection automatic sprinkler system where shown on the Drawings, as specified herein, and as needed for a complete and proper installation in accordance with pertinent requirements of NFPA 13, and local governmental agencies having jurisdiction.

B. Work includes providing design services; furnishing all labor, material, equipment and installation as necessary and reasonably incidental to the proper completion and proper operation of the fire protection systems. The work shall consist of but shall not necessarily be limited to the following:

1. Wet-pipe Sprinkler systems as specified in Section 211313.

1.3 DEFINITIONS

A. Words and phrases used throughout the Contract Documents shall be interpreted as indicated below:

1. Construction Documents – the basis for the work. It includes both the Drawings (plans) and Project Manual (specifications).

2. Contractor – The person or organization awarded the contract for fire protection design and construction services.

   In the case of a construction project administered as a multiple-prime contract, the term shall be further defined as the Contractor holding a prime contract for fire protection design and construction work.

   The terms "Fire Protection Contractor" and "Sprinkler Contractor" may be used interchangeably with the term Contractor.

3. Provide – To furnish and install materials, equipment, or systems.

4. Submittals – Submittals shall include Manufacturer's Catalog Data, Shop Drawings, Calculations, Certificates of Compliance, Testing Reports, Samples, and Operation and Maintenance Manuals.

5. Professional – The Architect and/or Engineer of record.
6. Work By Others – Work provided by a person or organization other than the Contractor.

1.4 CODES, REFERENCES, AND STANDARDS

A. The Contractor shall comply with all laws, ordinances, and regulations of all Authorities Having Jurisdiction, including those of all applicable City, County, State, Federal and Public Utility entities. All licenses, permits, fees, inspection fees, etc., shall be obtained by the Contractor and the cost shall be included in the Contract price.

B. The minimum standard of work under this contract shall be in accordance with the following model building codes and standards:

1. International Code Council (ICC)
    a. International Building Code with 2018 North Carolina Amendments
    b. International Fire Prevention Code with 2018 North Carolina Amendments
2. National Fire Protection Association
    a. NFPA 13 – Standard for the Installation of Sprinkler Systems
    b. NFPA 70 – National Electric Code
    c. Requirements for Automatic Sprinkler Systems, latest edition.

C. Other publications listed throughout Division 22 form a part of this specification to the extent referenced. All publications shall be the latest edition as adopted by the Authority Having Jurisdiction. The publications are referred to in the text by basic designation only.

1.5 QUALITY ASSURANCE, WORKMANSHIP AND COORDINATION

A. The Contractor must coordinate his work with that of the other trades so that all work will be performed in an orderly manner and with the least possible interference. Where coordination with other trades is required, the Professional shall make the final decision regarding changes to be made in the work.

B. The Contractor must thoroughly familiarize himself with all specifications and drawings for the project so that he clearly understands his responsibility in relationship to the work to be performed. The Contractor must plan and perform his work to permit the use of the building as soon as possible.

1. 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. The Contractor shall guarantee the workmanship, materials, and equipment, furnished against defects, leaks, performance and non-operation for a period of one (1) year after the date of final acceptance. Defective workmanship shall be construed as meaning defective materials and unsatisfactory installation and not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by defective workmanship as construed herein within the period covered by the Guarantee, including all incidental work required to correct the deficiency.

D. The Contractor shall expressly and completely follow all manufacturers' instructions required for validation of the manufacturer's warranty agreement including but not limited to service, maintenance and adjustments of the equipment.

E. The Contractor will be held responsible for the proper installation of all materials and equipment required for a complete installation within the intent and meaning of the Contract Documents.

1. All grooved joint 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.

2. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

F. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)

1.6 PROJECT RECORD DRAWINGS

A. Deviations from the Contractor's approved Design and Fabrication Drawings necessary to coordinate the work with other trades, to conform to the building conditions or to conform to the rules and regulations of Authorities Having Jurisdiction shall be made only after obtaining written permission from the Professional.

B. The Contractor shall keep a record of construction changes and deviations from the original Design and Fabrication Drawings. All changes shall be recorded on a separate set of prints which shall be kept at the job site specifically for that purpose. The record shall be made immediately after the work is completed. Documentation shall include:

1. changes in pipe routing location
2. valve locations
3. Equipment locations, etc.
4. actual capacities and values of equipment provided as indicated in equipment schedules

C. The marked-up record set of drawings shall be submitted to the Professional for review and approval before final acceptance of the Fire Protection Contract work.

1.7 FIELD MEASUREMENTS

A. Before ordering any equipment and material, or performing any work, the Contractor shall verify all measurements and dimensions at the job site and shall be held responsible for the correctness of same.

B. No extra compensation will be allowed because differences between actual dimensions and measurements and those indicated on the Contractor's drawings.

1.8 PROTECTION OF SERVICES AND EQUIPMENT

A. The Contractor, at his own expense, shall repair, replace and maintain in service any utilities, facilities or services (underground, aboveground, interior or exterior) damaged, broken, or otherwise rendered inoperative during construction due to activities on the part of the Contractor. The method used by the Contractor in repairing, replacing or maintaining the services shall be approved by the Professional.

B. The Contractor shall protect, at his own expense, such of his work, materials or equipment that is subject to damage during the project duration. All openings into any piping, ducts or equipment must be securely covered, or otherwise protected, to prevent injury due to carelessly or maliciously dropped tools or materials, grit, dirt, or any foreign material. The Contractor shall be held responsible for all damage so done until his work is fully and finally accepted.

C. It shall be the responsibility of the Contractor to protect motors, pumps, electrical equipment, and all similar items of equipment from dirt, grime, plaster, water, etc. during all phases of construction. This protection shall be provided by covering equipment with transparent plastic sheeting and/or locating the materials and equipment in an area free from the elements.

1.9 INTERRUPTION OF SERVICES

A. The Contractor shall schedule his work to avoid any major interruption of any utility services.

B. Existing utilities serving facilities occupied and used by the Owner or others shall not be interrupted except when such interruptions have been authorized in writing by the Owner or the Professional. Interruptions shall occur only after acceptable temporary utility services have been provided. The Contractor shall provide a minimum of ten (10) working days notice to the Professional and receive written notice to proceed before interrupting any utility.

1.10 CLEANUP

A. The Contractor shall maintain buildings, grounds, and public properties free from accumulations of waste materials, debris and rubbish. At reasonable intervals during the progress of work, and when directed by the Owner's Authorized Representative, the site and public properties shall be cleaned and waste materials, debris and rubbish shall be disposed of in appropriate manner. The Contractor shall provide containers for collection of waste materials, debris and rubbish. Waste materials, debris and rubbish shall be removed from the job site and legally disposed of at a landfill area in accordance with all applicable regulations. Burning or burying waste materials, debris or rubbish on project site shall not be permitted.

B. At the completion of the Project, remove waste materials, rubbish, tools, equipment, machinery, surplus materials, etc., and clean all sight-exposed fire protection fixtures and equipment. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight-exposed fire protection fixtures and equipment. Broom clean paved and concrete surfaces; rake clean other ground surfaces. Repair, patch and touch up marred surfaces to specified finish or to match adjacent surfaces.

1.11 SUBMITTALS

A. Submittals shall be in accordance with Division o1 of the Project Manual.

B. General

1. The Contractor shall provide to the Professional for review six (6) copies of required submittals, unless noted otherwise. All Catalog Data, Shop Drawings, Design (hydraulic) Calculations, and Certificates of Compliance shall be submitted as a single package. All delays to the job resulting from the Contractor's failure to provide submittals at one time will be the responsibility of the Contractor. Four (4) copies will be returned to the Contractor.
2. Submittals provided for review shall clearly and completely describe the specific product(s) they represent. Where differences exist between the item specified and that submitted for review, the submittal shall be highlighted.
3. Shop Drawings shall be prepared by a Certified NICET Level III technician with currently employment by the contractor. The plans should bear the signature, stamp, and certificate number of the technician.
4. Submittals shall bear the review stamp of the Contractor. The review stamp of the Contractor shall be affixed to shop drawings to indicate:

    a. The Contractor has coordinated the electrical characteristics of the equipment.
    b. The Contractor has verified that the equipment submitted will physically fit into the space allocated with adequate clearances for maintenance, access, and egress requirements.
    c. The Contractor shall bear all associated costs that may accrue due to failure to completely represent a given product.

5. Material and equipment shown on the drawings or specified herein shall not be incorporated in the work of this Contract until shop drawings, hydraulic calculations, engineering data and catalog information have been reviewed and accepted by the Professional.

6. Grooved joint couplings and fittings shall be shown on drawings and product submittals and shall be specifically identified with the applicable style or series designation.

C. Operation and Maintenance Manuals

1. Submit two (2) sets of 8-1/2" x 11" text sixty (60) days prior to operator training/pre-final inspection bound in three D side ring capacity expansion binders with durable plastic covers for review by the Professional.
2. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS – FIRE PROTECTION SYSTEMS", title of project, and subject matter of binder when multiple binders are required.
3. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
4. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified type on thirty (30) pound white paper.

    a. Part 1: Directory, listing names, addresses, and telephone numbers of Contractor, Subcontractors, and equipment suppliers.
    b. Part 2: Operation and maintenance instructions arranged by system or process flow and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:

1) Significant design criteria.
2) List of equipment.
3) Parts list for each component.
4) Maintenance instructions for equipment and systems.
5) Maintenance instructions for finishes, including recommended cleaning methods and materials and operating instructions.
6) Special precautions identifying detrimental agents.
7) Special Requirements of other sections of this specification noted to be included in the operating and maintenance manual.
8) Original copy (reproductions will not be accepted) of NFPA 25 – Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.

c. Part 3: Project documents and certificates, including the following:

1) All approved Submittals
2) Shop Drawings
3) Hydraulic Calculations
4) Certificates of Compliance
5) Photocopies of warranties and bonds
6) Material safety data sheets

5. Submit two (2) copies of completed volumes in final form fifteen (15) days prior to owner training. These copies will include Professional's previous review comments.

1.12 ELECTRICAL EQUIPMENT

A. The Contractor shall furnish all motors, combination starters/disconnects, overload protection and controls for equipment required to provide complete and workable systems, unless noted otherwise.

B. All motors, motor control equipment and wiring shall meet the requirements of the National Electric Code and shall comply with the requirements of the Public Utility Company furnishing service and with the rules and regulations of all Authorities Having Jurisdiction.

C. The Contractor shall verify electrical characteristics at the site before ordering electrical equipment.

D. Motors under ½ (one-half) horsepower shall be 120 volts. Motors ½ (one-half) horsepower and over shall be 3 (three) phase. All motors to be 1750 revolutions per minute (rpm) unless noted otherwise. Combination motor starters shall be of the fused switch type complete with magnetic motor starter. Units shall be of the NEMA size and type applicable to motor size, with 3-pole overload. Overload elements and fuses shall be of the proper size to protect the motor. Unless noted otherwise, units shall be equipped with indicating lights, HAND-OFF-AUTOMATIC (HOA) selector switch, four (4) auxiliary contacts two (2) normally open (N.O.) and two (2) normally closed (N.C.) and fused control transformer to provide 120-volt control voltage. Fusible disconnect switch operating handles shall be interlocked with the door so that the door cannot be opened with the switch in the "ON" position, except through a hidden release mechanism. The operating handle shall be arranged for padlocking in the "OFF" position with up to three padlocks. Fuses shall be furnished by the Contractor as required to comply with NEC requirements. Where R type fuses are indicated, fuse holders shall be provided with

rejection clips. Equipment shall be Square D, Allen-Bradley, or General Electric or accepted substitute, and shall be provided with a NEMA Type 1 enclosure, unless noted otherwise.

1.13 CONTROL WIRING

A. The Contractor shall provide all necessary control wiring and related conduit required for complete and workable systems.

B. All conduit and wiring shall be in accordance with the latest edition of the National Electrical Code. Installation of control wiring shall be performed in a neat and workmanlike manner by competent workmen. Workmanship shall be as specified in Division 16.

C. Control circuits shall be wired for 110-volt control, using fused individual control transformers. Circuits shall be fused and shall be interrupted when the disconnect device is opened.

1.14 INSPECTION AND TESTING

A. General

1. New fire protection systems which have been altered, extended or repaired shall be tested to disclose leaks and defects.
2. The Contractor shall notify the Professional a minimum of 5 (five) working days prior to testing to coordinate the testing and inspection procedures.
3. If the Professional determines that the fire protection systems do not pass the prescribed tests, then the Contractor shall be required to make the necessary repairs, at his own expense, and the Contractor shall re-inspect and re-test the systems. Repairing, inspection and testing shall be continued until all systems pass as determined by the Professional.
4. All new, altered, extended or replaced fire protection shall be left uncovered and unconcealed until it has been inspected, tested and accepted by the Professional. Where such work has been covered or concealed before it has been inspected, tested and accepted, it shall be uncovered by the Contractor, at his own expense as directed by the Professional.
5. All equipment, material, labor, etc., required for testing the fire protection systems shall be furnished by the Contractor.

1.15 INSTRUCTION OF THE OWNER

A. After acceptance of the Project, the Contractor shall furnish the services of personnel thoroughly familiar with the completed installation to instruct the Owner in the proper operation and maintenance of all equipment and appurtenances provided.

B. The Contractor shall provide the Owner with two weeks' notice before the instruction session.

1.16 CUTTING, PATCHING, FINISHING

A. Unless otherwise noted, the Contractor shall cut, patch and finish all chases and openings required for the installation of work to be performed under this Contract. All patching and finishing shall match adjacent undisturbed surfaces.

B. Cutting shall not cause damage to the building or leave unsightly surfaces. Where such unsightly conditions are caused by the Contractor, he shall be required to repair these.

C. The Contractor shall contact the holder of the guarantee and obtain written approval before cutting the roofing membrane so as not to void said guarantee.

D. No structural member shall be cut.

E. Penetrations made in fire rated chases, partitions, floors, etc. shall be sealed with an approved material and method as required to maintain the integrity of the fire separation.

F. All materials and methods to be used for patching and repairing shall be subject to the approval of the Professional and the Owner's Authorized Representative.

G. The Contractor shall set all sleeves, hangers, and anchors required for the Fire Protection Contract work and shall be responsible for their proper and permanent location.

H. No cutting shall be done which may affect the building structurally or architecturally without first securing the approval of the Professional. Cutting shall be accomplished in such a manner as not to cause damage to the building or leave unsightly surfaces which cannot be concealed by plates, escutcheons, or other construction. Where such unsightly conditions are caused, the Contractor shall be required, at his own expense, to repair the damaged areas.

I. Cutting of the construction excessively or carelessly done shall be repaired to match the original by the Contractor and to the satisfaction of the Professional who will make the final decision with respect to excessive or careless cutting work. The Contractor shall seal all openings he has made in plenum spaces, fire rated floors, ceilings or partitions after his work has been installed. The material used for sealing the openings shall have a fire rating equal to or greater than the rating on the floor, ceiling or partition material.

J. Where present equipment is removed and unused openings remain in walls, floors, partitions, etc., the Contractor shall properly patch all such openings except as hereinafter specified under "Work by Others." All patching and repairing shall be done by workmen skilled in this type of work and shall match present or new finishes.

K. Cutting, patching, and repairing of openings in exterior walls and roof shall be by the General Contractor.

1.17 CHASES AND OPENINGS

A. All chases and openings required for the installation of the work shall be coordinated with the other trades. The Contractor shall provide the other trades with sufficient time (1 (one) week minimum) for coordination of all chases and openings. The contractor shall be responsible for all work required to cut and patch the required openings. The work shall be performed to the satisfaction of the Professional.

B. Penetrations made in fire rated chases, partitions, floors, etc., shall be sealed with an approved material and method as required to maintain the integrity of the fire separation.

C. The Contractor shall provide all sleeves, hangers, and anchors required for installation of work in chases and openings.

1.18 PAINTING

A. Painting shall be in accordance with Division 09.

1.19 RELATED WORK

A. All work related to providing complete fire protection systems and equipment shall be the responsibility of the Contractor. The following related work shall be provided as indicated in other specification Divisions, unless noted otherwise, but shall remain the responsibility of the Contractor for workmanship and completeness:

1. General Contractor

a. Installation of access panels.
b. Final painting of walls, floors, and ceilings where the surfaces are being refinished and remodeled under the General Contract. Refer to General Construction Drawings.
c. Concrete housekeeping pads for fire protection equipment.

2. Food Service Equipment Contractor

a. Kitchen hood fire extinguishing systems.

3. Electrical Contractor

a. Verification of the proper rotation of three phase equipment, and making modifications as required to correct improper rotation.
b. Installation of all combination starters/disconnects and overload protectors.

1.20 MISCELLANEOUS STEEL AND ACCESSORIES

A. The contractor shall provide all necessary steel angles, channels, pipe, rods, nuts, bolts, etc., as shown on plans, as specified, or as may be required for complete and proper installation of sprinkler piping, systems and equipment. All material and workmanship shall be of the best quality and shall be installed in accordance with the best practices of the trade.

1.21 ACCESS PANELS

A. The Contractor shall furnish access doors to the General Contractor for installation in ceilings, walls, partitions and floors for access to valve and other appurtenances.

B. Access panels shall be of sufficient size to permit removal or access to equipment, except that the minimum size shall be 12-inches by 16-inches.

C. Access door locations shall be as determined by field conditions for optimum access to equipment, and shall be reviewed by the Professional before final installation

D. Access doors shall be suitable for installation in the finish material of the ceilings, walls, partitions, and floors.

E. Frame and panel access doors in restrooms, kitchens and as indicated shall be stainless steel.

F. Access doors with UL Listing shall be provided in rated construction assemblies. Access doors shall be "B-Label" and shall have a UL one and one-half (1-1/2) hour rating at 250 degrees F rating for both door and frame. Maximum size shall be 20" x 20" or 400 square inches in area. Frame shall be sixteen (16) gauge minimum steel, panel shall be twenty (20) gauge minimum steel. Access doors shall be provided with a baked-on enamel finish (prime coat), continuous type hinge on one side, flush-face type lock with key operation and self-latching cylinder locks.

G. Access doors without UL label shall be provided in all non-rated construction assemblies: Frame shall be sixteen (16) gauge minimum steel, panel shall be fourteen (14) gauge minimum steel. Access doors shall be provided with a baked-on enamel finish (prime coat), concealed spring type hinges and flush-face type lock with key operation and self-latching cylinder locks. Door shall open 175 degrees (minimum).

H. All access doors shall be keyed alike.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials used on fire protection systems shall meet the requirements of applicable codes, standards, and requirements of Local Authorities Having Jurisdiction and the Owner's Insurance Carrier.

2.3 SPRINKLER AND STANDPIPE PIPING, ABOVE GROUND

A. Piping: black steel meeting ASTM A53, ASTM A135, or ASTM A795.

1. Piping 1-1/2 and larger shall be Schedule 10 or the approximately equal "flow" products with roll-grooved, flanged, or welded connections.

2. Piping 1-1/4" and smaller shall be Schedule 40 with threaded or welded connections or Schedule 10S stainless steel with Vic-Press connections.

3. Piping shall be hot-dipped galvanized where specified herein or noted on the drawings.

B. Fittings: UL-listed, standard weight suitable for pressures up to 250 psig, cast iron meeting ASTM A126 or malleable iron meeting ASTM A197. Threaded cast iron fittings shall meet ANSI B16.4; flanged cast iron fittings shall meet ANSI B16.1. Threaded malleable iron fittings shall meet ANSI B16.3. Grooved fittings and couplings shall be UL-listed and shall be of ductile iron meeting ASTM A536, utilizing an EDPM gasket. Fittings shall be short pattern, with flow equal to standard pattern fittings. Plain-end fittings and couplings, or welded-segmented fittings shall not be used. Changes in pipe diameter shall be made using tapered reducing fittings. Bushings or grooved-end reducing couplings shall not be used unless standard reducing fittings are not regularly available.

1. Grooved joint couplings shall be:
   a. Rigid Type: Housings shall be cast with offsetting angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with NFPA-13. Couplings shall

be fully installed at visual pad-to-pad offset contact. (Tongue and recess type couplings, or any coupling that requires exact gapping of bolt pads on each side of the coupling at specified torque ratings, are not allowed.) Center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth.

1) 1-½" through 12": Installation-Ready, for direct stab installation without field disassembly. Victaulic Style 009N.

b. Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for seismic applications. Victaulic Installation-Ready Style 177 or Style 75 and 77.

2. Gaskets:

Fire Protection Service	Temp. Range	Gasket Recommendation
Dry Systems	Ambient	FlushSeal®, Grade EPDM, Type A
Freezer Applications	-40°F to 0°F	FlushSeal®, Grade L, Silicone
Water/Wet Systems	Ambient	Grade EPDM, Type A

2.4 VALVES FOR FIRE PROTECTION SYSTEMS

A. Gates Valves: Class 125, comply with MSS SP-80, bronze body, screwed bonnet, rising stem, solid wedge. 3" and larger; comply with MSS SP-70, iron body, bronze trim, rising stem, hand wheel, OS&Y, flanged or grooved ends. Basis of Design: Victaulic Series 771.

B. Butterfly Valves:

1. Comply with MSS SP-67, lug type, cast or ductile iron body, chrome plated ductile iron disk, EPDM seat, extended neck, handwheel and gear drive and integral indicating device, built-in tamper proof switch, 200 PSI rating.
2. Grooved end type with ductile iron body, EPDM pressure responsive seat, electroless-nickel coated ductile iron disk stainless steel stem, (Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seat-ing.) Handwheel and gear drive and integral indicating devices, with weatherproof actuator and supervisory switches, 300 PSI rating. Victaulic Series 705.

C. Spring-Actuated Check Valves: 250 PSI rating, grooved end ductile iron one-piece body, stainless steel spring and shaft, suitable for vertical or horizontal installations. Victaulic Series 717.

D. Check Valves: Class 125, comply with MSS SP-80 bronze body, screwed cap. "Y" pattern swing, bronze disc. 3" and larger, comply with MSS SP-71, class 125, iron body, bronze mounted, horizontal swing, cast iron disc.

2.5 DRAIN VALVES

A. Provide bronze compression stop with hose thread nipple and cap.

PART 3 - EXECUTION

3.1 GENERAL

A. All materials and equipment used shall be installed in strict accordance with the Standards under which the materials are accepted and approved, and in strict accordance with the manufacturer's instructions.

B. The Contractor's Drawings shall indicate every bend, offset, change in direction and appurtenance required to provide a complete and workable system.

C. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service and shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)

D. No joints allowed in piping that crosses cable trays. Cable tray installation shall be coordinated with all other trades prior to installation. Where water piping must cross a cable tray, a drip pan will be required to be provided.

END OF SECTION

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Stack-sleeve fittings.
   3. Sleeve-seal systems.
   4. Sleeve-seal fittings.
   5. Grout.

1.3 ACTION 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 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 minimum thickness; round tube closed with welded longitudinal joint.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE 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. Smith, Jay R. Mfg. Co.
   2. 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 SLEEVE-SEAL 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. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. Metraflex Company (The).
   4. Pipeline Seal and Insulator, Inc.
   5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping 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] [Plastic] [Stainless steel].
   3. Connecting Bolts and Nuts: [Carbon steel, with corrosion-resistant coating,] [Stainless steel] of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Available manufacturers:
   1. Hubbard Enterprises/Holdright; Hydroflame Sleeve/Device.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, 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 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-inch annular 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 specified in Section 079200 "Joint Sealants."

E. 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 for firestopping specified in Section 078413 "Penetration Firestopping."

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 1/4-inch annular 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 Section 076200 "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-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

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.

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-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.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above Grade: Galvanized-steel-pipe sleeves or sleeve-seal fittings.
2. Exterior Concrete Foundation below Grade: Galvanized-steel-pipe sleeves.
3. Exterior Concrete Walls below Grade Enclosing Interior Space: Galvanized-steel wall sleeves with sleeve-seal system.
   a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   b. Contractor Option: Sleeve-seal fittings.
4. Concrete Slabs-on-Grade: Galvanized-steel-pipe sleeves, except use galvanized-steel wall sleeves with sleeve-seal system if underslab waterproofing is specified for slab.
   a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
5. Concrete Slabs above Grade: Galvanized-steel pipe sleeves, 2 inches above floor, unless otherwise indicated.
6. Concrete Slabs above Grade Requiring Firestopping: Fire-resistance-rated watertight sleeve-seal fittings.
7. Concrete Slabs above Grade Requiring Firestopping, Wet Areas with Waterproofing or Roofing Membrane Specified: Stack-sleeve fittings, as required by approved firestopping assembly.
8. Interior CMU Walls and Partitions Not Requiring Firestopping: Galvanized-steel-pipe sleeves.
   a. Seal with paintable elastomeric joint sealant specified in Division 07 Section "Joint Sealants."
   b. Carry piping insulation, if any, through partition.
9. Interior CMU Walls and Partitions Requiring Firestopping: Galvanized-steel-pipe sleeves as required by approved firestopping assembly.
10. Interior Framed Partitions Not Requiring Firestopping: Galvanized sheet-steel sleeves.
    a. Seal with paintable elastomeric joint sealant specified in Division 07 Section "Joint Sealants."
    b. Carry piping insulation, if any, through partition.
11. Interior Framed Partitions Requiring Firestopping: Galvanized-steel-pipe sleeves or Galvanized sheet-steel sleeves as required by approved firestopping assembly.

END OF SECTION

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

B. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
e. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Isolation pads.
   2. Isolation mounts.
   3. Restrained elastomeric isolation mounts.
   4. Restraining braces.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
   1. The Sprinkler Contractor shall coordinate with the General Contractor to determine site classification and seismic requirements for this project. Where required, the Sprinkler Contractor shall be responsible for providing restraints to resist the earthquake effects on the Sprinkler system(s). The requirements for these restraints are found in the 2018 North Carolina Building Code.
   2. The Sprinkler Contractor shall refer to the latest edition of the "Seismic Restraint Manual Guidelines for Mechanical Systems" published by SMACNA for guidelines to determine the correct restraints for piping.
   3. The Sprinkler Contractor shall include shop drawings of the specific methods of seismic restraint to be used for this project before installation of piping, ductwork, and equipment.
   4. Any required anchorage of the equipment and materials for this project shall be an integral part of the design and specification of such equipment and materials. Manufacturers of all equipment shall provide anchorage details, isolators, seismic mounts and restraints, etc. necessary to comply with Code requirements.
   5. The Sprinkler Contractor shall retain the services of a Professional Structural Engineer licensed in the State of North Carolina to design seismic restraint elements required for this project. The engineer's computations, bearing his professional seal, shall accompany shop drawings which show Code compliance. Computations and shop drawings shall be submitted for review prior to the purchasing of materials, equipment, systems and assemblies.
   6. Internal seismic restraint elements of manufactured equipment shall be certified by a Professional Engineer retained by the manufacturer. Such certificate applies only to internal elements of the equipment. All equipment anchorage requirements shall be

coordinated with the building structure and shall be compatible thereto. All such anchorage shall be reviewed by the project's structural engineer.

7. The professional engineer retained by the Sprinkler Contractor for seismic restraint calculations shall visit the job site upon completion of the seismic restraint installation. This Engineer shall provide in writing verification of compliance with the approved seismic submittal. This verification shall bear the Engineer's professional seal. Job site inspection by other than this Engineer is not acceptable. This engineer shall also be responsible for any required special inspections and associated documentation.
8. Review of the seismic design and shop drawings by the Engineer/Architect or his agent shall not relieve the Sprinkler Contractor of his responsibility to comply with the seismic or any other requirements of the International Building Code.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES, or an agency acceptable to authorities having jurisdiction.
      b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
   2. Seismic-Restraint Details:
      a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
      b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
      c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Welding certificates.

D. Qualification Data: For professional engineer and testing agency.

1.6 QUALITY ASSURANCE

A. 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.

B. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene, rubber or hermetically sealed compressed fiberglass.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti, Inc.
5. Kinetics Noise Control.
6. Loos & Co.; Cableware Division.
7. Mason Industries.
8. TOLCO Incorporated; a brand of NIBCO INC.
9. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES, or an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

F. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

G. Resilient Isolation Washers and Bushings: One-piece, molded, oil and water-resistant neoprene, with a flat washer face.

H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts

with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

I. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 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. Baked enamel or powder coat for metal components on isolators for interior use.
   4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-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 evaluation service member of ICC-ES, or an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:
   1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

2. Install seismic-restraint devices using methods approved by [an evaluation service member of ICC-ES, or an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:
1. Comply with requirements in MSS SP-127 and NFPA 13.
2. Space lateral supports a maximum of 40 feet on center, and longitudinal supports a maximum of 80 feet on center.
3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, or an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with

requirements in Division 21 Section "Water-Based Fire-Suppression Systems" for piping flexible connections.

END OF SECTION

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Pipes, fittings, and specialties.
   2. Specialty valves.
   3. Sprinklers.
   4. Pressure gages.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Grooved joint couplings and fittings shall be referred to on drawings and product submittals and be identified by the manufacturer’s listed model or series designation.

B. Shop Drawings: For wet-pipe sprinkler systems.
   1. All design work shall be in Revit.
   2. Include plans, elevations, sections, and attachment details.
   3. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Domestic water piping.
   2. HVAC hydronic piping.
   3. Items penetrating finished ceiling include the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.

B. Qualification Data: For qualified Installer and Automatic Sprinkler System Designer.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.
   1.
   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.

D. Fire-hydrant flow test report.

E. 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."

F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for a minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering/Designer Responsibility: Preparation of working plans, calculations, and field test reports by a qualified automatic sprinkler designer holding a current certification from the National Institute for Certification of Engineering Technologies (NICET) as Fire Protection Engineering Technician, Level III, and subfield of Automatic Sprinkler System Layout, or a professional engineer who shall oversee and assume responsibility for system design and approve all submittals.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

C. 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.

2. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

1.9 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
1. Notify Owner no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
1. Sprinkler system design shall be approved by authorities having jurisdiction.
a. Sprinkler Occupancy Hazard Classifications:
1) Building Service Areas: Ordinary Hazard, Group 1
2) Electrical Equipment Rooms: Ordinary Hazard, Group 1
3) General Storage Areas: Ordinary Hazard, Group 1
4) Laundries: Ordinary Hazard, Group 1
5) Libraries except Stack Areas: Light Hazard
6) Library Stack Areas: Ordinary Hazard, Group 2
7) Machine Shops: Ordinary Hazard, Group 2
8) Mechanical Equipment Rooms: Ordinary Hazard, Group 1
9) Kitchen Service Areas: Ordinary Hazard, Group 1
2. Minimum Density for Automatic-Sprinkler Piping Design:
a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
3. Maximum Protection Area per Sprinkler: According to NFPA 13 and UL listing.

C. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

2.2 LISTED FIRE-PROTECTION VALVES

A. General Requirements:
1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:
1. Standard: UL 1091 except with ball instead of disc.
2. Valves NPS 1-1/2 and Smaller: Bronze or brass body with threaded or grooved ends.

3. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
4. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:
1. Standard: UL 1091.
2. Pressure Rating: 175 psig.
3. Body Material: Bronze.
4. End Connections: Threaded.

D. Iron Butterfly Valves:
1. Standard: UL 1091.
2. Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron.
4. Style: Lug or wafer.
5. End Connections: Grooved.
6. Seat: Pressure responsive elastomer.
7. Stem: Stainless steel, offset from the disc centerline to provide complete 360-degree circumferential seating.
8. Basis of Design: Victaulic Series 705.

E. Check Valves:
1. Standard: UL 312.
2. Pressure Rating: 250 psig minimum.
3. Type: Spring assisted swing check.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.
6. Spring: Stainless steel.
7. Installation: Vertical or horizontal.
8. Basis of Design: Victaulic Series 717.

F. Indicating-Type Butterfly Valves:
1. Standard: UL 1091.
2. Pressure Rating: 175 psig minimum.
3. Valves NPS 2 and Smaller:
   a. Valve Type: Ball or butterfly.
   b. Body Material: Bronze or brass.
   c. End Connections: Threaded.
4. Valves NPS 2-1/2 and Larger:
   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged, grooved, or wafer.
   d. Seat: Pressure responsive elastomer.
   e. Stem: Stainless steel, offset from the disc centerline to provide complete 360-degree circumferential seating.
   f. Basis of Design: Victaulic Series 705.
5. Valve Operation: Integral [electrical, 24v DC, prewired, single-circuit, supervisory switch indicating device.

G. Indicator Posts:
1. Standard: UL 789.
2. Type: Horizontal for wall mounting.

3. Body Material: Cast iron with extension rod and locking device.
4. Operation: Wrench.

2.3 TRIM AND DRAIN VALVES

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

2.4 STEEL PIPE AND FITTINGS

A. Standard-Weight, Galvanized-and-Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Galvanized- and Black-Steel Pipe: ASTM A 135/A 135M; ASTM A 795/A 795M, Type E; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Thinwall Galvanized-and-Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

D. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

E. Galvanized-and-Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

F. Galvanized-Steel Couplings: ASTM A 865/A 865M, threaded.

G. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

H. Malleable- or Ductile-Iron Unions: UL 860.

I. Cast-Iron Flanges: ASME 16.1, Class 125.

J. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

K. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

L. Grooved-Joint, Steel-Pipe Appurtenances:
1. Pressure Rating: 175-psig minimum.
2. Galvanized Uncoated Grooved-End Fittings for Steel Piping: ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubbercenter-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth, and ASTM A449 compliant bolts and nuts. Installation-Ready, for direct stab installation without field disassembly.

a. Rigid: Housings cast with offsetting angle-pattern bolt pads, fully installed at visual pad-to-pad offset contact. (Couplings that require exact gapping at specific torque ratings are not permitted.) Basis of Design: Victaulic Style 009N and 107N.
b. Flexible Type: For use in locations where vibration attenuation and stress relief are required. Basis of Design: Victaulic Installation-Ready Style 177N or Style 77.

4.

M. Installation-Ready™ fittings for Schedule [40] [10] grooved end steel piping in 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, prelubricated Grade "E" EPDM Type 'A' gasket; and ASTM A449 electroplated steel bolts and nuts. UL listed for a working pressure of 300 psi (2065 kPa) and FM approved for working pressure 365 psi (2517kPa).

2.5 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:
1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Alarm Valves:
1. Standard: UL 193.
2. Design: For horizontal or vertical installation.
3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
4. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
5. 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.
6. Valve internal components shall be replaceable without removal of valve from installed position.
7. Basis of Design: Victaulic Series 751.

G. Shotgun Riser Check Assembly:
1. Ductile iron construction, incorporating a control valve (Victaulic Series 705), 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.
2. The test & drain assemble shall contain an adjustable relief valve, with a range of 175 to 310 psi, and a universal test orifice of K5.6 [K2.8] [K4.2]; to provide testing capabilities of systems with k-factors ranging from K5.6 [K2.8] [K4.2] and larger.
3. Shotgun riser check assembly shall be rated for use at the maximum service pressure of 300 psi and shall be UL listed and FM approved.
4. Basis of Design: Victaulic Series UMC**.**

H. Automatic (Ball Drip) Drain Valves:
1. Standard: UL 1726.
2. Pressure Rating: 175-psig minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4.
5. End Connections: Threaded.

2.6 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:
1. Standard: UL 213.
2. Pressure Rating: 175-psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-tee and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:
1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:
1. Standard: UL 199.
2. Pressure Rating: 175 psig.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:
1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:
1. Standard: UL 1474.
2. Pressure Rating: 250-psig minimum.
3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:

1. Standard: UL 1474.
2. Type: Flexible hose for connection to sprinkler, and with open-gate one-piece bracket for connection to ceiling grid. The bracket shall allow installation before the ceiling tile is in place.
3. The drop system shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel Male threaded nipple or Victaulic FireLock IGS Groove Style 108 coupling for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head.
4. The drop shall include a UL approved Series AH1 with 3" bend radius; AH2 or AH2-CC braided hose with a bend radius to 2" to allow for proper installation in confined spaces.
5. Pressure Rating: 175-psig minimum.
6. Size: Same as connected piping, for sprinkler.
7. Union joints shall be provided for ease of installation.
8. Victaulic VicFlex™ Multiple-Use Flexible Stainless Steel Sprinkler Drop System [with captured coupling Style 108].

2.7 SPRINKLERS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Sprinklers shall be glass bulb type, with hex shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation.
   1.
   2. Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss integrally cast in the sprinkler body.

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

D. Automatic Sprinklers with Heat-Responsive Element:
   1. Nonresidential Applications: [UL 199] <Insert standard>.
   2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
   3. For Kiln Room, provide a temperature classification above the setpoint of the kiln. Designer responsible for confirming this temperature requirement.
   4. UL listed and FM approved rigid coupling to join sprinklers with IGS profile grooved ends to matching 1" IGS outlets; Coupling consists of two cast copper-alloy housing segments for connection of ½", ¾", and 1" sprinklers. Coupling includes an EPDM Type A gasket, with zinc-plated cap screws conforming to ASTM F835, and nylon insert locknut. Installation-ready, for direct push installation without field disassembly. Rated for a working pressure to 175 psi (1205 kPa). Victaulic Style V9.
   5.

E. Sprinkler Finishes: Chrome plated.

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: Chrome-plated steel, one piece, flat
   2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:
   1. Standard: UL 199.
   2. Type: Wire cage with fastening device for attaching to sprinkler.
   3. Sprinkler guards shall always be used in the gymnasium.

2.8 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections and shall be coordinated with the FACP.

2.9 PRESSURE GAGES

A. Standard: UL 393.

B. Dial Size: 3-1/2- to 4-1/2-inch diameter.

C. Pressure Gage Range: 0- to 250-psig minimum

D. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Include heat trace for exterior RPBP piping.

D. Coordinate the water tap with Charlotte Water Department.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
   2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

N. Fill sprinkler system piping with water.

O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

S. Flexible hose shall be installed to prevent sediment trapping.

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts in accordance with the manufacturer’s published instructions. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints. Grooved coupling manufacturer’s factory trained field representative shall provide on-site training for contractor’s field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts in accordance with the manufacturer's published instructions. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain 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. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

D. Do not install sprinklers that have been dropped, damaged, show a visible loss of fluid, or a cracked bulb.

E. The sprinkler bulb protector shall be removable by hand, without tools or devices that may damage the bulb.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Leak Test: After installation, charge systems 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. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   4. Energize circuits to electrical equipment and devices.
   5. Coordinate with fire-alarm tests. Operate as required.
   6. Coordinate with fire-pump tests. Operate as required.
   7. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.11 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-type fire-suppression standpipe piping, NPS 8 and smaller, shall be one of the following:
   1. Schedule 40 or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

2. Schedule 40 or Schedule 30or thinwall, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Schedule 40 or Schedule 30, black-steel pipe with cut or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Schedule 40 or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Schedule 40 or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
6. Thinwall or Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.12 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended or Gypboard Ceilings: Concealed sprinklers
   3. Wall Mounting: Sidewall sprinklers.
   4. Spaces Subject to Freezing: Pendent, dry sprinklers Sidewall, dry sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   2. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 (General Requirements) sections of the Project Manual apply to this Section.

B. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 22 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 22 sections contain statements more definitive or more restrictive.

1.2 SCOPE

A. Provide all labor, material, equipment and services necessary and reasonably incidental to the proper completion and proper operation of the building plumbing systems.

1.3 DEFINITIONS

A. Words and phrases used throughout the Contract Documents shall be interpreted as indicated below:
1. Construction Documents – the basis for the work. It includes both the Drawings (plans) and Project Manual (specifications).
2. The word "Contractor" as used in this Section of the Specifications refers to the Plumbing Contractor unless specifically noted otherwise. The word "provide" means furnish, fabricate, complete, install, erect, including labor and incidental materials, necessary to complete in place and ready for operation or use the items referred to or described herein, and/or as shown or referred to on the Contract Drawings.
3. Provide – To furnish and install materials, equipment, or systems.
4. Submittals – Submittals shall include Manufacturer's Catalog Data, Shop Drawings, Calculations, Certificates of Compliance, Testing Reports, Samples, and Operation and Maintenance Manuals.
5. Professional – The Architect and/or Engineer of record.
6. Work By Others – Work provided by a person or organization other than the Plumbing Contractor.

1.4 CODES, REFERENCES AND STANDARDS

A. The Contractor shall comply with all laws, ordinances, and regulations of all Authorities Having Jurisdiction, including those of all applicable City, County, State, Federal and Public Utility entities. All licenses, permits, fees, connection fees, tapping fees, inspection fees, etc., shall be obtained by the Contractor and the cost shall be included in the Contract price.

B. The minimum standard of work under this contract shall be in accordance with the following model building codes:
1. North Carolina State Building Codes 2018 Edition:
   a. North Carolina State Building Code.
   b. North Carolina State Plumbing Code.
   c. North Carolina State Mechanical Code.
   d. North Carolina State Fire Prevention Code.

e. North Carolina State Fuel Gas Code.
f. North Carolina State Energy Code.

C. Other publications listed throughout Division 22 form a part of this specification to the extent referenced. All publications shall be the latest edition as adopted by the Authority Having Jurisdiction. The publications are referred to in the text by basic designation only.

1.5 QUALITY ASSURANCE, WORKMANSHIP AND COORDINATION

A. The Contractor must coordinate his work with that of the other trades so that all work will be performed in an orderly manner and with the least possible interference. Where coordination with other trades is required, the Professional shall make the final decision regarding changes to be made in the work.

B. The Contractor must thoroughly familiarize himself with all the Construction Documents for the project so that he clearly understands his responsibility in relationship to the work to be performed. The Contractor must plan and perform his work to permit the use of the building as soon as possible.

C. The Contractor shall guarantee the workmanship, materials, and equipment, furnished against defects, leaks, performance and non-operation for a period of one (1) year after the date of final acceptance. Defective workmanship shall be construed as meaning defective materials and unsatisfactory installation and not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by defective workmanship as construed herein within the period covered by the Guarantee, including all incidental work required to correct the deficiency.

D. The Contractor shall expressly and completely follow all manufacturers' instructions required for validation of the manufacturer's warranty agreement including but not limited to service, maintenance and adjustments of the equipment.

E. The Contractor shall be held responsible for the proper installation of all materials and equipment required for a complete installation within the intent and meaning of the Contract Documents.

1.6 AS BUILT DRAWINGS

A. Changes from the Contract Drawings necessary to coordinate the work with other trades, to conform to the building conditions or to conform to the rules and regulations of Authorities Having Jurisdiction shall be made only after obtaining written permission from the Professional.

B. The Contractor shall keep a record of construction changes and deviations from the original Contract Drawings. All changes shall be recorded on a separate set of prints which shall be kept at the job site specifically for that purpose. The record shall be updated daily. Documentation shall include:
1. location and elevation of new and existing plumbing lines
2. points of connection to existing utility lines
3. changes in pipe routing location
4. valve locations
5. equipment locations, etc.

6. actual capacities and values of equipment provided as indicated in equipment schedules

C. The marked-up record set of drawings shall be delivered to the Professional before final acceptance of the Plumbing Contract work.

1.7 FIELD MEASUREMENTS

A. It shall be the Contractor's responsibility to verify the location of any and all existing underground utilities in the vicinity of his work. When it has been indicated that these utilities are to remain in place, the Contractor shall provide adequate means of support and protection during excavation operations.

B. Before ordering any equipment and material, or performing any work, the Contractor shall verify all measurements and dimensions at the job site and shall be held responsible for the correctness of same.

C. No extra compensation will be allowed because differences between actual dimensions and measurements and those indicated on the drawings.

D. Any difference which may be found shall be submitted to the Professional for consideration before proceeding with the work.

1.8 PROTECTION OF SERVICES AND EQUIPMENT

A. The Contractor, at his own expense, shall repair, replace and maintain in service any utilities, facilities or services (underground, aboveground, interior or exterior) damaged, broken, or otherwise rendered inoperative during construction due to activities on the part of the Contractor. The method used by the Contractor in repairing, replacing or maintaining the services shall be approved by the Professional.

B. The Contractor shall protect, at his own expense, such of his work, materials or equipment that is subject to damage during the project duration. All openings into any piping, ducts or equipment must be securely covered, or otherwise protected, to prevent injury due to carelessly or maliciously dropped tools or materials, grit, dirt, or any foreign material. The Contractor shall be held responsible for all damage so done until his work is fully and finally accepted.

C. It shall be the responsibility of the Contractor to protect motors, pumps, electrical equipment, and all similar items of equipment from dirt, grime, plaster, water, etc. during all phases of construction. This protection shall be provided by covering equipment with transparent plastic sheeting and/or locating the materials and equipment in an area free from the elements.

1.9 INTERRUPTION OF SERVICES

A. The Contractor shall schedule his work to avoid any major interruption of any utility services.

B. Existing utilities serving facilities occupied and used by the Owner or others shall not be interrupted except when such interruptions have been authorized in writing by the Owner or the Professional. Interruptions shall occur only after acceptable temporary utility services have been provided. The Contractor shall provide a minimum of ten (10) working days

notice to the Professional and receive written notice to proceed before interrupting any utility.

1.10 CLEANUP

A. The Contractor shall maintain buildings, grounds and public properties free from accumulations of waste materials, debris and rubbish. At reasonable intervals during the progress of work, and when directed by the Owner's Authorized Representative, the site and public properties shall be cleaned, and waste materials, debris and rubbish shall be disposed of in appropriate manner. The Contractor shall provide containers for collection of waste materials, debris and rubbish. Waste materials, debris and rubbish shall be removed from the job site and legally disposed of at a landfill area in accordance with all applicable regulations. Burning or burying waste materials, debris or rubbish on project site shall not be permitted.

B. At the completion of the Project, remove waste materials, rubbish, tools, equipment, machinery, surplus materials, etc., and clean all sight-exposed plumbing fixtures and equipment. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight-exposed plumbing fixtures and equipment. Broom clean paved and concrete surfaces; rake clean other ground surfaces. Repair, patch and touch up marred surfaces to specified finish or to match adjacent surfaces.

1.11 SUBMITTALS

A. Submittals shall be in accordance with Division 01 of the Project Manual.

B. General
1. The Contractor shall submit required submittals to the Professional. All Catalog Data, Shop Drawings, Calculations, and Certificates of Compliance shall be submitted as a single package. Failure of the contractor to provide a complete submittal package may result in delay in processing time. All such delays to the job resulting from the contractor's failure to provide submittals at one time will be the responsibility of the Contractor. Submittals shall clearly identify the contract documents specification section or drawing referenced, identifying and highlighting each item to be reviewed.
2. Submittals provided for review shall clearly and completely describe the specific product(s) they represent. Where differences exist between the item specified and that submitted for review, the submittal shall be highlighted.
3. Submittals shall bear the review stamp of the Contractor. The review stamp of the Contractor shall be affixed to shop drawings to indicate:
    a. The Contractor has coordinated the electrical characteristics of the equipment.
    b. The Contractor has verified that the equipment submitted will physically fit into the space allocated with adequate clearances for maintenance, access, and egress requirements.
    c. The Contractor shall bear all associated costs that may accrue due to failure to completely represent a given product.
4. Material and equipment shown on the drawings or specified herein shall not be incorporated in the work of this Contract until shop drawings, engineering data and catalog information have been reviewed and accepted by the Professional.

C. Trade Name References
1. Material and equipment are described and listed in the Project Documents by trade name, by manufacturer's name and model number, or by performance attributes. It is

intended that trade names or manufacturer's names shall establish standards of quality, performance, capacity, materials, and design for the item specified.

2. Where more than one manufacturer is listed for an item, those mentioned are considered equivalent if the quality, style, capacities, materials and performance of the specified item are equivalent. All materials and equipment shall be subject to the acceptance by the Professional.

D. Substitutions
   1. No substitution shall be made without the review and acceptance by the Professional.
   2. Where the phrase "or accepted substitute" or "or equal" appears in the Contract Documents, it shall refer to the requirement of acceptance by the Professional of the material or equipment involved.
   3. It shall be the responsibility of the Contractor to ensure that each manufacturer can furnish a substitute in complete conformity with the requirements of this Project. The Contractor shall assume all costs or extra charges associated with the substitution, including: any architectural, structural, mechanical, or electrical changes required, costs in connection with work of the other trades necessitated substitutes, and any additional engineering costs required.
   4. The Contractor shall indicate the specified equivalent on shop drawings or catalog data which are submitted as substitutions.
   5. At the request of the Professional samples of items that are to be used in substitution of specified items shall be submitted. If such a request is made, a sample of both the specified item and the proposed substitute item shall be submitted simultaneously. The scheduling of the submission of such samples shall be as directed and shall in no way delay the progress of the project. The Professional will assume no liability whatsoever for any samples submitted.

E. Operation and Maintenance Manuals
   1. Submit two (2) sets of 8-1/2" x 11" text sixty (60) days prior to operator training/pre-final inspection bound in three D side ring capacity expansion binders with durable plastic covers for review by the Professional.
   2. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
   3. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
   4. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified type on thirty (30) pound white paper.
      a. Part 1: Directory, listing names, addresses, and telephone numbers of Professional, Contractor, Sub
      b. Part 2:Operation and maintenance instructions arranged by system or process floor and subdivided
         1) Significant design criteria.
         2) List of equipment.
         3) Parts list for each component.
         4) Maintenance instructions for equipment and systems.
         5) Maintenance instructions for finishes, including recommended cleaning methods and materials and Operating instructions.
         6) Special precautions identifying detrimental agents.
         7) Special Requirements of other sections of this specification noted to be included in the operating and maintenance manual.
      c. Part 3: Project documents and certificates, including the following:
         1) All approved Submittals

2) Certificates of Compliance
3) Photocopies of warranties and bonds
4) Material safety data sheets

5. Submit completed volume in final form fifteen (15) days prior to owner training. The completed volume will include Professional's previous review comments.
6. Submit final volume revised, within ten (10) days after pre-final observation.

1.12 ELECTRICAL EQUIPMENT

A. All motors, motor control equipment and wiring shall meet the requirements of the National Electric Code and shall comply with the requirements of the Public Utility Company furnishing service and with the rules and regulations of all Authorities Having Jurisdiction.

B. The contractor shall verify electrical characteristics at the site before ordering electrical equipment.

1.13 EXCAVATION, BACKFILLING AND COMPACTION

A. General
1. Prior to beginning any work, the Contractor shall have all underground utilities mark by calling 811 "Call Before You Dig", www.nc811.org.
2. The Contractor shall perform all excavation, backfilling, compaction and necessary finishing for all piping, equipment, and accessories. Piping installation shall be in accordance with local water, sewer and gas utility regulations and applicable State and Local codes.
3. The Contractor shall do all bracing, sheathing, and shoring necessary to perform and protect his excavations. The contractor shall provide safety rails, lights, signs, etc. as necessary or required for safety, as directed by the Professional, or as required to conform to governing laws.
4. The Contractor shall provide, maintain, and operate pumping equipment of sufficient capacity to ensure that all his excavations and trenches are always kept free of water.
5. All surfaces of streets, walkways, seeded areas, or finished grade areas disturbed by the excavation shall be restored to their original condition and/or as indicated on the Project Documents.
6. Protect existing structures, utilities, sidewalks, pavements and other facilities not indicated for removal, from damage caused by settlement, lateral movement, undermining, washout and other hazards resulting from excavation operations.
7. Existing utility lines shown on the Project Documents do not indicate the exact in-place location of the lines and do not show every pipe, fitting or appurtenance that may exist at the project site. The location and depth of all utilities shall be marked and recorded prior to any excavation. Should uncharted or incorrectly charted, existing piping or other utilities be uncovered during excavation, contact the Professional immediately for directions before proceeding further with work in this area. Cooperate with owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner.
8. If it becomes necessary to install any lines or equipment in locations other than those shown, the Professional's acceptance shall be obtained before starting the excavation.
9. The presence of explosives on the project site or the use of explosives in the execution of the work under this contract is not permitted.

B. Excavation
1. All plumbing excavation is classified.

2. Trenches shall be dug to uniform width not less than 12-inches or more than 16-inches wider than the bell diameter of the piping. Trench sides shall be vertical. Excavate trenches to depth indicated or required. Carry depth of trenches for piping as required to establish required slopes and invert elevations. Beyond building perimeter, keep bottom of trenches sufficiently below finished grade to protect against frost. The bottom of trenches shall be accurately graded to provide uniform and smooth flow throughout. Any over-excavation shall be backfilled with modified aggregate and thoroughly tamped to 95% compaction.
3. If trench excavation operations are performed when the atmospheric temperature is less than thirty-five (35) degrees Fahrenheit, the Contractor shall provide at his own expense cold weather protection as required to protect excavated trench bottoms from freezing. Under no circumstances will any pipe be permitted to be laid in a trench containing water or on a subgrade containing frost.
4. Catch Basins, Pits, Manholes, Tanks, etc., - Excavation for the various catch basins, pits, manholes, etc., shall follow the general procedures as outlines hereinbefore. The excavation shall extend as required for proper installation or construction. Backfill shall be carefully placed in layers and tamped.
    a. The base for all tanks, pits, manholes, etc., shall be a minimum of 12-inches compacted fill in 4-inch layers to ninety-five (95) percent compaction or as detailed and noted on the Project Documents.
5. The base for all trenches shall be probed for rocks, stumps, unsuitable soils, soft pockets and areas of excess yielding. Remove projecting stones and sharp objects along trench subgrade. Soft spots and unsuitable soils shall be excavated an additional 6-inches and replaced with clean backfill compacted to ninety-five percent compaction.
6. Reconstruct trenches damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

C. Trench Inspection
1. Notify Professional when trench excavations have reached required depth and trenches are compacted and ready for pipe embedment. Trenches shall be free of debris and unsuitable soils.
2. If the existing soil in the trench bottom is judged to be unsuitable by the Professional, a minimum of the top 6-inches of the trench subgrade shall be removed and replaced with clean backfill compacted to ninety-five percent compaction.

D. Pipe Embedment
1. For pipes less than 6 inches in nominal diameter and flat-bottomed, hand-excavate trench bottoms and support pipe on an undisturbed subgrade.
2. For pipes 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. All pipes shall be laid on cleaned native soil (no rocks or other debris) or a First-Class granular sand bedding material uniformly graded conforming to ASTMC33. The bedding area shall extend from 4-inches (or one-fourth the pipe diameter, whichever is greater) below the bottom of the pipe to 12” above the top of the pipe.
4. The bedding shall provide uniform longitudinal support to the pipe and shall be laid to provide the grade and line as shown on the drawings or as directed by the Professional.
5. Compaction of embedment materials under the haunches and around the pipe to the springline of the pipe shall be by hand tamping. Final embedment for ferrous pipe

materials shall extend from the springline of the pipe to a depth of 12-inches (minimum) above the top of the pipe.

6. Take up and re-lay pipe that is not laid true to required alignment or grade. Pipe that has had its joints disturbed after laying shall be taken up and relayed. Deviation from the required lines and grades will not be permitted unless approved by the Professional.

E. Compaction

1. Thoroughly compact subgrade prior to the installation of 4-inches of First-Class pipe bedding. Following satisfactory pipe laying and in-line structure installation, backfill trenches to a height of at least 12-inches above the top of the outside barrel of the pipe.
2. All fill shall be compacted to ninety-five (95) percent. Each layer shall be compacted to the specified percent of maximum density obtained at optimum moisture content, in accordance with ASTM D1557, method D and ASTM D1556 sand cone method.
3. Compactions shall be accomplished by approved equipment suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
4. Thoroughly compact successive layers of backfill material with a vibrating compactor of a type and size satisfactory to the Professional. Compacting of this backfill by puddling or jetting will not be permitted. Use mechanical tampers to compact backfill materials in trench refill operations to produce a density of backfill at the bottom of each layer of not less than 95-percent of the maximum density obtained at optimum moisture content.
5. The use of special equipment such as the "HYDRA-HAMMER" for compaction of backfill is prohibited.

F. Backfilling

1. Backfilling shall not be undertaken until all tests and inspections have been made. Use care to avoid damaging or displacing piping systems.
2. Trench Backfill:
   a. Ordinary/Native backfill material shall consist of cleaned material excavated from the site free from frozen matter, stumps, roots, brush, other organic matter, cinders or other corrosive material, debris, rocks or stones which are larger than 6 inches, in any dimension, or other materials considered unacceptable by the Professional.
   b. Imported Backfill- material imported from off-site locations. Material shall be free of rock or gravel larger than 3 inches, and free of debris, waste, frozen materials, vegetation and other deleterious matter. Material shall meet the acceptable ASTM soil classification groups for locally available material. Topsoil shall not be used as fill.
3. Trench backfill material shall be placed from the top of the pipe bedding to the ground surface or to the bottom of the pavement section, whichever is applicable.
4. Backfilling shall be carefully performed, and the original surface restored.
5. All trench backfill shall be brought to subgrade ready for base material or topsoil. After the initial aggregate backfill layer has been paced, refill remainder of the trench using backfill materials as follows:
   a. Lawns – Successive 6-inch layers of clean earth backfill material shall be deposited after initial aggregate backfill. This backfill shall consist of excavated material free from large clods of earth and stone. If large stones (greater than 6-inches) are encountered, remove stones from site and haul in clean earth

backfill. The entire trench shall be uniformly tamped after each successive layer is deposited. Replace topsoil to approximate depth of existing as final refill operation and crown to such height as required by the Professional. Maintain crowned surface to the satisfaction of the Professional.

b. Walks and Parking Areas – Clean earth backfill compacted in 6-inch layers to a point 8-inches below the adjacent existing surfaces. Refill the remaining 8-inches with compacted stone and replace walk or paving as required.

c. Paved Areas – When working within the right-of-way limits of all North Carolina State highways, backfilling must be in conformance with the requirements of the North Carolina Department of Transportation, which is made a part of these specifications by this reference thereto. Trenches located within the areas described above shall be backfilled with aggregate material from the top of the "pipe bedding" to the bottom elevation of the pavement structure and must be spread and compacted in layers not to exceed 4 inches when using a mechanical damper.

1.14 CONCRETE

A. Concrete shall comply with Division 03 of the Project Manual.

B. Reinforcing shall conform to ASTM A-615, Grade 60. Concrete exposed to freezing and thawing, salts, sulfates and corrosion shall comply with International Building Code with North Carolina amendments.

C. All concrete shall be of minimum 3000 pounds per square inch (psi) strength in 28 (twenty-eight) days. All concrete shall be mixed by machine. No wet or moistened mixture containing cement shall remain unplaced for a period exceeding 30 (thirty) minutes and shall not be used after its initial set. Re-tempering after initial set is prohibited. Exposed surfaces shall be protected from drying for at least 7 (seven) days. All forms shall be built true and rigid. Form removal shall not injure the concrete.

D. All concrete is to be finished with a hard, smooth troweled finish and is to be faced smooth with rounded corners.

1.15 INSPECTION AND TESTING

A. General
1. New plumbing systems and parts of existing systems which have been altered, extended or repaired shall be tested to disclose leaks and defects.
2. The Contractor shall notify the Professional a minimum of 5 (five) working days prior to testing to coordinate the testing and inspection procedures.
3. If the Professional determines that the plumbing systems do not pass the prescribed tests, then the Contractor shall be required to make the necessary repairs, at his own expense, and the Contractor shall re-inspect and re-test the systems. Repairing, inspection and testing shall be continued until all systems pass as determined by the Professional.
4. All new, altered, extended or replaced plumbing shall be left uncovered and unconcealed until it has been inspected, tested and accepted by the Professional. Where such work has been covered, or concealed before it has been inspected, tested and accepted, it shall be uncovered by the contractor, at his own expense as directed by the Professional.

5. All equipment, material, labor, etc., required for testing the plumbing systems shall be furnished by the Contractor.

B. Sanitary and Vent Systems
1. The system shall be tested in accordance with the North Carolina State Plumbing Code.
2. Rough Plumbing – Systems shall be tested upon completion of the rough piping installation and proved watertight. The water test shall be applied to the system either in its entirety or in sections after rough piping has been installed.
   a. Where applied to the entire system, all openings in the piping shall be closed, except the highest opening, and the system filled with water to point of overflow.
   b. Where the system is tested in sections, each opening shall be plugged, except the highest opening of the section under test, and each section shall be filled with water. A section shall not be tested with less than a 10-foot head of water.
   c. In testing successive sections, at least the upper 10-feet of the next preceding section shall be tested, such that a joint or pipe in the building, except the uppermost 10 feet of the system, shall not have been subjected to a test of less than a 10-foot head of water.
   d. The water shall be kept in the system or in the portion under test for a minimum of 2 (two) hours before inspection starts. The system shall then be inspected to ensure that it is tight at all points.
   e. The Contractor shall provide a written Test and Inspection Report that the above prescribed test(s) have been performed in accordance with these Specifications. The report is subject to approval by the Professional.
3. Finished Plumbing – After the plumbing fixtures have been set and their traps filled with water, the plumbing fixture connections shall be tested and proved gas and watertight. Complete this process again prior to substantial completion.
   a. A smoke test shall be made by filling all traps with water and then introducing into the system smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, the stack openings shall be closed and a pressure equivalent to a 1-inch water column shall be introduced and maintained for the period of the inspection.
   b. Where the local Authority Having Jurisdiction finds that a smoke test need not be performed, a peppermint test shall be performed. Two (2) ounces of oil of peppermint shall be poured into the roof terminal of every line or stack to be tested. The oil of peppermint shall be followed at once by 10 quarts of hot (140-degrees Fahrenheit) water. All roof vent terminals shall then be sealed. The system shall then be inspected for the detection of odor of peppermint. If odor of peppermint is detected, repairs shall be made, and the system shall be retested.
   c. The above tests shall be witnessed by the Authority Having Jurisdiction or by Professional or his representative and the Commissioning Agent.
   d. The above tests shall be performed a second time immediately before substantial completion.
   e. The Contractor shall provide a written Test and Inspection Report that the above prescribed test(s) have been performed in accordance with these Specifications. The report is subject to approval by the Professional.

C. Building Sewer
1. The building sewer shall be tested by insertion of a test plug at the point of connection with the existing sewer system. The building sewer shall then be filled with

water under a head of not less than 10-feet. The water level at the top of the test head of water shall not drop for at least 15 (fifteen) minutes.

D. Domestic Water Systems
1. The system shall be tested either in its entirety or in sections.
2. The system shall be tested and proved tight under a water pressure of 125 pounds per square inch for a period of 2 hours.
3. Potable water shall be used for testing.
4. No joints allowed in piping that crosses cable trays. Cable tray installation shall be coordinated with all other trades prior to installation. Where water piping must cross a cable tray, a drip pan will be required to be provided.

E. Fuel Gas Systems
1. The systems shall be tested in accordance with NFPA 54.
2. All fuel gas piping shall be pneumatically tested for tightness prior to commencement of gas service. Air or nitrogen shall be used as the test medium. The piping system shall be pressurized to 100 psig for a period of 2 hours. All joints shall be leak tested with detection solution while the system is pressurized. The Contractor shall provide a valved ¼ inch FPT connection in the system to which shall be attached a 24-hour pressure recording gauge. The Contractor shall arrange for a gas company representative to witness the test. Leaks shall be repaired by tightening or replacing joints. Caulking of joints is not permitted.

1.16 STERILIZATION OF THE DOMESTIC WATER SYSTEM

A. After the system has been tested and approved, the entire new system, including valves and accessories, shall be chlorinated. Disinfecting shall be in accordance with AWWA C651.

B. Chlorine may be applied in any of the following forms:
1. Liquid chlorine gas-water mixture
a. Chlorine gas-water mixture shall be applied by a solution feed chlorinating device.
2. Direct chlorine gas feed
a. Chlorine gas shall b fed directly from a chlorine cylinder with a suitable device for regulating the rate of flow and the effective diffusion of gas within the line.
3. Calcium hypochlorite and water mixture.
a. Calcium hypochlorite shall be HTH, Perchlorene and Maxochlor, or accepted substitute. A solution consisting of five (5%) percent powder to ninety-five (95%) percent water by weight shall be prepared. The calcium hypochlorite and water mixture, first made into a paste and then thinned to a slurry, shall be injected or pumped into the system.

C. The system or part thereof shall be filled with a water/chlorine solution containing at least 50 parts per million of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million of chlorine and allowed to stand for 3 hours. During the chlorination process all valves and accessories shall be operated.

D. After the chlorination process, the chlorine shall be flushed from the system until the system water is equal in chemical and bacteriological composition to those of the permanent source of water supply.

E. Laboratory tests of the water shall be paid for by the Contractor.

1.17 INSTRUCTION OF THE OWNER

A. After acceptance of the Project, the Contractor shall furnish the services of personnel thoroughly familiar with the completed installation to instruct the Owner in the proper operation and maintenance of all equipment and appurtenances provided.

B. The Contractor shall provide the Owner with two weeks' notice before the instruction session.

1.18 CUTTING, PATCHING, FINISHING

A. Unless otherwise noted, the Contractor shall cut, patch and finish all chases and openings required for the installation of work to be performed under this Contract. All patching and finishing shall match adjacent undisturbed surfaces.

B. Cutting shall not cause damage to the building or leave unsightly surfaces. Where such unsightly conditions are caused by the Contractor, he shall be required to repair these at no additional cost to the owner.

C. The Contractor shall contact the holder of the guarantee and obtain written approval before cutting the roofing membrane so as not to void said guarantee.

D. No structural member shall be cut.

E. Penetrations made in fire rated chases, partitions, floors, etc. shall be sealed with an approved material and method as required to maintain the integrity of the fire separation.

F. All materials and methods to be used for patching and repairing shall be subject to the approval of the Professional and the Owner's Authorized Representative.

G. The Contractor shall set all sleeves, hangers, and anchors required for the Plumbing Contract work and shall be responsible for their proper and permanent location.

H. No cutting shall be done which may affect the building structurally or architecturally without first securing the approval of the Professional. Cutting shall be accomplished in such a manner as not to cause damage to the building or leave unsightly surfaces which cannot be concealed by plates, escutcheons, or other construction. Where such unsightly conditions are caused, the Contractor shall be required, at his own expense, to repair the damaged areas.

I. Cutting of the construction excessively or carelessly done shall be repaired to match the original work by the Contractor and to the satisfaction of the professional who will make the final decision with respect to excessive or careless cutting work. The Contractor shall seal all openings he has made in plenum spaces, fire rated floors, ceilings or partitions after his work has been installed. The material used for sealing the openings shall have a fire rating equal to or greater than the rating of the floor, ceiling, or partition material.

J. Where present equipment is removed, and unused openings remain in walls, floors, partitions, etc., the Contractor shall properly patch all such openings except as hereinafter

specified under "Work by Others." All patching and repairing shall be done by workmen skilled in this type of work and shall match present or new finishes.

K. Cutting, patching, and repairing of openings in exterior walls and roof shall be by the General Contractor.

1.19 CHASES AND OPENINGS

A. All chases and openings required for the installation of the work shall be coordinated with the other trades. The Contractor shall provide the other trades with sufficient time (1 (one) week minimum) for coordination of all chases and openings. The contractor shall be responsible for all work required to cut and patch the required openings. The work shall be performed to the satisfaction of the Professional.

B. Penetrations made in fire rated chases, partitions, floors, etc. shall be sealed with an approved material and method as required to maintain the integrity of the fire separation.

C. The Contractor shall provide all sleeves, hangers, and anchors required for installation of the work in chases and openings.

1.20 PAINTING

A. Painting shall be in accordance with Division 09.

1.21 RELATED WORK

A. All work related to providing complete plumbing systems and equipment shall be the responsibility of the Contractor. The following related work shall be provided as indicated in other specification Divisions, unless noted otherwise, but shall remain the responsibility of the Contractor for workmanship and completeness:
   1. General Contractor
      a. Installation of access panels.
      b. Leaders and gutters.
      c. New catch basins and foundation drains. Final connections shall be by the Contractor, as indicated on the drawings and as herein specified.
      d. Final painting of existing walls, floors, and ceilings where the surfaces are being refinished and remodeled under the General Contract. Refer to General Construction Drawings.
      e. Equipment and furnishings including shop equipment and laboratory equipment. Final connections to all equipment and furnishings shall be provided by the Contractor. The Contractor shall be responsible for coordination of plumbing services with the equipment and furnishings.
      f. Installation and flashing of roof penetrations including but not limited to roof drains, vents through roof, gas piping, etc. Final connections shall be provided by the Contractor.
      g. Casework mounted sinks and lavatories, including faucets, bubblers, strainers, tailpieces, traps, gas cocks, and inter-connecting piping. The Contractor shall install the sinks, equipment and appurtenances and shall make final plumbing connections. Rough-in plumbing work shall be in accordance with rough-in drawings as furnished by the General Contractor Final connections to all fixtures shall be provided by the Contractor. The Contractor shall be responsible for coordination of plumbing services with the fixtures and equipment.

h. Concrete housekeeping pads for plumbing equipment.

2. Food Service Equipment Contractor
   a. Food service equipment including food preparation equipment, hand washing sinks, dishwashing equipment, dishwasher booster heaters, wash-down kitchen hoods, refrigeration equipment, and sink traps and faucets. Final connections to all fixtures and equipment and all associated work including inter-connecting piping, fittings, valves, gauges, gas lines, flexible quick disconnects, and hose assemblies shall be provided by the Contractor. The Contractor shall provide individual supply piping stops at each piece of equipment. All work shall be installed in accordance with the standards and requirements of the National Sanitation Foundation (NSF), the Department of Health and applicable plumbing codes. Rough-in plumbing work shall be in accordance with rough-in drawings as furnished by the Food Service Equipment Contractor. Final connections to all fixtures shall be provided by the Contractor. The contractor shall be responsible for coordination of the plumbing services with the food preparation equipment.
3. Mechanical Contractor
   a. Condensate drain piping.
4. Electrical Contractor
   a. Installation of all combination starters/disconnects and overload protectors.

1.22 MISCELLANEOUS STEEL AND ACCESSORIES

A. The contractor shall provide all necessary steel angles, channels, pipe, rods, nuts, bolts, etc., as shown on plans, as specified, or as may be required for complete and proper installation of plumbing fixtures, systems, and equipment. All material and workmanship shall be of the best quality and shall be installed in accordance with the best practices of the trade.

1.23 ACCESS PANELS

A. The Contractor shall furnish access doors to the General Contractor for installation in ceilings, walls, partitions and floors for access to valves, traps, fittings, and all appurtenances.

B. Access panels shall be of sufficient size to permit removal or access to equipment, except that the minimum size shall be 12-inches by 16-inches.

C. Access door locations shall be as determined by field conditions for optimum access to equipment and shall be reviewed by the Professional before final installation and shall be subject to the following.
   1. Bottom of access doors shall not be lower than the top of the partition base, or a minimum of 6 inches above floor.
   2. Tops and/or sides of access panels shall be a minimum of 6-inches from the ceiling or opening or from the edge of a wall return.

D. Access doors shall be suitable for installation in the finish material of the ceilings, walls, partitions, and floors.

E. Frame and panel access doors in restrooms, kitchens and as indicated shall be stainless steel.

F. Access doors with UL Listing shall be provided in rated construction assemblies. Access doors shall be "B-Label" and shall have a UL one and one-half (1-1/2) hour rating at 250 degrees F rating for both door and frame. Maximum size shall be 20" x 20" or 400 square inches in area. Frame shall be sixteen (16) gauge minimum steel, panel shall be twenty (20) gauge minimum steel. Access doors shall be provided with a baked-on enamel finish (prime coat), continuous type hinge on one side, flush-face type lock with key operation and self-latching cylinder locks.

G. Access doors without UL label shall be provided in all non-rated construction assemblies: Frame shall be sixteen (16) gauge minimum steel, panel shall be fourteen (14) gauge minimum steel. Access doors shall be provided with a baked-on enamel finish (prime coat), concealed spring type hinges and flush-face type lock with key operation and self-latching cylinder locks. Door shall open 175 degrees (minimum).

H. All access doors shall be keyed alike.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials used on plumbing systems shall comply with the following lead ban requirements:
   1. Solders with lead content exceeding 0.2% (two-tenths of a percent) are prohibited. Brass and bronze materials containing 0.25% (two and a half tenths of a percent) or greater lead are prohibited.

PART 3 - EXECUTION

3.1 GENERAL

A. All materials and equipment used shall be installed in strict accordance with the Standards under which the materials are accepted and approved, and in strict accordance with the manufacturer's instructions.

B. The Contract Documents are not intended to indicate every bend, offset, change in direction and appurtenance required to provide a complete and workable system.

C. The contract drawings are diagrammatic and are indicative of the work to be performed. It is not intended that they show every pipe, fitting or apparatus required for a complete installation.

D. Except where otherwise indicated, minimum cover shall not be less than the following:
   1. sanitary sewer piping: 2'-0"
   2. water piping: 3'-0"
   3. gas piping: 2'-0"

E. No joints allowed in piping that crosses cable trays. Cable tray installation shall be coordinated with all other trades prior to installation. Where water piping must cross a cable tray, a drip pan shall be provided.

END OF SECTION

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION 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 cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral water stop 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 minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Smith, Jay R. Mfg. Co.
2. 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 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping 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 Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Presealed Systems.
2. Hubbard Enterprises/Holdright; Hydroflame Sleeve/Device.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Non-shrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

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-inch annular 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 specified in Section 079200 "Joint Sealants."

E. 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 for firestopping specified in Section 078413 "Penetration Firestopping."

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 1/4-inch annular 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 Section 076200 "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-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

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.

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-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 water stop 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.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade: Galvanized-steel-pipe sleeves or sleeve-seal fittings.
   2. Exterior Concrete Foundation below Grade: Galvanized-steel-pipe sleeves.
   3. Exterior Concrete Walls below Grade Enclosing Interior Space: Galvanized-steel wall sleeves with sleeve-seal system.
      a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Contractor Option: Sleeve-seal fittings.
   4. Concrete Slabs-on-Grade: Galvanized-steel-pipe sleeves, except use galvanized-steel wall sleeves with sleeve-seal system if under slab waterproofing is specified for slab.
      a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   5. Concrete Slabs above Grade: Galvanized-steel pipe sleeves, 2 inches above floor, unless otherwise indicated.
   6. Concrete Slabs above Grade Requiring Firestopping: Fire-resistance-rated watertight sleeve-seal fittings.
   7. Concrete Slabs above Grade Requiring Firestopping, Wet Areas with Waterproofing or Roofing Membrane Specified: Stack-sleeve fittings, as required by approved firestopping assembly.
   8. Interior CMU Walls and Partitions Not Requiring Firestopping: Galvanized-steel-pipe sleeves.
      a. Seal with paintable elastomeric joint sealant specified in Division 07 Section "Joint Sealants."
      b. Carry piping insulation, if any, through partition.
   9. Interior CMU Walls and Partitions Requiring Firestopping: Galvanized-steel-pipe sleeves as required by approved firestopping assembly.
   10. Interior Framed Partitions Not Requiring Firestopping: Galvanized sheet-steel sleeves.
      a. Seal with paintable elastomeric joint sealant specified in Division 07 Section "Joint Sealants."
      b. Carry piping insulation, if any, through partition.
   11. Interior Framed Partitions Requiring Firestopping: Galvanized-steel-pipe sleeves or Galvanized sheet-steel sleeves as required by approved firestopping assembly.

END OF SECTION

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. Escutcheons for New Piping:
a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

e. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Thermowells.
6. Dial-type pressure gages.
7. Gage attachments.
8. Test plugs.
9. Sight flow indicators.

B. Related Sections:
1. Section 211100 "Facility Fire-Suppression Water-Service Piping" for fire-protection water-service meters outside the building.
2. Section 211200 "Fire-Suppression Standpipes" for fire protection pressure gages.
3. Section 211313 "Wet-Pipe Sprinkler Systems"
4. Section 221113 "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
5. Section 221116 "Domestic Water Piping" for water meters inside the building.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to requirements, provide products by one of the following:
1. Thermometers:
a. Ashcroft.

b. Palmer.
c. Taylor.
d. H.O. Trerice.

2. Gauges:
a. Ashcroft.
b. Palmer.
c. Taylor.
d. H.O. Trerice.

2.2 BIMETALLIC-ACTUATED THERMOMETERS

A. Standard: ASME B40.200.

B. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.

C. Dial: Non-reflective aluminum with permanently etched scale markings and scales in deg F.

D. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

E. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

F. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

G. Window: Plain glass.

H. Ring: Stainless steel.

I. Element: Bimetal coil.

J. Pointer: Dark-colored metal.

K. Accuracy: Plus or minus 1 percent of scale range.

2.3 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
1. Standard: ASME B40.200.
2. Case: Sealed type, cast aluminum or drawn steel; 5-inch nominal diameter.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
5. Dial: Non-reflective aluminum with permanently etched scale markings graduated in deg F.
6. Pointer: Dark-colored metal.
7. Window: Glass.
8. Ring: Stainless steel.
9. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
a. Design for Thermowell Installation: Bare stem.
11. Accuracy: Plus or minus 1 percent of scale range.

B. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:
1. Standard: ASME B40.200.
2. Case: Sealed type, cast aluminum or drawn steel; 6-inch nominal diameter with back flange and holes for panel mounting.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Non-reflective aluminum with permanently etched scale markings graduated in deg F.
6. Pointer: Dark-colored metal.
7. Window: Glass.
8. Ring: Stainless steel.
9. Connector Type(s): Union joint, back; with ASME B1.1 screw threads.
10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
    a. Design for Thermowell Installation: Bare stem.
11. Accuracy: Plus or minus 1 percent of scale range.

2.4 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
1. Standard: ASME B40.200.
2. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
3. Case Form: Adjustable angle unless otherwise indicated.
4. Tube: Glass with magnifying lens and red organic liquid.
5. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F.
6. Window: Glass.
7. Stem: Aluminum and of length to suit installation.
    a. Design for Thermowell Installation: Bare stem.
8. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.5 THERMOWELLS

A. Thermowells:
1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.6 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Standard: ASME B40.100.
2. Case: Sealed type(s); cast aluminum or drawn steel; 6-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Dark-colored metal.
8. Window: Glass.
9. Ring: Stainless steel.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Standard: ASME B40.100.
2. Case: Liquid-filled type; cast aluminum or drawn steel; 6-inch nominal diameter with back flange and holes for panel mounting.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Dark-colored metal.
8. Window: Glass.
9. Ring: Stainless steel.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.7 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.8 TEST PLUGS

A. Description: Test-station fitting made for insertion into piping tee fitting.

B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

C. Thread Size: NPS 1/4 ASME B1.20.1 pipe thread.

D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F

E. Core Inserts: EPDM self-sealing rubber.

2.9 SIGHT FLOW INDICATORS

A. Description: Piping inline-installation device for visual verification of flow.

B. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

C. Minimum Pressure Rating: 125 psig.

D. Minimum Temperature Rating: 200 deg F.

E. End Connections for NPS 2 and Smaller: Threaded.

F. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 1/3 of the pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:
1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Inlet and outlet of each remote domestic water chiller.
5. As additionally indicated on plans.

L. Install pressure gages in the following locations:
1. Building water service entrance into building.

2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.
4. As additionally indicated on plans.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility. All gage faces shall be visible and readable by a person standing on the floor.

END OF SECTION

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Copper-alloy ball valves.
2. Ferrous-alloy ball valves.
3. Ferrous-alloy butterfly valves.
4. Bronze-alloy check valves.
5. Gray-iron swing check valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Non rising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from a single source from a single manufacturer.

B. ASME Compliance:
1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 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 and plug 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 MANUFACTURERS

A. Subject to requirements, provide valves from a single listed manufacturer for entire project:
1. Fairbanks.
2. Hammond.
3. Nibco.

2.2 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:
1. Gear Drive: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

G. Extended Valve Stems: On insulated valves.

H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

I. Valve Grooved Ends: AWWA C606.

1. Solder Joint: With sockets according to ASME B16.18.
   a. Caution: Use solder with melting point below 840 deg F for angle, check, and globe valves; below 421 deg F for ball valves.
2. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45.

2.3 COPPER-ALLOY BALL VALVES

A. Copper-Alloy Ball Valves, General: MSS SP-110.

A. One-Piece, Copper-Alloy Ball Valves: Brass or bronze body with chrome-plated bronze ball, PTFE or TFE seats, full port and 400-psig minimum CWP rating.

B. Two-Piece, Copper-Alloy Ball Valves: Bronze body with regular-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

C. Three-Piece, Copper-Alloy Ball Valves: Bronze body with regular-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.4 FERROUS-ALLOY BALL VALVES

A. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.

B. Ferrous-Alloy Ball Valves: Class 150, full or regular port.

2.5 BRONZE ALLOY CHECK VALVES

A. Bronze Alloy Check Valves, General: MSS SP-139.

B. Type 2, Class 125, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

C. Type 2, Class 125, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

2.6 GRAY-IRON SWING CHECK VALVES

A. Gray-Iron Swing Check Valves, General: MSS SP-71.

B. Type I, Class 125, gray-iron, swing check valves with metal seats.

C. Type II, Class 125, gray-iron, swing check valves with composition to metal seats.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. 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.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 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: Angle, ball, butterfly, or globe valves.
3. Pump Discharge: Spring-loaded, lift-disc check valves.

B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.

C. Domestic Water Piping: Use the following types of valves:
1. Ball Valves, NPS 2 and Smaller: Three-piece, 400-psig CWP rating, copper alloy.
2. Butterfly valves, 2-1/2" and larger
3. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 150, bronze-alloy.
4. Provide extended valve stems for insulated piping.

D. Sanitary Waste and Storm Drainage Piping: Use the following types of valves:
1. Ball Valves, NPS 2 and Smaller: Three-piece, 400-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
3. Swing Check Valves, NPS 2 and Smaller: Type 3, Class 125, bronze.
4. Swing Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 125, gray iron.
5. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig minimum CWP rating.

E. Select valves, except wafer and flangeless types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End, Steel Piping: Valve ends may be grooved.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and as follows:
1. Swing Check Valves: In horizontal position with hinge pin level.

3.4 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.

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.

3.5 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.

END OF SECTION

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Steel pipe hangers and supports.
   2. Fastener systems.
   3. Equipment supports.
   4. Pipe stands.

1.3 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Powder-actuated fastener systems.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:
1. AAA Technology & Specialties Co., Inc.
2. B-Line Systems, Inc.; a division of Cooper Industries.
3. Empire Industries, Inc.
4. ERICO/Michigan Hanger Co.
5. Globe Pipe Hanger Products, Inc.
6. Grinnell Corp.
7. National Pipe Hanger Corporation.
8. PHD Manufacturing, Inc.
9. PHS Industries, Inc.
10. Piping Technology & Products, Inc.

C. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 FASTENER SYSTEMS
1. Manufacturers:
a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. MasterSet Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated or stainless steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2.4 EQUIPMENT SUPPORTS

A. Description: Welded, shop or field-fabricated equipment support made from structural-steel shapes.

2.5 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

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. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:
1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type 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.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, 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 APPLICATIONS

A. Specific hanger and support requirements are specified 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. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
   3. Carbon or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
   4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
   2. Carbon or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   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.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
   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. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
      a. Light (MSS Type 31): 750 lb.
   8. Medium (MSS Type 32): 1500 lb.
   9. Heavy (MSS Type 33): 3000 lb.
   10. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
   11. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   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.

K. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

L. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

C. Fastener System Installation:
1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
a. Install hangers and supports to allow controlled thermal 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.

F. 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 Section 077200 "Roof Accessories" for curbs.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. Install building attachments within concrete slabs or attach to structural steel. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

I. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

K. Insulated Piping: Comply with the following:
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: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install 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. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
5. NPS 4: 12 inches long and 0.06 inch thick.
6. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
7. Insert Material: Length at least as long as protective shield.
8. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 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 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Valve tags.
   5. Warning tags.

1.3 ACTION 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 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.

D. Use same identification system throughout the project.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: 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. 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, 1/8 inch thick, and having predrilled 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.
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 and provided in the Boiler Room.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White

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.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. 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 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain.

B. Ceiling Valve Tags: Engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Phenolic Plastic, 3-inch by 2-inch, 0.0625-inch minimum thickness Attach valve tags to ceiling grid with screws or rivets to the ceiling grid main component.

C. 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.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."
   1. Paint and color code all exposed piping in the boiler room and mechanical rooms in addition to pipe labels located at 10’-0” intervals.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as access panels, 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 10 feet along each run.
   7. On piping above removable acoustical ceilings, spaced at maximum intervals of 25 feet along each run. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:
   1. Domestic Water Piping, Cold:
      a. Background Color: Blue.
      b. Letter Color: White.
   2. Domestic Water Piping, Hot:
      a. Background Color: Red.
      b. Letter Color: White.
   3. Sanitary Waste and Storm Drainage Piping:
      a. Background Color: Black.
      b. Letter Color: White.
   4. Natural Gas Piping:
      a. Background Color: Yellow
      b. Letter Color: Black

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; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and

units. List tagged valves in a valve schedule. Where valves are located above T-bar type ceilings, install 3-inch by 2-inch phenolic ceiling valve tag with matching valve tag information on the corner of the ceiling tile closest to the valve.

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. Cold Water: 2 inches, square.
      b. Hot Water: 2 inches, round.
      c. Gas: 2 inches, round.
   2. Valve-Tag Color:
      a. Cold Water: Natural.
      b. Hot Water: Natural.
      c. Gas: Yellow
   3. Letter Color:
      a. Cold Water: White.
      b. Hot Water: Black.
      c. Gas: White

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Mineral fiber.
      b. Polyolefin.
      c. Flexible elastomeric.
   2. Adhesives.
   3. Mastics.
   4. Sealants.
   5. Factory-applied jackets.
   6. Field-applied jackets.
   7. Tapes.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
   1. Product Data: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
   2. Laboratory Test Reports: For adhesives and sealants, documentation indicating that product complies 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."

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 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. One-piece pre-molded fitting covers in return air plenums must meet ASTM E84 requirements. Do not use PVC molded fitting covers in return air plenums.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville; Micro-Lok.
   b. Knauf Insulation; 1000 Pipe Insulation.
   c. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Armacell LLC; Tubolit.
   b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

c. RBX Corporation; Therma-cell.

I. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
1. Products: Subject to compliance with requirements, provide the following:
a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.
2. Adhesive 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.
2. Adhesive 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."
3. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.
4. Adhesive 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."
5. Products: Subject to compliance with requirements, provide the following:
a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.
6. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Adhesive 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."

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
   1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-35.
      b. Foster Products Corporation, H. B. Fuller Company; 30-90.
      c. ITW TACC, Division of Illinois Tool Works; CB-50.
      d. Marathon Industries, Inc.; 590.
      e. Mon-Eco Industries, Inc.; 55-40.
      f. Vimasco Corporation; 749.
   2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
   5. Color: White.

2.4 SEALANTS

A. Sealants 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. Joint Sealants:
   1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-76.
      b. Foster Products Corporation, H. B. Fuller Company; 30-45.
      c. Marathon Industries, Inc.; 405.
      d. Mon-Eco Industries, Inc.; 44-05.
      e. Pittsburgh Corning Corporation; Pittseal 444.
      f. Vimasco Corporation; 750.

C. ASJ Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-76.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. Color: White.

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Adhesive: As recommended by jacket material manufacturer.
   2. Color: [White] [Color-code jackets based on system. Color as selected by Architect].
   3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:
   1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
      a. Factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
      d. Factory-Fabricated Fitting Covers:
         1) Same material, finish, and thickness as jacket.
         2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
         3) Tee covers.
         4) Flange and union covers.
         5) End caps.
         6) Beveled collars.
         7) Valve covers.
         8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
   2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
      a. Factory cut and rolled to size.
      b. Material, finish, and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper
      d. Factory-Fabricated Fitting Covers:
         1) Same material, finish, and thickness as jacket.
         2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
         3) Tee covers.
         4) Flange and union covers.
         5) End caps.
         6) Beveled collars.
         7) Valve covers.
         8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
      b. Compac Corp.; 104 and 105.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   4. Adhesion: 90 ounces force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. One-piece pre-molded fitting covers in return air plenums must meet ASTM E84 requirements. Do not use PVC molded fitting covers in return air plenums.

I. Install pipe insulation continuously through hangers with a sheet metal saddle at all pipe hangers.

J. Provide rigid insulation at all hangers for all insulated piping 2” and larger in inner diameter.

K. Install 20-gauge galvanized metal jackets on all exposed insulated lines within 8'-0" above finished floor in occupiable spaces (boiler rooms and mechanical rooms included). Prime metal jacket with paint grip finish.

L. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

M. Install insulation with least number of joints practical.

N. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

P. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

Q. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

S. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

T. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.

3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Division 07 Section "Penetration Firestopping".

F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
7. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
8. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

3.5 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.6 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water: Insulation shall be one of the following:
1. Flexible Elastomeric: 1/2” thick insulation with ASJ for pipe sizes 1/2” thru 1-1/4” and 1” thick insulation with ASJ for pipe sizes 1-1/2” and larger.

B. Domestic Hot Water and domestic hot water circulation: Insulation shall be one of the following:
1. Preformed Mineral Fiber: 1” thick insulation with ASJ for pipe sizes 1/2” thru 1-1/4” and 1-1/2” thick insulation with ASJ for pipe sizes 1-1/2” and larger.

C. Storm water and Overflow: Insulation shall be one of the following:
1. Polyolefin: 1” thick insulation.
2. In concealed areas, Preformed Mineral Fiber: 1” thick insulation with ASJ

D. Sanitary Waste above grade receiving condensate discharge from HVAC unit: Insulation shall be one of the following:
1. Polyolefin: 1” thick insulation.
2. In concealed areas, Preformed Mineral Fiber: 1” thick insulation with ASJ

E. Roof Drain and Overflow Drain Bodies: Insulation shall be one of the following:
1. Polyolefin: 1” thick insulation.
2. In concealed areas, Preformed Mineral Fiber: 1” thick insulation with ASJ

F. Floor Drain Bodies above grade receiving condensate discharge from HVAC unit: Insulation shall be one of the following:
   1. Polyolefin: 1" thick insulation.
   2. In concealed areas, Preformed Mineral Fiber: 1" thick insulation with ASJ

3.12 Field Applied Jacket Schedule

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping:
   1. PVC, Color-Coded by System: 20 mils30 mils thick.
   2. Aluminum, Smooth Corrugated: 0.016 inch 0.020 inch 0.024 inch thick.
   3. Painted Aluminum, Smooth Corrugated: .016 inch 0.020 inch 0.024 inch thick.
   4. Stainless Steel, Type 304 or ype 316], Smooth 2B Finish Corrugated : 0.010 inch 0.016 inch 0.020 inch 0.024 inch thick.

END OF SECTION

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes domestic water piping inside the building.

B. Water meters will be furnished and installed by CMUD.

C. See Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Indicating products comply with requirements.

B. System purging and disinfecting activities report.

C. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
   2. Do not interrupt water service without Owner's written permission.

1.6 QUALITY ASSURANCE

A. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

C. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
   1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
   2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
   3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

D. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
   1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
   2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
   3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 VALVES

A. Balancing and drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

B. Union Ball Valves: MSS SP-122, with full-port ball, socket or threaded detachable end connectors, and pressure rating not less than 150 psig at 73 deg F.

C. Non-Union Ball Valves: MSS SP-122, with full- or reduced-port ball, socket or threaded ends, and pressure rating not less than 150 psig at 73 deg F.

D. Check Valves: Swing or ball-check design and pressure rating not less than 150 psig at 73 deg F.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Section 220500 "Common Work Results for Plumbing".

3.2 PIPE AND FITTING APPLICATIONS

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 may be used on aboveground piping, unless otherwise indicated.

C. Domestic Water Piping on Service Side of Water Meter inside the Building: Use any of the following piping materials for each size range:
   1. NPS 6 and smaller: Hard copper tube, Type L; copper pressure fittings; and soldered joints.

D. Designer Note: Minimize all water piping under building. Water piping shall be below grade only when entering building. If required elsewhere, notify CMS.

E. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter. Use any of the following piping materials for each size range:
   1. NPS 2-1/2" and Smaller: Type K (ASTM B88) seamless soft annealed copper tubing with no joints.
   2. NPS 3" and larger: Ductile Iron Pipe and fittings (AWWA C151, AWWA C110) with rubber gasket joints and rods (AWWA C111).

F. Aboveground Domestic Water Piping: Use any of the following piping materials for each size range:
   1. NPS 2" and Smaller: Type 'L' hard drawn seamless copper tubing (ASTM B 88) and cast copper alloy fittings (ASME B16.18) with lead free 95-5 tin/silver solder joints (ASTM B 32).
   2. NPS 2-1/2 and larger: Type 'L' hard drawn seamless copper tubing (ASTM B 88) and cast copper alloy fittings (ASME B16.18) with BCuP silver / phosphorus / copper brazed joints (AWS A5.8).

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use bronze ball valves for piping NPS 2 and smaller. For piping 2-1/2" and larger, use bronze butterfly valves.
   2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 and smaller.
   3. Drain Duty: Hose-end drain valves.

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 valves for piping NPS 6 and smaller. NPS 1/2 or NPS 3/4 (DN 15 or DN 20) inlet, hose-end drain valves may be adequate for this application.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
   1. Install hose-end drain valves at low points in water mains, risers, and branches.
   2. Install stop-and-waste drain valves where indicated.

3.4 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. 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.

C. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."

D. 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."

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.

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."

H. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

L. 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.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

N. Install piping to permit valve servicing.

O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the 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.

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 for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping."

T. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 "Domestic Water Pumps."

U. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "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 22 05 17 "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 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.5 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. 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. All joints shall be lead free.

3.6 ROUGHING-IN FOR WATER METERS

A. Rough-in domestic water piping for water meter installation according to utility company's requirements.

B. Water meters will be furnished and installed by the local utility company.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hanger and support devices are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. 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.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

F. 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.
6. NPS 6: 10 feet with 5/8-inch rod.

G. Install supports for vertical copper tubing every 10 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

A. Install piping adjacent to equipment and machines to allow service and maintenance.

B. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

C. Connect domestic water piping to water-service piping with shutoff valve, extend and connect to the following where indicated on the drawings:
1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water supply 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. Refer to Division 22 Section "Plumbing Fixtures."
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.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:
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 24 hours 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 test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:
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 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 required corrective action.

C. Domestic water piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 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
3. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
a. Repeat procedures if biological examination shows contamination.
b. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-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 procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Utility Outlet boxes.
8. Hose stations.
9. Hose bibbs.
10. Wall hydrants.
11. Post hydrants.
12. Drain valves.
13. Water-hammer arresters.
14. Air vents.
15. Flexible connectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.
1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. NSF Compliance:
1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: [125 psig] unless otherwise indicated.

2.2 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:
1. Standard: ASSE 1011.
2. Body: Bronze, non-removable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Rough bronze.

C. Pressure Vacuum Breakers:
1. Standard: ASSE 1020.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Accessories:
a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers:
1. Standard: ASSE 1035.
2. Size: NPS 1/4 or NPS 3/8 matching faucet size.
3. Body: Bronze.
4. End Connections: Threaded.
5. Finish: Chrome plated.

2.3 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:
1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:
a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check, Backflow-Prevention Assemblies:
1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications unless otherwise indicated.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:
   a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
   b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

C. Beverage-Dispensing-Equipment Backflow Preventers:
1. Standard: ASSE 1022.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4 or NPS 3/8.
4. Body: Stainless steel.
5. End Connections: Threaded.

D. Dual-Check-Valve Backflow Preventers:
1. Standard: ASSE 1024.
2. Operation: Continuous-pressure applications.
3. Body: Bronze with union inlet.

E. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:
1. Standard: ASSE 1032.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4 or NPS 3/8.
4. Body: Stainless steel.
5. End Connections: Threaded.

F. Hose-Connection Backflow Preventers:
1. Standard: ASSE 1052.
2. Operation: Up to 10-foot head of water back pressure.
3. Inlet Size: NPS 1/2 or NPS 3/4.
4. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
5. Capacity: At least 3-gpm flow.

2.4 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:
1. Standard: ASSE 1003.
2. Pressure Rating: Initial working pressure of 150 psig.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
4. Valves for Booster Heater Water Supply: Include integral bypass.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water-Control Valves:
1. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.

2. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
3. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
   a. Pattern: Globe-valve design.
   b. Trim: Stainless steel.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.5 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:
1. Type: Ball valve with two readout ports and memory-setting indicator.
2. Body: Brass or bronze.
3. Size: Same as connected piping, but not larger than NPS 2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves:
1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:
1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig.
3. Type: Thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Tempered-Water Setting: <Insert deg F>.
8. Valve Finish: Rough bronze.

B. Individual-Fixture, Water Tempering Valves:
1. Standard: ASSE 1070, thermostatically controlled, water tempering valve.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Inlets and Outlet: Threaded.
6. Finish: Rough or chrome-plated bronze.
7. Tempered-Water Setting: 110Insert deg F.

2.7 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 that complies with AWWA C550 or that is FDA approved, epoxy coated 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: [0.020 inch] [0.033 inch] [0.062 inch].
   b. Strainers NPS 2-1/2 to NPS 4: [0.045 inch] [0.062 inch] [0.125 inch].
   c. Strainers NPS 5 and Larger: [0.10 inch] [0.125 inch] [0.25 inch].
6. Drain: Factory-installed, hose-end drain valve.

2.8 UTILITY OUTLET BOXES

A. Ice Maker Outlet BoxesIMB1:
1. Basis-of-Design Product: IPS Corp., Guy Gray, Model MIB1AB.
2. Icemaker Outlet Boxes:
3. Mounting: Recessed.
4. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
5. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
6. Supply Shutoff Fitting: NPS 1/2 ball valve with integral water hammer arrestor and NPS 1/2 copper, water tubing.
7. Provide inline double check valve (ASSE 1024) on supply line to ice maker.

B. Clothes Washer Outlet BoxesWMB1:
1. Basis-of-Design Product: IPS Corp., Guy Gray, T200TPPVCHA.
2. Mounting: Wall, Recessed
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 ball valves with integral water hammer arrestors, NPS 1/2-inch copper, water tubing.
6. Drain: NPS 2-inch standpipe and deep seal P-trap.

C. Condensate Drain Outlet Boxes IDB1:
1. Basis-of-Design Product: IPS Corp., Guy Gray, Model T200LV.
2. Mounting: Wall, Recessed
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Trap Seal Guard: 2” inline trap guard equal to Rectorseal “SureSeal”.
5. Drain: NPS 2-inch and deep seal P-trap

2.9 HOSE STATIONS

A. Single-Temperature-Water Hose Stations:
1. Standard: ASME A112.18.1.
2. Cabinet: Stainless-steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
3. Hose-Rack Material: Stainless steel.

4. Body Material: Bronze with stainless-steel wetted parts.
5. Body Finish: Rough bronze.
6. Mounting: Wall, with reinforcement or Floor, with stainless-steel pedestal, as indicated.
7. Supply Fittings: [NPS 1/2] [NPS 3/4] ball valve and check valve and [NPS 1/2] [NPS 3/4] copper, water tubing. Omit check valve if check stop is included with fitting.
8. Vacuum Breaker:
   a. Integral or factory-installed, non-removable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
   b. Garden-hose thread complying with ASME B1.20.7 on outlet.

2.10 HOSE BIBBS, WALL HYDRANTS

A. Hose bibbs General
   1. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.
   2. Manufacturers: Subject to requirements, provide basis of design product or a comparable product of one of the following manufacturers:
      a. Woodford
      b. Zurn Industries.
      c. J.R. Smith

B. Wall Hydrant HB1: Interior, Concealed Box Type
   1. Basis-of-Design Product: Woodford model MB24-1/2
   2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants..
   3. Pressure Rating: 125 psig.
   4. Valve Body Material: Commercial, Bronze.
   5. Seat: Bronze, replaceable.
   6. Valve: Compression
   7. Supply Connection: 1/2-inch solder-joint inlet, vertical.
   8. Outlet: 3/4 inch, with integral vacuum breaker complying with ASSE 1011 and garden-hose thread complying with ASME B1.20.7.
   9. Mounting: Wall, recessed, encased.
   10. Finish: Stainless Steel.
   11. Operation: Loose key.
   12. Operating Key: One with each hydrant.
   13. Include wall flange with each hydrant.

C. Wall Hydrant HB2: Exterior, Non-freeze, Concealed Box Type
   1. Basis-of-Design Product: Woodford Model MB65.
   2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
   3. Pressure Rating: 125 psig.
   4. Valve Body Material: Commercial, Bronze.
   5. Seat: Bronze, replaceable.
   6. Valve: Compression
   7. Casing and Operating Rod: Provide length required to match wall thickness. Include wall clamp.
   8. Supply Connection: 3/4-inch solder-joint inlet, vertical.
   9. Outlet: 3/4 inch with integral vacuum breaker complying with ASSE 1011 and garden-hose thread complying with ASME B1.20.7.
   10. Mounting: Wall, recessed, encased.

11. Finish: Stainless Steel.
12. Operation: Loose key.
13. Operating Keys(s): One with each wall hydrant.
14. Include wall flange with each hydrant.

D. Wall Hydrant HB3: Exterior, Non-freeze, Concealed Box Type, Hot and Cold mixer:
1. Basis-of-Design Product: Woodford Model HCB67.
2. Application: Can Wash
3. Standard: ASSE 1052.
4. Pressure Rating: 125 psig.
5. Valve Body Material: Commercial, Bronze.
6. Seat: Bronze, replaceable.
7. Valve: Compression
8. Casing and Operating Rods: Of length required to match wall thickness. Include wall clamp.
9. Supply Connections: 3/4-inch hot water and 3/4-inch cold water.
10. Outlet: Exposed with integral vacuum breaker complying with ASSE 1011 and garden-hose thread complying with ASME B1.20.7.
11. Check Valves: Integral, located at each inlet
12. Mounting: Wall, flush mounted, encased.
13. Finish: Stainless Steel.
14. Operating Keys(s): One with each wall hydrant.
15. Include wall flange with each hydrant.

E. Roof Hydrant: HB4: Exterior, Non-freeze, Automatic draining.
1. Basis of Design Product: Woodford Model RHY2-MS
2. Standard: ASSE 1052
3. Pressure Rating: 100 psig.
4. Operation: Lever handle
5. Mounting: Roof, with integral mounting system under deck flange, shim and support casting.
6. Mounting system: Hydrant support base, Underdeck flange, Shim, and bolts.
7. Head: Copper alloy, with pail hook.
8. Inlet: NPS 1-inch
9. Casing: Zinc-plated steel with atmospheric-vent device.
10. Outlet: 3/4 inch with integral backflow preventer complying with ASSE 1052 and garden-hose thread complying with ASME B1.20.7.
11. Drain Port: NPS 1/8 inch

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:
1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Metal bellows.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 AIR VENTS

A. Bolted-Construction Automatic Air Vents:
1. Body: Bronze.
2. Pressure Rating and Temperature: 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] [NPS 1/2] minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.14 SPECIALTY VALVES

A. Comply with requirements for general-duty metal valves in Section 22 05 23 "General-Duty Valves for Plumbing Piping."

2.15 FLEXIBLE CONNECTORS

A. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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 unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

G. Install outlet boxes recessed in wall or surface mounted on wall. Comply with requirements for fire-retardant-treated-wood blocking in Section 06 10 53 "Miscellaneous Carpentry."

H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified. Comply with requirements for fire-retardant-treated-wood blocking in Section 06 10 53 "Miscellaneous 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.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

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. Reduced-pressure-principle backflow preventers.
   3. Carbonated-beverage-machine backflow preventers.
   4. Dual-check-valve backflow preventers.
   5. Water pressure-reducing valves.
   6. Calibrated balancing valves.
   7. Primary, thermostatic, water mixing valves.
   8. Manifold, thermostatic, water mixing-valve assemblies.
   9. Photographic-process, thermostatic, water mixing-valve assemblies.
   10. Primary water tempering valves.
   11. Outlet boxes.
   12. Hose stations.

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 Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, and double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

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

SECTION 221123.21 - INLINE DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Horizontally mounted, in-line, separately coupled centrifugal pumps.
   2. Horizontally mounted, in-line, close-coupled centrifugal pumps.

B. Related Sections include the following:
   1. Section 221123.13 "Domestic-Water Packaged Booster Pumps" for booster systems.

1.3 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.

1.4 ACTION 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.
   1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, without amendments, Section 7 - "Service Water Heating."

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.6 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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 HORIZONTALLY MOUNTED, IN-LINE, SEPARATELY COUPLED CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bell & Gossett Domestic Pump; ITT Corporation.
2. Armstrong Pumps Inc.
3. TACO Incorporated.

B. Description: Factory-assembled and -tested, in-line, single-stage, separately coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shafts mounted horizontal.

C. Pump Construction:
1. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
3. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
4. Coupling: Flexible.
5. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
6. Bearings: Oil-lubricated; bronze-journal or ball type.
7. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.

D. Motor: Single speed, with grease-lubricated ball bearings; and [resiliently] [or] [rigidly] mounted to pump casing.

2.2 HORIZONTALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong Pumps Inc.
2. Bell & Gossett Domestic Pump; ITT Corporation.
3. TACO Incorporated.

B. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.

C. Pump Construction:
1. Casing: Radially split with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.

3. Shaft and Shaft Sleeve: Steel shaft with deflector, with copper-alloy shaft sleeve. Include water slinger on shaft between motor and seal.
4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket.
5. Bearings: Oil-lubricated; bronze-journal or ball type.
6. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.

D. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "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.

2.4 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
1. Type: Water-immersion temperature sensor, for installation in piping.
2. Range: 65 to 200 deg F
3. Enclosure: NEMA 250, [Type 4X] <Insert type>.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 120 V, ac.
7. Settings: Start pump at [105 deg F] [110 deg F] [115 deg F] <Insert temperature> and stop pump at [120 deg F] [125 deg F] <Insert temperature>.
8. Occupied and unoccupied settings shall be controlled by a a standalone 7-day, 24-hour timer for the pumps.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install in-line, seal-less centrifugal pumps with shaft horizontal unless otherwise indicated.

C. Install horizontally mounted, in-line, separately coupled and close-coupled centrifugal pumps with shaft(s) horizontal.

D. Pump Mounting: Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using elastomeric pads. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Minimum Deflection: 1/4 inch.
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 concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use 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.

E. Install continuous-thread hanger rods and spring hangers of size required to support pump weight.
1. Comply with requirements for vibration isolation devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

F. Install pressure switches in water supply piping.

G. Install thermostats in hot-water return piping.

H. Install timers [on wall in engineer's office] <Insert location>.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." 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. Install suction and discharge piping equal to or greater than size of pump nozzles.
1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
c. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties."
3. Install pressure gage at suction of each pump and pressure gage at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

D. Connect [pressure switches,] [thermostats,] [time-delay relays,] [and] [timers] to pumps that they control.

E. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Set thermostats, timers, and time-delay relays for automatic starting and stopping operation of pumps.
   5. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. 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.
      c. Verify that pump is rotating in the correct direction.
   6. Prime pump by opening suction valves and closing drains and prepare pump for operation.
   7. Start motor.
   8. Open discharge valve slowly.
   9. Adjust temperature settings on thermostats.
   10. Adjust timer settings.

3.6 ADJUSTING

A. Adjust domestic water pumps to function smoothly and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Procedures for compliance with certain US Green Building Council's (USGBC) LEED prerequisites and credits needed for the Project to obtain LEED certification apply to this Section.

1.2 SUMMARY

A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
   1. Pipe and fittings.
   2. Special pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water.
   2. Waste, Force-Main Piping: 100 psig.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 SUBMITTALS

A. Field quality-control inspection and test reports.

B. Product Data: For each type of product indicated

C. Manufacturer's Certificate: Indicating products comply with requirements.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
   1. Gaskets: ASTM C 564, rubber.

B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
   1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:
1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.3 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L,water tube, drawn temper.

B. Copper Pressure Fittings:
1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inchmaximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
a. Standard: ASTM C 1173.
b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
c. Sleeve Materials:
1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2) For Dissimilar Pipes: ASTM D 5926
4. Shielded, Non-pressure Transition Couplings:
a. Standard: ASTM C 1460.
b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

5. Pressure Transition Couplings:
   a. Standard: AWWA C219.
   b. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
   c. Center-Sleeve Material: Manufacturer's standard.
   d. Gasket Material: Natural or synthetic rubber.
   e. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:
1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
   a. Description:
      1) Standard: ASSE 1079.
      2) Pressure Rating: [150 psig].
      3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
   a. Description:
      1) Standard: ASSE 1079.
      2) Factory-fabricated, bolted, companion-flange assembly.
      3) Pressure Rating: [150 psig].
      4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric Nipples:
   a. Description:
      1) Standard: IAPMO PS 66
      2) Electroplated steel nipple.
      3) Pressure Rating: 300 psigat 225 deg F.
      4) End Connections: Male threaded or grooved.
      5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

C. Aboveground, soil, waste, and vent piping NPS 8 and smaller shall be any of the following:
1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

D. Underground, soil, waste, and vent piping NPS 8 and smaller shall be any of the following:
1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

E. Aboveground sanitary-sewage force mains shall be the following:
1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.

F. Underground sanitary-sewage force mains NPS 4 larger shall be any of the following:
1. Ductile-iron, mechanical-joint piping and mechanical joints.

3.2 PIPING INSTALLATION

A. Excavating, trenching, and backfilling are specified in Section 220500 "Common Work Results for Plumbing".

B. Piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. 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.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install piping to permit valve servicing.

H. Install piping free of sags and bends.

I. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

J. 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 220517 "Sleeves and sleeve seals for plumbing piping"

K. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section 220517 "Sleeves and sleeve seals for plumbing piping"

L. 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."

M. 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.

N. 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.

O. 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 all piping sizes.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

P. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

S. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

T. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

U. Install force mains at elevations indicated.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

C. .

D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.4 VALVE INSTALLATION

A. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
   1. Use gate or full-port ball valve for piping NPS 2 and smaller.
   2. Use gate valve for piping NPS 2-1/2 and larger.

B. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.

C. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
   1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
   2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
   3. Install backwater valves in accessible locations.
   4. Backwater valves are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.5 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in OD's.
   2. In Drainage Piping: Unshielded, nonpressure transition couplings.
   3. In Aboveground Force Main Piping: Fitting-type transition couplings.
   4. In Underground Force Main Piping:
      a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
      b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:
   1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer than100 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.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. 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 and NPS 8: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. 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 and 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.

I. Install supports for vertical copper tubing every 10 feet.

J. Support piping not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

B. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
2. Plumbing 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. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
5. Pit installation option in first subparagraph below shall be detailed on the drawings.
6. Install horizontal backwater valves in pit with pit cover flush with floor.
7. Comply with requirements for backwater valves cleanouts and drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
8. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

C. Connect force-main piping to the following:
1. Sanitary Sewer: To exterior force main.

2. Sewage Pump: To sewage pump discharge.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. 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.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.9 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.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. 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.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

F. Diagnostic video of sanitary waste lines following completion of floor slabs on grade and at end of project; Refer to section 014500-4 (1.4 G) for requirements.

3.10 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Floor drains.
   3. Floor sinks.
   4. Trench drains.
   5. Roof flashing assemblies.
   6. Miscellaneous sanitary drainage piping specialties.
   7. Trap-guard-seal, waterless, inline.
   8. Flashing materials.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.5 COORDINATION

A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:
   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.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass or cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:
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. Sioux Chief Manufacturing Company, 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.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Outlet Connection: Spigot or threaded.
7. Adjustable Housing Material: Cast iron with threads.
8. Frame and Cover Material and Finish: Nickel-bronze copper alloy, painted cast iron or polished bronze.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Light Duty.
11. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:
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.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk brass or cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.
8. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron 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. 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.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Outlet: Bottom or side as required.
6. Top or Strainer Material: Bronze, gray iron or nickel bronze.
7. Top of Body and Strainer Finish: Nickel bronze, polished bronze or rough bronze.
8. Top Shape: Round.
9. Top Loading Classification: Light Duty.
10. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
11. Trap Material: Bronze or cast iron.
12. Trap Pattern: Deep seal P-trap.
13. Trap Features: Provide RectorSeal Sure-Seal trap guard at each floor drain.

2.3 FLOOR SINKS

A. Basis of Design Product: Subject to compliance with requirements, provide the product indicated on the drawings or a comparable product by one of the following:
   1. Josam Company; Josam Div.
   2. MIFAB, Inc.
   3. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   4. Tyler Pipe; Wade Div.
   5. Watts Drainage Products Inc.
   6. Zurn Plumbing Products Group.

B. Cast-Iron Floor Sinks:
   1. Standard: ASME A112.6.7 .
   2. Pattern: Sanitary drain.
   3. Body Material: 16 gage, type 304 stainless steel.
   4. Seepage Flange: Required.
   5. Anchor Flange: Required.
   6. Clamping Device: Required.
   7. Outlet: Bottom, threaded.
   8. Strainer Material: Stainless Steel.
   9. Top of Body and Strainer Finish: Stainless Steel.
   10. Top Shape: Square.
   11. Dimensions of Top or Strainer: 12” x 12” x 8” deep with anti-spalsh dome strainer, refer to food service plans for grate configuration for each floor sink
   12. Top Loading Classification: Heavy Duty.
   13. Trap Material: Cast iron.
   14. Trap Pattern: Deep-seal P-trap.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:
   a. Acorn Engineering Company; Elmdor/Stoneman Div.
   b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
1. Open-Top Vent Cap: Without cap.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device, which forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

B. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

C. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.6 TRAP-GUARD, WATERLESS, INLINE DEVICE
1. Basis-of-Design Product: RectorSeal Sure Seal series or equal product by one of the following:
   a. RectorSeal, SureSeal
   b. Josam
   c.
2. Standard: ASSE 1072.
3. Housing: HDPE, High Density Polyethylene.
4. Diaphragm: Heavy Duty Silicone.
5. Gasket: EPDM rubber.
6. Size: As required to match the floor drain outlet.

2.7 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
      b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
   3. Install floor-drain flashing collar or 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, unless otherwise indicated.
   5. Install an inline trap guard in the outlet of every floor drain during the trim out stage of the project to avoid construction debris from damaging the trap guard.

G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

H. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

I. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

K. Install vent caps on each vent pipe passing through roof.

L. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

N. Install waterless, inline-type trap-guards in all floor drains at base of floor drain body (not in strainer).

O. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Commercial, electric, domestic-water booster heaters.
   2. Commercial, electric, storage, domestic-water heaters.
   3. Commercial, light-duty, storage, electric, domestic-water heaters.
   4. Flow-control, electric, tankless, domestic-water heaters.
   5. Thermostat-control, electric, tankless, domestic-water heaters.
   6. Domestic-water heater accessories.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   1. Submit documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

B. Shop Drawings:
   1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.

B. Product Certificates: For each type of -commercial-, electric, domestic-water heater, from manufacturer.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.7 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 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: 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.

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."

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, 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 Periods: From date of Substantial Completion.
      a. Commercial, Electric, Domestic-Water Booster Heaters:
         1) Controls and Other Components: Five years.
      b. Commercial, Electric, Storage, Domestic-Water Heaters:
         1) Storage Tank: Five years.
         2) Controls and Other Components: Five years.
      c. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
         1) Storage Tank: Five years.
         2) Controls and Other Components: Three years.
      d. Residential, Electric, Storage, Domestic-Water Heaters:
         1) Storage Tank: Five years.
         2) Controls and Other Components: Three years.
      e. Electric, Tankless, Domestic-Water Heaters: Five year(s).
      f. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, domestic-WATER HEATERS

A. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Lochinvar Corporation.
b. Rheem Manufacturing Company.
c. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
d. State Industries.
2. Standard: UL 174.
3. Storage-Tank Construction: Steel, vertical arrangement.
a. Tappings: ASME B1.20.1 pipe thread.
b. Pressure Rating: 150 psig.
c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
4. 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: ASSE 1005.
d. Insulation: 2-inch-thick minimum, Comply with ASHRAE/IESNA 90.1.
e. Jacket: Steel with enameled finish.
f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kW total.
h. Temperature Control: Adjustable thermostat.
i. Safety Control: High-temperature-limit cutoff device or system.
j. Relief Valve: ASME rated and stamped for 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 valve with sensing element that extends into storage tank.
5. Special Requirements: NSF 5 construction with legs for off-floor installation.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. AMTROL Inc.
b. Honeywell International Inc.
c. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
d. State Industries.
e. Taco, Inc.
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.
3. Construction:
a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.

b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Air-Charging Valve: Factory installed.

B. 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 NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and [calibrated] [memory-stop] balancing valves to provide balanced flow through each domestic-water heater.
1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
2. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig-maximum outlet pressure unless otherwise indicated.

G. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. 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.

H. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

J. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test [commercial] domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."
   1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
   2. Maintain manufacturer's recommended clearances.
   3. Arrange units so controls and devices that require servicing are accessible.
   4. 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.
   5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   7. Install anchor bolts to elevations required for proper attachment to supported equipment.
   8. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
   1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

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 commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

E. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

F. Install thermometers on inlet and outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

G. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

H. Fill electric, domestic-water heaters with water.

I. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "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. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "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 Owner's maintenance personnel to adjust, operate, and maintain electric, domestic-water heaters.

END OF SECTION

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Water closets.
   2. Flushometer valves.
   3. Toilet seats.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
   1. Flushometer-Valve Repair Kits: Six of each type.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets, P1: Floor mounting, floor outlet, vitreous china fixture designed for flushometer valve operation, with specified toilet seat.
   1. Basis of Design Product: American Standard Model 2234.001 or comparable product by one of the following:
      a. Kohler.
      b. Toto USA, Inc.
   2. Fixture:
      a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
      b. Color: White.
      c. Material: Vitreous china.
      d. Bowl Type: Elongated with siphon-jet design.
      e. Height: 15” Standard

f. Water Consumption: 1.28 gal./flush.
g. Spud Size and Location: NPS 1-1/2 inch, top.
h. Outlet Size and Location: 4-inch, bottom.
i. Outlet Rough-In: 10 inches.

3. Flushometer Valve: P1, sensor operated.
4. Toilet Seat: P1
5. Waste Fitting: 4" heavy-duty cast-iron closet flange with compression seal and test cap.
6. Note: Off-set water closet flanges are NOT acceptable. Provide heavy duty diameter flange bolts as manufactured by Oatey Johni-bolt.

B. Water Closets, P1A: Accessible, floor mounting, floor outlet, vitreous china fixture designed for flushometer valve operation, with specified toilet seat.
1. Basis of Design Product: American Standard Model 3043.001 or comparable product by one of the following:
a. Kohler.
b. Toto USA, Inc.
2. Fixture:
a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Color: White.
c. Material: Vitreous china.
d. Bowl Type: Elongated with siphon-jet design.
e. Height: 17" Accessible
f. Water Consumption: 1.28 gal./flush.
g. Spud Size and Location: NPS 1-1/2 inch, top.
h. Outlet Size and Location: 4-inch, bottom.
i. Outlet Rough-In: 10 inches.
3. Flushometer Valve: P1A, sensor operated.
4. Toilet Seat: P1A
5. Waste Fitting: 4-inch heavy-duty cast-iron closet flange with compression seal and test cap.
6. Note: Off-set water closet flanges are NOT acceptable. Provide heavy duty diameter flange bolts as manufactured by Oatey Johni-bolt.

C. Water Closets, P1B: Child accessible, floor mounting, floor outlet, vitreous china fixture designed for flushometer valve operation, with specified toilet seat.
1. Identical to fixture P1, except install using child accessible rough-in dimensions.
2. Note: Coordinate flush valve location to avoid conflict with grab bar location.

2.2 FLUSHOMETER VALVES

A. Water Closet Flushometers, P1, P1A, P1B: Brass body, non-hold-open, battery powered (10-year battery), sensor operated actuator with true mechanical override, control stop with check valve, vacuum breaker, chloramine resistant diaphragm, copper or brass tubing, and polished chrome-plated finish on exposed parts.
1. Basis of Design Product: American Standard 6066.761.002 dual flush or comparable product by one of the following:
a. Zurn Industries.
b. Sloan.
c.
2. Standards: ASSE 1037
3. Minimum Pressure Rating: 125 psig.

4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer Valve Finish: Chrome plated.
7. Style: Exposed flush valve with integral sensor.
8. Water Consumption: 1.6 / 1.1 gal./flush.
9. Minimum Inlet: NPS 1 inch.
10. Minimum Outlet: NPS 1-1/4 inch.
11. Sensor: Integral with flush valve, listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
12. Power Supply: Battery powered with a minimum 10-year capacity based on 4,000 flushes per month and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.

2.3 TOILET SEATS

A. Toilet Seats, P1, P1A, P1B:
1. Basis of Design Product: Bemis 1955CT-047 or comparable product by one of the following:
a. American Standard
b. Kohler
c. Church.
d.
2. Seat: Standards: IAPMO/ANSI Z124.5.
3. Material: Plastic, with anti-microbial agent.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: Black.

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 water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:
1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.

B. Flushometer-Valve Installation:
1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.

3. Install actuators in locations that are easy for people with disabilities to reach.

C. Install toilet seats on water closets.

D. Wall Flange and Escutcheon Installation:
1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224213.16 - COMMERCIAL URINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Urinals.
2. Flushometer valves.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
1. Flushometer-Valve Repair Kits: Six of each type.

PART 2 - PRODUCTS

2.1 URINIAL FIXTURES

A. Urinals P2: High-Efficiency wall hung, back outlet, 14-inch extended rim, washout [, accessible].
1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard Model 6590.001 or comparable product by one of the following:
a.
b. Kohler.
c. TOTO USA, Inc.
2. Fixture:
a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Color: White.
c. Material: Vitreous china.
d. Type: Washout with extended shields.
e. Strainer or Trapway: Manufacturer's standard strainer with integral trap.

f. Water Consumption: 0.5 gpf.
g. Spud Size and Location: NPS 3/4, top.
h. Outlet Size and Location: NPS 2, back.

3. Flushometer Valve: P2.
4. Waste Fitting:
   a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
   b. Size: NPS 2.
5. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

B. Urinals P2A: High-efficiency wall hung, back outlet, 14-inch extended rim, washout, accessible.
   1. Identical to Urinal P2, except install at accessible mounting height.

2.2 URINAL FLUSHOMETER VALVES

A. Urinal Flushometers, P2, P2A: Brass body, non-hold-open, battery powered (10-year battery), sensor operated actuator with true mechanical override, control stop with check valve, vacuum breaker, chloramine resistant diaphragm, copper or brass tubing, and polished chrome-plated finish on exposed parts.
   1. Basis-of-Design Product: American Standard 6604.050.002 or comparable product meeting performance requirements by one of the following:
      a. Zurn Industries.
      b. Sloan
   2. Standard: ASSE 1037.
   3. Compliance: EPA WaterSense when used with approved urinal.
   4. Minimum Pressure Rating: 125 psig.
   5. Features: Include integral check stop and backflow-prevention device.
   6. Material: Brass body with corrosion-resistant components.
   7. Exposed Flushometer-Valve Finish: Chrome plated.
   8. Style: Exposed flush valve with integral sensor.
   9. Consumption: 0.5 gallon per flush.
   10. Sensor: Integral with flush valve, listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
   11. Power Supply: Battery powered with a minimum 10-year capacity based on 4,000 flushes per month, listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.

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 urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Urinal Installation:
1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:
1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:
1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.

D. Wall Flange and Escutcheon Installation:
1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

3.3 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Lavatories.
2. Lavatory faucets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
1. Faucet Repair Kits: Six of each type.

1.6 QUALITY ASSURANCE

A. Manufacturer Source: Provide each type of fixture and faucet from a single manufacturer for project.

PART 2 - PRODUCTS

2.1 Designer Note: If powered metered faucets are selected, they shall be hard-wired.

2.2 WALL-MOUNTED LAVATORIES

A. Lavatory, front approach accessible P3: Rectangular, enameled, cast iron, carrier mounted.
1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard model 4869.004 equipped for concealed arm carrier or comparable product by one of the following:
a. Kohler.
b.
2. Fixture:

a.
b. Standard: ASME A112.19.1/CSA B45.2.
c. Type: Straight-front apron with straight back.
d. Nominal Size: Rectangular, 18" by 20" inches.
e. Faucet-Hole Punching: 3-hole, 4-inch center drilling.
f. Faucet-Hole Location: Top.
g. Drain: Grid.
h. Color: White.
i. Material: Enameled Cast Iron.
j. Mounting Height: Per standard mounting height drawing.

3. Faucet: P3.
4. Protective Shielding Guard(s): Refer to Division 10 Section "Toilet Accessories."
5. Support: ASME A112.6.1M, Type III, lavatory concealed arm carrier. Include rectangular, steel uprights and extended stud lengths to compensate for block wall thickness.

2.3 FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets P3: Automatic, electronic, 10-year battery powered, sensor operated, commercial, single post, solid-brass, vandal resistant. All electronics and batteries shall be located within faucet body above deck. Under sink electronics are not acceptable.
1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard 7755.305 faucet with integral ASSE 1070 thermostatic mixing valve, PK00.WRK 10-year battery pack and 775P.400 4-inch deck plate or comparable product by one of the following:
a.
b. Chicago Faucets.
c. Zurn Industries.
d.
2. Standard: ASME A112.18.1/CSA B125.1.
3. Body Type: Single post, 3/8-inch inlet.
4. Body Material: Commercial, solid brass.
5. Finish: Polished chrome plate.
6. Sensor: Programmable, multi-function, listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
7. Power Supply: 10-year battery pack rated @ 4000 uses, listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
8. Maximum Flow Rate: 0.5 gpm.
9. Mounting Type: Deck, exposed.
10. Spout: Rigid type, 5-inch
11. Spout Outlet: Multi-laminar spray.
12. Operation: Sensor operated meeting ADA and ANSI/ICC A117.1.
13. Mixing Valve: Integral ASSE 1070 mixing valve with removable temperature setting lever.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers: NPS 3/8-inch.
1. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

G. Tempering Valves: Refer to Division 22 Section "Domestic Water Piping Specialties."

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: McGuire 155A, Grid type with NPS 1-1/4 offset and 6” straight tailpiece.

C. Trap: McGuire 8902C
1. Size: NPS 1-1/2 by NPS 1-1/4 with cleanout plug.
2. Material: Chrome-plated, cast-brass trap and elbow with 0.032-inch-thick brass tube to wall and chrome-plated, brass or steel wall flange.

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 lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for carrier-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust and maintain lavatory faucets and tempering valves.

3.6 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Service basins.
2. Service sinks.
3. Utility sinks.
4. Handwash sinks.
5. Sink faucets.
6. Supply fittings.
7. Waste fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics, [electrical characteristics,] and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. 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.

PART 2 - PRODUCTS

2.1 SERVICE BASINS

A. Service Basins P6: Terrazzo, floor mounted.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Florestone Products Co., Inc., Model 82, or comparable product by one of the following:
a. Acorn Engineering Company.
b. Stern-Williams Co., Inc.

c. Fiat.
2. Fixture:
a. Standard: IAPMO PS 99.
b. Shape: Square.
c. Nominal Size: 24 by 24 inches.
d. Height: 12inches.
e. Tiling Flange: On two sides.
f. Rim Guard: On top surfaces.
g. Wall Guards: Stainless steel, on two sides.
h. Drain: Grid with NPS 3 outlet and quick connector.
3. Mounting: On floor and flush to wall.
4. Faucet: P6.

2.2 UTILITY SINKS

A. Utility Sinks P5A Accessible: Stainless steel, counter mounted.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay Manufacturing Co., LRADQ1919, or comparable product by one of the following:
a. Advance Tabco.
b. Just Manufacturing.
2. Fixture:
a. Standard: ASME A112.19.3/CSA B45.4.
b. Type: Self-rimming.
c. Number of Compartments: One.
d. Overall Dimensions: 19 by 19 by 6 inches.
e. Metal Thickness: 0.050 inch.
f. Drain: McGuire 151AM Basket Strainer with NPS 1-1/2 tailpiece.
g. Drain Location: Centered in compartment.
3. Faucet(s): P5A.
a. Number Required: One.
b. Mounting: Deck-mounted.
4. Supply Fittings:
a. Standard: ASME A112.18.1/CSA B125.1.
b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
1) Operation: Loose key.
2) Risers: NPS 1/2, ASME A112.18.6, braided or corrugated stainless-steel flexible hose.
5. Waste Fittings:
a. Standard: ASME A112.18.2/CSA B125.2.
b. Trap(s): McGuire 8903C
1) Size: NPS 1-1/2 with cleanout plug.
2) Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.
6. Mounting: On counter with sealant.

B. Utility Sinks, Visual Arts, Accessible P5B: Stainless steel, freestanding, scullery-type.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay Manufacturing, WNSF8124R and LK86RT lever drain with overflow drain, or comparable product by one of the following:
a. Advance Tabco.
b. Just Manufacturing Co.

2. Fixture:
   a. Standard: ASME A112.19.3/CSA B45.4.
   b. Type: With backsplash and 1-1-2-inch rolled rim.
   c. Number of Compartments: One.
   d. Sink Dimensions: 24 by 24 by 14 inch.
   e. Metal Thickness: 0.050 inch.
   f. Drain: Grid with NPS 1-1/2 tailpiece and twist drain.
   g. Drain Location: Near back of compartment.
   h. Drainboard(s): 24-inch Right side.
   i. Lever drain: Design basis Elkay LK86RT with overflow drain.
3. Supports: Adjustable-length tubular steel legs and steel cross braces.
4. Faucet(s): P5B.
   a. Number Required: One.
   b. Mounting: On backsplash.
5. Supply Fittings:
   a. Standard: ASME A112.18.1/CSA B125.1.
   b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
      1) Operation: Loose key.
      2) Risers: NPS 1/2, ASME A112.18.6, braided or corrugated stainless-steel flexible hose.
6. Waste Fittings:
   a. Standard: ASME A112.18.2/CSA B125.2.
   b. Trap(s):
      1) Size: NPS 1-1/2.
      2) Material: Stainless-steel, two-piece plaster-type P trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.3 HANDWASH SINKS

A. Handwash Sinks, accessible P3H: Stainless steel, wall mounted.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay Manufacturing Elkay ELVW022193, or comparable product by one of the following:
      a. Advance Tabco.
      b. Just Manufacturing Co.
   2. Fixture:
      a. Standards: ASME A112.19.3/CSA B45.4 and NSF/ANSI 2.
      b. Type: Basin with radius corners, back for faucet, and support brackets.
      c. Nominal Size: 20 by 18 inches.
   3. Faucet: P3H.
   4. Mixing Valve: Temperature and pressure balancing, 0.5 to 3.0 gpm, 115 deg. F.
   5. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
   6. Waste Fittings: Comply with requirements in "Waste Fittings" Article.
      a. Standard: ASME A112.18.2/CSA B125.2.
      b. Trap(s): McGuire 8902C
         1) Size: NPS 1-1/4 with cleanout plug.
         2) Material: Stainless-steel, two-piece plaster-type P trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.
   7.
   8. Drain: McGuire 155A with 1-1/4” tailpiece 6” long.

9. Support: ASME A112.6.1M, Type II, sink carrier.

2.4 SINK FAUCETS

A. Sink Faucets, General
1. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.
2. Manufacturers: Subject to requirements, provide basis of design product or a comparable product of one of the following manufacturers:
a. Chicago Faucets.
b. American Standard.
c. Zurn Industries.

B. Sink Faucets P6: Manual type, two-lever-handle mixing valve.
1. Basis-of-Design Product: American Standard 8344.012.
2. Application: Service basins.
3. Standard: ASME A112.18.1/CSA B125.1.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: Widespread.
6. Body Material: Commercial, solid brass.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 4.0 gpm.
9. Handle(s): Lever.
10. Mounting Type: Back/wall, exposed.
11. Spout Type: Rigid, solid brass with wall brace.
12. Vacuum Breaker: Required for hose outlet.
13. Spout Outlet: Hose thread according to ASME B1.20.7.

C. Sink Faucets P5A: Manual type, two-lever-handle mixing valve.
1. Basis-of-Design Product: American Standard 6530.170.
2. Application: Countertop sinks.
3. Standard: ASME A112.18.1/CSA B125.1.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: 4 inch center.
6. Body Material: Commercial, solid brass.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 2.2 gpm.
9. Handle(s): Wrist blade, 4 inches.
10. Mounting Type: Deck, exposed.
11. Spout Type: Rigid gooseneck.
12. Vacuum Breaker: Not required for hose outlet.
13. Spout Outlet: Aerator.

D. Sink Faucets P5B: Manual type, two-lever-handle mixing valve.
1. Basis-of-Design Product: American Standard 7298.152.
2. Application: Freestanding utility sinks with backsplash.
3. Standard: ASME A112.18.1/CSA B125.1.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: Widespread.

6. Body Material: Commercial, solid brass.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 4.0 gpm.
9. Handle(s): Wrist blade, 4 inches.
10. Mounting Type: Back/wall, exposed.
11. Spout Type: Rigid, solid brass.
12. Vacuum Breaker: Required for hose outlet.
13. Spout Outlet: Hose thread according to ASME B1.20.7.

E. Sink Faucets [PSF#4]: Manual type, single-control mixing valve.
1. Basis-of-Design Product: American Standard 7500.180.002
2. Application: Hand wash sink.
3. Standard: ASME A112.18.1/CSA B125.1.
4. General: Coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: Single hole.
6. Body Material: Commercial, solid brass.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 1.5 gpm.
9. Handle(s): Wrist blade, 4 inches.
10. Mounting Type: Deck, concealed.
11. Spout Type: Rigid gooseneck.
12. Spout Outlet: Laminar flow.

2.5 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:
1. NPS 1/2
2. Chrome-plated, rigid-copper pipe.

2.6 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:
1. Size: NPS 1-1/2.

2. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.7 GROUT

A. Standard: ASTM C 1107/C 1107M, 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 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.
1. Exception: Use ball valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224716 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes pressure water coolers and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of pressure water cooler.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filter Cartridges: Equal to 20 percent of quantity installed for each type and size indicated, but no fewer than 3 of each.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

A. Pressure Water Coolers, accessible [PWC#02]: Wall mounted, bi-level with integral sensor operated bottle filler and water filter.
   1. Basis of Design Product: Subject to compliance with requirements, provide Murdock model A172408F-VR-BF12-WF3 or comparable products by one of the following:
      a. Halsey Taylor.
      b. Elkay.
   2. Cabinet: Bi-level with two attached cabinets, vandal resistant, all stainless steel.
   3. Bubbler: Two, with adjustable stream regulator, located on each cabinet deck.
   4. Control: Push button.
   5. Bottle Filler: Touchless activation, auto shut-off, with visual user interface display.
   6. Drain: Grid with NPS 1-1/4 tailpiece.
   7. Supply: NPS 3/8 with shutoff valve.
   8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.

9. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with 3000 gallon capacity sized for unit peak flow rate.
10. Cooling System: High efficiency electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
    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.
11. Capacities and Characteristics:
    a. Cooled Water: 8 gph.
    b. Ambient-Air Temperature: 90 deg F.
    c. Inlet-Water Temperature: 80 deg F.
    d. Cooled-Water Temperature: 50 deg F.
    e. Electrical Characteristics:
        1) Volts: 120-V ac.
        2) Phase: Single.
        3) Hertz: 60.
12. Support: ASME A112.6.1M, Type I water-cooler carrier.

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 fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by Mecklenburg County.

B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

C. Install mounting frames, affixed to building construction. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1: GENERAL

1.1 RELATED PROVISIONS

a. The requirements of the general conditions and of Division 01 apply to that portion of the work specified in this section.

b. These specifications and the accompanying drawings shall include the furnishing of all labor, tools, materials, fixtures, transportation, appurtenances and service necessary and incidental to the installation of a complete and operative system as indicated and intended on the Drawings and as herein specified.

c. Contractor shall coordinate the work and equipment of this division with the work and equipment specified elsewhere in order to assure a complete and satisfactory installation. Work such as excavation, backfill, concrete, flashing, etc., which is required by the work of this Division of the Specifications, shall be provided by this Division unless otherwise indicated.

d. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.

1.2 DESCRIPTION OF THE WORK:

a. Work included under this Division includes installation of a new cooling and heating system and associated electrical system and controls system. The systems shall be installed complete, with boilers, piping, chiller, pumps and auxiliaries as hereinafter called for. Miscellaneous items including conduits, concrete slab, etc., are to be provided as indicated.

b. It shall be the responsibility of the Contractor to provide a complete and operating system according to the true intent and meaning of the plans and specifications and all pipe, controls and equipment, etc.

1.3 DEFINITION

a. The word "Contractor" as used in this Section of the Specifications refers to the HVAC Contractor unless specifically noted otherwise. The word "provide" means furnish, fabricate, complete, install, erect, including labor and incidental materials, necessary to complete in place and ready for operation or use the items referred to or described herein, and/or as shown or referred to on the Contract Drawings.

1.4 HVAC CONTRACTOR'S QUALIFICATIONS

a. It is assumed that the contractor has had sufficient general knowledge and experience to anticipate the needs for a construction of this nature. The contractor shall furnish all items required to complete the construction in accordance with reasonable interpretation of the intent of the Drawings and Specifications. Any

minor items required by Code, law or regulations shall be provided whether or not specified or specifically shown.

b. All work must be done by first class and experienced mechanics properly supervised, and it is understood that the Engineer has the right to stop any work that is not being properly done and has the right to demand that any incompetent workman be removed from the job and a competent workman be substituted therefor.

c. All work must be done in strict accordance with standards of AME, ASHRAE and the building laws of all character in force in the locality where the apparatus is being installed. All work must also be in accordance with rules and regulations of the National Board of Fire Underwriters.

1.5 DUTIES OF CONTRACTOR

a. Contractor is responsible for familiarizing himself with the details of the construction of the building. Work under these specifications installed improperly or which requires changing due to improper reading or interpretation of building plans shall be corrected and changed as directed by Engineer without additional cost to the Owner.

b. Contractor shall leave the premises in a clean and orderly manner upon completion of work, and shall remove from premises all debris that has accumulated during the progress of the work. The HVAC Contractor shall have the permanent HVAC systems in sufficient readiness for furnishing temporary climatic control at the time the building is enclosed. The HVAC systems control shall maintain climatic control throughout the enclosed portion of the building sufficient to allow completion of the interior finishers of the building. A building shall be considered enclosed when it has windows installed and when doorways and other openings have protection which will provide reasonable climatic control. The appropriate climatic condition shall be jointly determined by the Contractor and the Architect. Use of the equipment in this manner shall in no way affect the warranty requirements of the Contractor.

1.6 CODES, RULES, PERMITS AND FEES

a. The contractor shall give all necessary notices, obtain all permits and pay all government sales taxes, fees and other costs including utility connections or extension, in connection with his work; file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction; obtain all required certificates for inspection for his work and deliver same to the Architect before request for acceptance and final payment for the work.

b. The contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus, ordinances, rules and regulations as required to complete the project in accordance with the intent of the drawings.

c. All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, with the requirements of all governmental departments having jurisdiction.

1.7 SURVEYS AND MEASUREMENTS

a. The contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check correctness of same as related to the work.

b. Should the contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and Specifications, he shall notify the Architect and shall not proceed with his work until he has received instructions from the Architect.

1.8 PLANS

a. Except where dimensions are shown, mechanical plans are diagrammatic; see Architectural drawings for building dimensions and locations of windows, doors, ceiling diffusers, lights, etc. The plans are not intended to show each and every fitting, valve, pipe or pipe hanger, or a complete detail of all the work to be done, but are for the purpose of illustrating the type of system, pipe and duct sizes, etc. and special conditions considered necessary for the experienced mechanic to take off his material and lay out his work. Contractor shall be responsible for taking such measurements as may be necessary at the job, and adapting his work to the local conditions.

1.9 DRAWINGS AND SPECIFICATIONS

a. Plans are diagrammatic, and it sometimes occurs that conditions exist in buildings which require certain changes in drawings and specifications. In event that such changes are necessary, the same are to be made by Contractor without expense to the Owner, provided however, that such changes, do not require furnishing more material or performing more labor than the true intent of the drawings and specifications demand.

b. It is understood that while the drawings are to be followed as closely as circumstances will permit, the Contractor is held responsible for the installation of the system according to the true intent and meaning of the drawings. Anything not entirely clear on the drawings or in the specifications will be fully explained if application is made to the Engineer. Should however, conditions arise where in the judgment of the Contractor certain changes would be advisable. Contractor will communicate with Engineer and secure approval of the changes before going ahead with the work.

c. The electrical and mechanical systems for this job have been designed on the basis of the mechanical equipment listed or data given herein or on the drawings. It shall be the responsibility of the Contractor to determine that the electrical service outlets, wiring, conduit and all overcurrent protective and safety devices furnished are adequate to meet Code Requirements for the equipment which he proposes to use. Changes required in the electrical system to accommodate the proposed mechanical equipment shall be worked out and the details submitted for approval. The cost of making the necessary changes to the electrical system shall be the responsibility of the Contractor.

1.10 SHOP DRAWINGS

a. Refer to Division 01.

b. All items submitted to Architect for review shall bear stamp or notation indicating contractor's prior review and approval.

c. Any Electrical or other changes required by substituted equipment to be made at no change in contract price.

d. Submit manufacturer's certified performance data for all equipment.

e. Coordinate installation drawings with other parts of the work, whether specified in this Division or other Divisions.

f. Approval of shop drawings by the Engineer shall not relieve the Contractor from his obligation to provide equipment, control, and operation to the true intent of plans and specifications.

g. The Contractor shall submit to the Engineer, within ten (10) days after approval of bids by the owner, a list indicating the manufacturer of all equipment and materials which he proposes to use. After that date, no substitution will be approved and all items shall be as specified.

1.11 SCAFFOLDING, RIGGING, HOISTING:

a. This contractor shall furnish all scaffolding rigging, hoisting, and services necessary to erection and delivery into the premises of any equipment and apparatus furnished. Remove same from premises when no longer required.

1.12 FOUNDATIONS, SUPPORTS, PIERS, ATTACHMENTS:

a. Contractor shall furnish and install all necessary foundations, supports, pads, bases and piers required for all air conditioning equipment, piping, pumps, tanks, compressors, and for all other equipment furnished under this contract.

1.13 SLEEVES AND OPENINGS:

a. Contractor must have an experienced mechanic on the job before concrete slab floors or concrete masonry walls are poured or built into place, whose duty it shall be to locate exact positions of any and all holes necessary for future installation of his pipe work, ducts or equipment. Where pipes pass through concrete or masonry walls or floors, steel pipe sleeves shall be furnished. These shall be the same length as wall thickness and shall extend 1/2" above finished floors. Pipe sleeves in equipment room floors shall extend 3" above refinished floor. Pipe sleeves in equipment room floors shall extend 3" above finished floor. Sleeves shall be placed in position by this Contractor.

b. This Contractor shall arrange for proper openings in the building to admit his equipment. If it becomes necessary to cut any portion of building to admit his equipment, portions cut must be restored to their former condition by this Contractor.

c. This Contractor will provide duct openings or chases in masonry or concrete; however, it is this Contractor's responsibility to advise exact dimensions, shape and locations of openings required in sufficient time for the Contractor to make necessary provisions. This Contractor shall be responsible for correct size and location of each opening for his equipment through these openings.

d. Wall openings that require a fire or smoke damper shall be made as nearly possible to the damper or duct size so that an angle frame can close the opening entirely.

e. Where pipes or ducts penetrate floors or partitions which are fire or smoke barriers, the integrity of the barrier shall not be compromised by such penetration.

1.14 CUTTING AND PATCHING:

a. The Contractor shall do all cutting, fitting and patching as required to install piping and equipment except openings through the roof shall be provided by the General Contractor. Patching shall be done by mechanics skilled in the various trades and work shall match the existing work.

b. All exposed openings in walls and floors for piping shall be core drilled. Cutting of holes by hand will not be allowed.

c. Provide all required protection including but not limited to, welding blankets, dust covers, shoring bracing and supports to maintaining structural integrity, safety and cleanliness of the work.

1.15 EXCAVATION AND BACKFILLING:

a. All excavation and backfilling, pudding and tamping required to properly install work under this contract shall be done by this Contractor.

b. Backfill shall be clear of rocks and trash. Backfilling shall be water tamped so as to provide firm footing for finish work, and shall be maintained at proper level for duration of the Contract. No backfilling shall be done until work to be covered has been inspected. Excessive excavation material shall be deposited on site and leveled as directed by the engineer.

1.16 POURED IN PLACE CONCRETE WORK:

a. Furnish and install all concrete work required for the construction of anchors, guide bases and elsewhere as indicated on the Drawings. Refer to appropriate Section in Division 3 for specification requirements.

PART 2: PRODUCTS

2.1 MATERIALS

a. Provide equipment complete with all components and accessories necessary to its satisfactory operation.

b. Listing of a manufacturer's name in this Division does not infer conformity to all requirements of the Contract Documents, nor waive requirements thereof.

PART 3: EXECUTION

3.1 BELT DRIVES

a. V-belt drives shall be rated at not less than 200% of nominal motor horsepower.

b. Motor sheaves shall be adjustable type.

c. Scheduled fan static pressures are estimated. Provide one extra drive per device as required to allow adjustment to deliver scheduled air quantities against actual system resistance.

d. Provide guards for all belt drives not enclosed within equipment housings. Provide openings in guard at driving and driven sheaves for use of revolution counter.

3.2 MAINTENANCE AND OPERATING INSTRUCTIONS

a. Upon completion of all work, the Contractor shall furnish a complete set of operating instructions for all equipment. Such instructions shall be diagrammatic in form on heavy white paper, suitably framed, protected with glass and hung where directed by the owner. A preliminary draft of the instruction sheets shall be submitted to the engineer for approval before making same.

b. Manufacturer's instruction books, card, etc., (to each individual piece of equipment furnished under this contract) shall be furnished to the owner. These shall contain instructions for the operation and maintenance of all equipment. Where such is not furnished by the manufacturer, the contractor shall give written instructions to the owner for the maintenance of the equipment involved.

c. All above ceiling equipment shall be accessible using a standard step ladder. No special scaffolding or other means of accessibility will be acceptable.

3.3 DUCTS, PLENUM, ETC.

a. As indicated on drawings, provide a system of ducts for supplying returning and exhausting air from various spaces. All details of the ductwork are not indicated and the necessary bends, offsets and transformations must be furnished whether shown or not.

b. All sheet metal ducts, casing, plenums, etc., of sizes indicated, shall be constructed from prime galvanized sheet steel, and shall be in accordance with or equal to standards set forth in latest issue of SMACNA low velocity duct manual for gauges of materials, (2" pressure), workmanship, method of fabrication and erection.

c. All uninsulated panels of ducts over twelve inches (12") wide shall be cross-broken, except on plenums, which shall be braced with angle iron as required to prevent breathing.

d. All ductwork must present a smooth interior and joints must be airtight. Where there is evidence of undue leakage at the joints in low pressure ducts, they shall be sealed with cement similar to Foster 30-02.

e. Depending upon space requirements, round or square elbows may be used as required or at the Contractors option in low velocity ducts. All elbows shall be constructed for minimum pressure drop. All elbows with an inside radius less than 3/4 the width of the duct must be fitted with multiple double thickness turning vanes.

f. No transformations or offsets shall be made with a slope greater than (7 to 1), space conditions permitting.

g. Where indicated on drawings, ductwork is to be lined with flexible fiberglass acoustics material weighing not less than 1 1/2 lb. per cubic foot and having a flame spread classification of not more than twenty-five (25) as listed under Underwriters Laboratories. Liner shall be applied according to SMACNA duct liner standard. Thickness shall be as indicated on the drawings. Duct sizes on plan are inside clear sizes, increase the actual sheet metal size accordingly in sizing the duct.

h. The lining shall be secured to the ductwork with a suitable adhesive and with mechanical fasteners center. Liner shall be cut such that adjacent sections of insulation butt together and are sealed with Foster 30-02 joints.

i. All duct connections to and from all centrifugal fans or cabinets containing fans, shall be made with fabric equal to "Ventfab" as made by Ventfabrics, Inc., not less than four inches (4") long secured by peripheral iron straps holding fabric in galvanized iron, except as otherwise noted.

j. Vertical ducts shall be supported by means of an angle iron frame riveted to the ductwork on at least two (2) sides. Horizontal runs of ductwork shall be supported on not more than 8'-0" centers as required.

k. Manual volume and splitter dampers shall be furnished and installed where shown and where necessary for proper regulation of the air distribution. A quadrant and set screw equal to "Ventlock" #641 shall be installed for all dampers which are concealed above plaster or gypsum board ceilings, or behind the masonry construction, furnish and install concealed regulators ("Ventlock" #666) with chrome cover plate.

l. All ductwork shall operate without chatter and vibration, and shall be free from pulsations.

m. See section 233113 for metal ductwork requirements.

3.4 ACCESS DOORS OR PANELS

a. Provide duct access doors of approved construction at any apparatus requiring service and inspection. Doors shall suit finish in which installed.

b. Access doors in rated walls or assemblies shall be rated as required to maintain rating of assembly. Rated access doors shall bear U.L. Label.

3.4 ITEMS OF ELECTRICAL EQUIPMENT

a. All electrical work shall be done by properly licensed electrical mechanics in accordance with Division 26 of the specifications under supervision of a licensed Electrical Contractor as approved by the Architect.

b. The Electrical Contractor shall provide all power wiring to motor starter and/or disconnect switch and from starter/disconnect switch to motor. The Mechanical Contractor shall provide all control wiring, low voltage or line voltage, as required for the operation of all mechanical equipment. All control devices such as motor starters, thermostats, switches, etc. shall be provided by the Mechanical Contractor.

c. All motor starters shall be provided with a "hand-off-auto" switch on the starter cover.

d. All items of mechanical equipment electrically operated shall be in complete accordance with electrical division of the specifications. Mechanical equipment, other than individually mounted motors, shall be factory prewired so that it will only be necessary to bring connections to a single set of terminals.

e. Mechanical equipment electrical components shall all be bonded together and connected to electrical system ground.

f. All mechanical equipment electrical components shall be U.L. listed and labeled.

g. No joints allowed in piping that crosses cable trays. Cable tray installation shall be coordinated with all other trades prior to installation. Where water piping must cross a cable tray, a drip pan will be required to be provided.

3.5 WARRANTY AND SERVICE

a. Upon completion of all work, the contractor shall check the system out so that all motor bearings are greased as required and have all systems balanced. He shall be responsible for original service, of starting the system up, and providing one set of replacement filters after final acceptance.

b. All equipment shall carry a full one - year warranty with a five - year warranty on the cooling cycle on all packaged type equipment in accordance with Division 01 of the specifications.

3.6 INSPECTION AND ACCEPTANCE TEST

a. The project will be checked periodically as construction progresses. The contractor shall be responsible for notifying the Engineer at least 48 hours in advance when any work to be covered up is ready for inspection. No work will be covered up until approved by the Engineer.

b. Upon completion of erection of all equipment and work specified herein and shown approved shop drawings, and at the time designated by the engineer, the contractor shall start all apparatus, making necessary tests as directed and as specified herein,

and make adjustments of all parts of all equipment before acceptance of equipment by the owner. The contractor must demonstrate to the owner, by performance, that all equipment operates as specified and meets the guarantee called for.

c. Tests shall include satisfactory evidence that all systems operate as called for on the drawings, and that all pieces of equipment operate at specified ratings under specified operating conditions.

d. The contractor shall furnish all fuel and power required for these purposes, and provide the proper and necessary help required to operate the system while tests are being made.

e. All drainage piping shall be tested by filling with water to a point 10' above the underground drains or to point of discharge to grade and let stand thus filled for 3 hours.

f. Tests on all pipe work shall be subject to the inspection of the Engineer. He shall be given 24-hours notice when a section pipe is to be tested and the test shall not be removed until permission is given by the Engineer.

3.7 AS BUILT DRAWINGS

a. This contractor shall keep on the job at all times, a clean set of contract drawings in blueprint form. As the job progresses, any and all deviations from the arrangements, piping runs, equipment locations, etc., shown on the bid prints shall be marked on this set with red ink. These prints shall not be used for any other purpose than to be marked up as "As-Built" Drawings.

3.8 OWNER TRAINING

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain the equipment listed below:
   1. DDC Control Systems
   2. Air Handlers

B. Extent of Training:

   1. Base extent of training on scope and complexity of equipment installed and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
   2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
   3. Minimum Training Requirements:

      a. Provide not less than the number days of training indicated below.
         1) DDC Control Systems - 2 days (16 hours)
         2) Air Handlers - 1 day (8 hours)

      b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.

C. Training Schedule:

1. Schedule training with Owner **20** business days before expected Substantial Completion.
2. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays, with two morning sessions and two afternoon sessions.
3. Provide staggered training schedule as requested by Owner.

D. Training Attendee List and Sign-in Sheet:

1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
4. At end of each training day, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

E. Attendee Training Manuals:

1. Provide each attendee with a color hard copy of all training materials and visual presentations.
2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

F. Organization of Training Sessions:

1. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate the following three levels of operators:

    a. Daily operators.
    b. Advanced operators.
    c. System managers and administrators.

G. Training Outline:

1. Submit training outline for Owner review at least **10** business day before scheduling training.
2. Outline shall include a detailed agenda for each training day that is broken down into each of four training sessions that day, training objectives for each training session and synopses for each lesson planned.

H. On-Site Training:

1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
5. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

I. Training Content:

1. Basic operation of each system.
2. Understanding each unique product type installed including performance and service requirements for each.
3. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.

END OF SECTION

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with 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. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:
1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

L. Include phase loss protection for poly-phase motors.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

C. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Smith, Jay R. Mfg. Co.
2. 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 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.

2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping 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] [Stainless steel].
3. Connecting Bolts and Nuts: [Carbon steel, with corrosion-resistant coating,] [Stainless steel] of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Presealed Systems.
2. Hubbard Enterprises/Holdright; Hydroflame Sleeve/Device.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, 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 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-inch annular 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 specified in Section 079200 "Joint Sealants."

E. 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 for firestopping specified in Section 078413 "Penetration Firestopping."

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 1/4-inch annular 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 Section 076200 "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-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

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.

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-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.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls above Grade: Galvanized-steel-pipe sleeves or sleeve-seal fittings.
   2. Exterior Concrete Foundation below Grade: Galvanized-steel-pipe sleeves.
   3. Exterior Concrete Walls below Grade Enclosing Interior Space: Galvanized-steel wall sleeves with sleeve-seal system.
      a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
      b. Contractor Option: Sleeve-seal fittings.
   4. Concrete Slabs-on-Grade: Galvanized-steel-pipe sleeves, except use galvanized-steel wall sleeves with sleeve-seal system if underslab waterproofing is specified for slab.
      a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   5. Concrete Slabs above Grade: Galvanized-steel pipe sleeves, 2 inches above floor, unless otherwise indicated.
   6. Concrete Slabs above Grade Requiring Firestopping: Fire-resistance-rated watertight sleeve-seal fittings.
   7. Concrete Slabs above Grade Requiring Firestopping, Wet Areas with Waterproofing or Roofing Membrane Specified: Stack-sleeve fittings, as required by approved firestopping assembly.
   8. Interior CMU Walls and Partitions Not Requiring Firestopping: Galvanized-steel-pipe sleeves.
      a. Seal with paintable elastomeric joint sealant specified in Division 07 Section "Joint Sealants."
      b. Carry piping insulation, if any, through partition.
   9. Interior CMU Walls and Partitions Requiring Firestopping: Galvanized-steel-pipe sleeves as required by approved firestopping assembly.
   10. Interior Framed Partitions Not Requiring Firestopping: Galvanized sheet-steel sleeves.
      a. Seal with paintable elastomeric joint sealant specified in Division 07 Section "Joint Sealants."
      b. Carry piping insulation, if any, through partition.
   11. Interior Framed Partitions Requiring Firestopping: Galvanized-steel-pipe sleeves or Galvanized sheet-steel sleeves as required by approved firestopping assembly.

END OF SECTION

SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

B. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. Escutcheons for New Piping:
a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
e. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

2. Escutcheons for Existing Piping:
   a. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
   b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
   c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
   d. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
   e. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. New Piping: One-piece, floor-plate type.
   2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.

1.3 SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

C. Product Certificates: For each type of meter and gage, from manufacturer.

D. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flo Fab Inc.
   b. Tel-Tru Manufacturing Company.
   c. Trerice, H. O. Co.
   d. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-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 deg F.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.
   a. Design for Air-Duct Installation: With ventilated shroud.
   b. Design for Thermowell Installation: 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 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

A. Thermowells:
1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR.
4. Material for Use with Steel Piping: CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Flo Fab Inc.
b. Tel-Tru Manufacturing Company.
c. Trerice, H. O. Co.
d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
e. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Liquid-filled or sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal.
11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of steel pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flow Design, Inc.
2. Trerice, H. O. Co.
3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
4. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids (except steam).

H. Install test plugs in piping tees.

I. Install permanent indicators on walls or brackets in accessible and readable positions.

J. Install connection fittings in accessible locations for attachment to portable indicators.

K. Install thermometers in the following locations:
1. Inlet and outlet of each chiller (condenser and evaporator).
2. Inlet and outlet of each hydronic boiler.
3. Inlet and outlet of each hydronic coil in air-handling units.

L. Install pressure gages in the following locations:
1. Suction and discharge of each pump.

M. All thermometers shall be legible from ground level.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines and equipment.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each chiller shall be the following:
1. Industrial-style, liquid-in-glass type.
2. Test plug with EPDM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each hydronic boiler shall be the following:
1. Industrial-style, liquid-in-glass type.
2. Test plug with EPDM self-sealing rubber inserts.

C. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:
1. Industrial-style, liquid-in-glass type.
2. Test plug with EPDM self-sealing rubber inserts.

D. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.

B. Scale Range for Heating, Hot-Water Piping: 20 to 240 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each pressure-reducing valve shall be the following:
1. Liquid-filled or sealed, direct-mounted, metal case.

2. Test plug with EPDM self-sealing rubber inserts.

B. Pressure gages at suction and discharge of each pump shall be the following:
1. Liquid-filled or sealed, direct-mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 200 psi.

B. Scale Range for Heating, Hot-Water Piping: 0 to 200 psi.

END OF SECTION

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following general-duty valves:
1. Copper-alloy ball valves.
2. Ferrous-alloy ball valves.
3. Ferrous-alloy butterfly valves.
4. Bronze check valves.
5. Gray-iron swing check valves.
6. Ferrous-alloy wafer check valves.
7. Bronze globe valves.
8. Cast-iron globe valves.

B. Related Sections include the following:
1. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and charts.
2. Division 23 Section "Instrumentation and Control for HVAC" for control valves and actuators.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:
1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. PTFE: Polytetrafluoroethylene plastic.
4. TFE: Tetrafluoroethylene plastic.

1.4 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 rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

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.

1.6 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 and globe valves closed to prevent rattling.
4. Set ball 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 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 VALVES - GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:
1. Gear Drive: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

G. Extended Valve Stems: On insulated valves.

H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

I. Valve Grooved Ends: AWWA C606.
   1. Solder Joint: With sockets according to ASME B16.18.
      a. Caution: Use solder with melting point below 840 deg F for angle, check, and globe valves; below 421 deg F for ball valves.
   2. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45.

2.3 COPPER-ALLOY BALL VALVES

A. Available Manufacturers:

B. Manufacturers:
   1. Copper-Alloy Ball Valves:
      a. Conbraco Industries, Inc.; Apollo Div.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Crane Co.; Crane Valve Group; Stockham Div.
      d. Grinnell Corporation.
      e. Jamesbury, Inc.
      f. Kitz Corporation of America.
      g. Legend Valve & Fitting, Inc.
      h. NIBCO INC.
      i. Watts Industries, Inc.; Water Products Div.

C. Copper-Alloy Ball Valves, General: MSS SP-110.

D. Two-Piece, Copper-Alloy Ball Valves: Bronze body with regular-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.4 FERROUS-ALLOY BALL VALVES

A. Available Manufacturers:

B. Manufacturers:
   1. Conbraco Industries, Inc.; Apollo Div.
   2. Crane Co.; Crane Valve Group; Stockham Div.
   3. Hammond Valve.
   4. Jamesbury, Inc.
   5. Kitz Corporation of America.
   6. Milwaukee Valve Company.
   7. NIBCO INC.
   8. Worcester Controls.

C. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.

D. Ferrous-Alloy Ball Valves: Class 150, full port.

E. Ferrous-Alloy Ball Valves: Class 300, full port.

2.5 FERROUS-ALLOY BUTTERFLY VALVES

A. Available Manufacturers:

B. Manufacturers:
   1. Ferrous-Alloy Butterfly Valves:
      a. Crane Co.; Crane Valve Group; Stockham Div.
      b. Grinnell Corporation.
      c. Hammond Valve.
      d. Kitz Corporation of America.
      e. Milwaukee Valve Company.
      f. NIBCO INC.
      g. Red-White Valve Corp.
      h. Tyco International, Ltd.; Tyco Valves & Controls.
      i. Watts Industries, Inc.; Water Products Div.
   2. Grooved-End, Ductile-Iron Butterfly Valves:
      a. Grinnell Corporation.
      b. Hammond Valve.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
      e. Victaulic Co. of America.

C. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.

D. Flangeless, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer type with one or two-piece stem.

E. Single-Flange, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer-lug type with one or two-piece stem.

F. Flanged, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Flanged-end type with one or two-piece stem.

G. Grooved-End, 175-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Ductile-iron or steel body with grooved or shouldered ends.

2.6 BRONZE CHECK VALVES

A. Available Manufacturers:

B. Manufacturers:
   1. Type 2, Bronze, Horizontal Lift Check Valves with Nonmetallic Disc:
      a. Cincinnati Valve Co.
      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. Walworth Co.
   2. Type 2, Bronze, Vertical Lift Check Valves with Nonmetallic Disc:
      a. Grinnell Corporation.
      b. Kitz Corporation of America.
      c. Milwaukee Valve Company.
   3. Type 4, Bronze, Swing Check Valves with Nonmetallic Disc:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Crane Co.; Crane Valve Group; Stockham Div.

d. Grinnell Corporation.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corp.
i. Walworth Co.
j. Watts Industries, Inc.; Water Products Div.

C. Bronze Check Valves, General: MSS SP-80.

D. Type 2, Class 125, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

E. Type 2, Class 125, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

F. Type 2, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

G. Type 2, Class 150, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

H. Type 2, Class 200, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

I. Type 2, Class 200, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

J. Type 4, Class 125, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

K. Type 4, Class 150, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

L. Type 4, Class 200, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

2.7 GRAY-IRON SWING CHECK VALVES

A. Available Manufacturers:

B. Manufacturers:
1. Type II, Gray-Iron Swing Check Valves with Composition to Metal Seats:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Div.
c. Mueller Co.
d. Watts Industries, Inc.; Water Products Div.
2. Grooved-End, Ductile-Iron Swing Check Valves:
a. Grinnell Corporation.
b. Mueller Co.
c. Victaulic Co. of America.

C. Gray-Iron Swing Check Valves, General: MSS SP-71.

D. Type II, Class 125, gray-iron, swing check valves with composition to metal seats.

E. Type II, Class 250, gray-iron, swing check valves with composition to metal seats.

F. 175-psig CWP Rating, Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends.

2.8 BRONZE GLOBE VALVES

A. Available Manufacturers:

B. Manufacturers:
1. Type 2, Bronze Globe Valves with Nonmetallic Disc:
   a. Cincinnati Valve Co.
   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. Grinnell Corporation.
   f. Hammond Valve.
   g. Kitz Corporation of America.
   h. Milwaukee Valve Company.
   i. NIBCO INC.
   j. Powell, Wm. Co.
   k. Red-White Valve Corp.
   l. Walworth Co.

C. Bronze Globe Valves, General: MSS SP-80, with ferrous-alloy handwheel.

D. Type 2, Class 150, Bronze Globe Valves: Bronze body with PTFE or TFE disc and union-ring bonnet.

2.9 CAST-IRON GLOBE VALVES

A. Available Manufacturers:

B. Manufacturers:
1. Type I, Cast-Iron Globe Valves with Metal Seats:
   a. Cincinnati Valve Co.
   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. Grinnell Corporation.
   f. Hammond Valve.
   g. Kitz Corporation of America.
   h. Milwaukee Valve Company.
   i. NIBCO INC.
   j. Powell, Wm. Co.
   k. Red-White Valve Corp.
   l. Walworth Co.

C. Cast-Iron Globe Valves, General: MSS SP-85.

D. Type I, Class 125, Cast-Iron Globe Valves: Gray-iron body with bronze seats.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. 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.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 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, butterfly, or globe valves.

B. When 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. Hot Water, and Chilled Water Piping: Use the following types of valves:
   1. Ball Valves, NPS 2 and Smaller: One-piece, 400-psig CWP rating, copper alloy.
   2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
   3. Butterfly Valves, NPS 2-1/2 and Larger: Flangeless, single-flange or flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
   4. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
   5. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 150, bronze.
   6. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
   7. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
   8. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
   9. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

D. Condenser Water Piping: Use the following types of valves:
   1. Ball Valves, NPS 2 and Smaller: One-piece, 400-psig CWP rating.

2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
3. Butterfly Valves, NPS 2-1/2 and Larger: Flangeless, single-flange or flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
4. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
5. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 150.
6. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
7. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.

E. Select valves, except wafer and flangeless types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water services.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End, Copper Tubing and Steel Piping: Valve ends may be grooved. Do not use for steam or steam condensate piping.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow.

3.4 JOINT CONSTRUCTION

A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping joint construction.

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.

3.5 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.

END OF SECTION

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangars.
   3. Fastener systems.
   4. Equipment supports.

B. See Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.

C. See Division 23 Section "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Powder-actuated fastener systems.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:
1. AAA Technology & Specialties Co., Inc.
2. B-Line Systems, Inc.; a division of Cooper Industries.
3. Empire Industries, Inc.
4. ERICO/Michigan Hanger Co.
5. Globe Pipe Hanger Products, Inc.
6. National Pipe Hanger Corporation.
7. PHD Manufacturing, Inc.
8. PHS Industries, Inc.
9. Piping Technology & Products, Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 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.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated or stainless steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop or field-fabricated equipment support made from structural-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Non-staining, noncorrosive, and nongaseous.
2. Design Mix: 5,000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 8.
2. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 8.
2. Carbon or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 8, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
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.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
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. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use 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.
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

J. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. No hangars shall be supported from a lay-in ceiling grid.

B. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

C. Fastener System Installation:
1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

F. Install 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.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

I. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

K. Insulated Piping: Comply with the following:
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: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install 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. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
5. Insert Material: Length at least as long as protective shield.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for 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 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Freestanding and restrained spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Restraining braces and cables.

B. Certain systems and components of the project are intentionally designed to avoid vibration problems. Vibration isolation systems are more critical than standard construction. The Contractor is cautioned not to overlook these specific components in favor of standard construction practices in any pricing, submittal, or construction procedure.

C. Mount rotating and reciprocating equipment, ductwork, and piping on vibration isolators as noted in these Documents. Select, install and adjust isolators to prevent the transmission of objectionable vibration and noise to the building structure.

1.2 PERFORMANCE REQUIREMENTS

A. The Mechanical Contractor shall be responsible for providing restraints to resist the earthquake effects on the mechanical system. The requirements for these restraints are found in the North Carolina State Building Code and ASCE 7.

B. The Mechanical Contractor shall refer to the latest edition of the "Seismic Restraint Manual Guidelines for Mechanical System" published by SMACNA for guidelines to determine the correct restraints for sheet metal ducts, piping, and conduit, etc.

C. The Mechanical Contractor shall retain the services of a Professional Structural Engineer registered in the State of North Carolina to design seismic restraint elements required for this project. The engineer's computations, bearing his professional seal, shall accompany shop drawings which show Code compliance. Computations and shop drawings shall be submitted for review prior to the purchasing of materials, equipment systems, and assemblies.

D. For all existing mechanical equipment noted to remain, the Mechanical Contractor shall visit the site to document existing seismic restraints, or lack thereof. The Mechanical Contractor shall provide this information to the Professional Structural Engineer retained to design seismic restraint elements for this project. The Professional Structural Engineer shall review the existing restraints and indicate any additional requirements. Computations and shop drawings shall include all existing mechanical equipment noted to remain.

E. The professional engineer retained by the Mechanical Contractor for seismic restraint calculations shall visit the job site upon completion of the seismic restraint installation. This Engineer shall provide in writing verification of compliance with the approved seismic submittal. This verification shall bear the Engineer's professional seal. Job site inspection by other than this Engineer is not acceptable. This engineer shall also be responsible for any required special inspections and associated documentation related to seismic restraints.

F. Seismic-Restraint Loading:
1. Site Class as Defined in the NC State Building Code (Chapter 16) and ASCE 7, as determined by the project Structural Engineer of record.
2. Assigned Seismic Use Group or Building Category as Defined in the NC State Building Code (Chapter 16) and ASCE 7.
   a. Component Importance Factor.
   b. Component Response Modification Factor.
   c. Component Amplification Factor.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second).
4. Design Spectral Response Acceleration at 1-Second Period.

1.3 SUBMITTALS

A. Product Data: For each product indicated.

B. Vibration Isolation Mounts and Hangers: In a single consolidated submittal, provide catalog datasheets, shop drawings and other documents as necessary to indicate equipment unit number, isolator type, supported weight, scheduled deflection, proposed deflection under operating load, spring free height, spring operating height, spring solid height (at coil bind), and spring diameter for each isolator. Submittals based upon rated deflection will be rejected. Indicate the weight and lowest rotational or reciprocal speed of each piece of isolated equipment. Indicate bridge bearing quality neoprene components and neoprene durometer where provided. Use the format below to summarize isolator characteristics for submittal review by the Engineer and project Acoustics Consultant. Submittals will be reviewed for compliance and a Review/Comment sheet returned to the Architect and Engineer for their use.

C. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Elastomeric Pads: For pads supporting equipment (not piping), submit calculations showing supported weight, required deflection, pad support area, load per square inch, operating deflection, unloaded pad height (not including shims and top plate) and percent deflection. Indicate bridge-bearing quality neoprene where provided.

SAMPLE SUBMITTAL FORMAT:	MOUNT/HANGER	PAD
Supported Equipment	P-1	CU-1
Isolator Type	Mason SLRS-B2-680	
Supported Weight	1750 LB	320 LB
Lowest Speed	1500 RPM	-
Scheduled Deflection	1.5 inch	0.07 inch

Operating Deflection	1.6 inch	0.11 inch
Spring (Pad) Free Height	4.125 inch	0.75 inch
Operating Height	2.525 inch	0.64 inch
Solid Height	1.125 inch	-
Spring Diameter	2.875 inch	-
Pad Support Area	-	16 sq. in.
Remarks		Bridge bearing quality neoprene, 30 durometer

E. Equipment Bases: Provide detailed drawings for steel bases, sub-bases, and rails showing all steel work, reinforcing method of isolator attachment, and location of equipment attachment bolts.

F. Concrete Inertia Bases: Provide shop drawings showing all steel work, required concrete, and method of isolator attachment, and location of equipment attachment bolts.

G. Shop Drawings: Submit shop drawings and manufacturer's installation instructions for thrust restraints and sway braces wherever they are required. Submit shop drawings for piping isolation details where Type A pads are used; see Paragraph on Piping Isolation.

H. Field Quality-Control Inspection Report: Upon completion of the installation and after the system is put into operation, the manufacturer's representative shall make a final inspection and submit his report to the Architects and Engineers in writing certifying the correctness of installation and compliance with approved submittal data. The contractor shall allow for the cost of this service in his bid.

I. Welding certificates.

J. Qualification Data: For professional engineer.

1.4 QUALITY ASSURANCE

A. Drawings are schematic only. Choose the size and number of mounts and hangers to meet these specifications. Provide brackets, rails, bases, braces, snubbers, etc. as needed for a complete and correct installation.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear pre-approval by ICC-ES, or pre-approval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. When pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs shall be signed and sealed by a qualified professional engineer.

E. Provide vibration isolators and equipment bases for Related Divisions from the product line of a single manufacturer whenever possible unless approved by the project Acoustics Consultant. Isolators not supplied by the primary vibration isolator manufacturer shall be rejected.

F. The vibration isolator manufacturer's representative shall determine isolator sizes and mountings and shall provide field supervision and inspection to assure proper installation, adjustment and performance. Representative shall alert the Engineer and project Acoustics Consultant to any isolator selections, which may experience resonance with the approved equipment and upgrade any isolators that are found to resonate with the supported equipment. The Contractor shall include in his bid vibration isolation system elements as recommended by the manufacturer's representative to make a complete, correct, and safe installation. Supply and install any incidental materials needed, even when not explicitly specified or shown in the Construction Documents, without claim for additional payment.

G. Skilled workers who are experienced in the necessary crafts to meet the requirements of this Section shall perform the work.

H. Unacceptable Types: Do not use Mason models C, CI or CS, Amber-Booth models XL or XK, Kinetics models SL or SM or equivalent on this project in any location.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Mason Industries, Inc., Hauppauge, New York.
2. Kinetics Noise Control, Dublin, Ohio.
3. Amber-Booth Company, Inc., Houston, Texas.

B. Since manufacturers’ products vary, specific models listed in this Specification may not be approved when they do not meet all requirements in this section. Model designations listed herein are intended only as a guide.

2.2 SPRING REQUIREMENTS

A. Steel springs and neoprene elements shall have static deflections under operating load equal to or greater than deflections shown in this specification section. Submittals based on rated deflection will be disapproved.

B. All steel springs as installed shall have a minimum additional travel to solid (coil bind) equal to 50 percent of the deflection under operating load.

C. Spring diameter shall be no less than 80 percent of the compressed height of the spring at operational load.

D. Steel springs shall not be welded to other elements of the isolator unless specifically noted in the submittal and approved by the project Acoustics Consultant.

E. Steel springs shall not take a permanent set when compressed to coil bind.

F. Steel springs shall be color coded to allow positive identification after installation.

2.3 ELASTOMER REQUIREMENTS

A. All elastomeric (neoprene) components shall be selected for maximum hardness of 40 durometer, shore A rating, where possible. In no case shall hardness exceed 50 durometer. Use bridge-bearing quality neoprene meeting AASHTO Highway Bridge Specifications in all elastomeric components where installed in irretrievable locations and as noted elsewhere in the documents.

2.4 CORROSION RESISTANCE

A. All isolators and associated hardware shall be designed or treated for resistance to corrosion. Steel components shall be PVC coated, or phosphated and painted with industrial grade enamel. All nuts, bolts and washers shall be zinc electroplated. Structural steel bases and exposed steel components of concrete inertia bases shall be cleaned of welding slag and primed with zinc-chromate or metal etching primer. A finish coat of industrial grade enamel shall be applied over the primer.

B. All isolators exposed to the weather shall have steel parts PVC coated, hot-dip galvanized or zinc-electroplated plus coating of Neoprene or Bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel. Nuts, bolts, and washers may be zinc electroplated.

2.5 EQUIPMENT SET ON FLOORS AND HOUSEKEEPING PADS

A. When any of the isolated equipment is to be set directly on the floor or a housekeeping pad, provide Mason "Super-W" or approved equal neoprene pads under the unit. For units supported by load-bearing sleepers, neoprene pads (with load-distributing steel shims, when necessary) shall be provided to the extent specified by the pad manufacturer's representative or engineer. Pads shall meet requirements of Paragraph on TYPE A: ELASTOMERIC PADS.

2.6 EQUIPMENT BOLTED TO FLOORS OR HOUSEKEEPING PADS

A. Bolts or snubbers used to keep the pads securely in place shall be sleeved or grommeted with neoprene and secured with a neoprene washer to prevent rigid metal-to-metal contact. When the mounting base plate is to be bolted to the structure or framework rigidly connected to the structure, Mason HLB neoprene bushings and Mason HLW neoprene washers shall be used between each bolt and the isolator base plate to prevent mechanical short circuit. These additional neoprene washers and bushings may be omitted only when the base plate and friction pad incorporate neoprene elements that eliminate rigid contact between bolts and the base plate. Bolt holes shall be properly sized to allow for bushings. The hold down bolt shall incorporate steel washers to distribute load evenly over neoprene washers. Neoprene bushings and washers shall meet conditions of Paragraph on ELASTOMERIC GROMMETS.

2.7 TYPE A: ELASTOMERIC PADS

A. Shall be 5/16-inch minimum thickness waffled or ribbed neoprene pads Mason model W or SW, Amber-Booth model NR, Kinetics model NP or approved equal. Where multiple layers are specified or are required to provide the specified deflection, pads shall be interleaved

with 16-gauge steel shim plates, Mason model WSW, Amber-Booth model SP-NR style E or approved equal. Size pads for deflection as required in Table 1. Maximum pad deflection is 20 percent of unloaded height, except bridge-bearing quality pads, which have maximum deflection of 15 percent of unloaded height. Provide load distributing top plates when needed for uniform loading. Provide pads of sufficient thickness to achieve the specified minimum deflection. Cork shall not be used in elastomeric pad assemblies. Neoprene shall meet conditions of Paragraph on ELASTOMER REQUIREMENTS.

2.8 TYPE B: NEOPRENE-IN-SHEAR FLOOR MOUNT ISOLATORS

A. Shall have steel bottom plates with bolt holes for bolting to foundations, a threaded steel insert at top of the mounting for attaching equipment, and friction surfaces both top and bottom. All metal surfaces shall be neoprene covered to resist corrosion. Mounts shall be double deflection and designed for deflection as required in Table 1 of this specification. Maximum mount deflection is 0.35 inches at rated load. Neoprene shall meet conditions of Paragraph on ELASTOMER REQUIREMENTS. Isolators shall be Mason model ND, Amber-Booth model RVD, Kinetics model RD or approved equal.

2.9 TYPE D: OPEN SPRING FLOOR MOUNT ISOLATORS

A. Shall be freestanding and laterally stable with no housing, and shall have leveling adjustment bolts, which shall be rigidly connected to the equipment. Size and select isolators for deflection as required in Table 1 in this specification. Provide with ¼ inch minimum elastomeric friction pad Type A between the base plate and the support. Pad shall meet conditions of Paragraph on ELASTOMER REQUIREMENTS. Vibration isolator vendor shall size elastomeric pads and associated load distributing shim plates to achieve deflection equal to 10 to 20 percent of the vertical thickness of the pads. Isolators shall be Mason model SLF, Amber-Booth model SW, Kinetics model FDS or approved equal.

2.10 TYPE E: RESTRAINED OPEN SPRING FLOOR MOUNT ISOLATORS

A. For equipment with operating weight greater than installed weight shall have built-in adjustable limit stops to prevent equipment from rising when weight is removed. Isolators shall be as Type D above plus height limiting studs and adjustable nuts, with ½ inch minimum clearance around the studs. Size and select isolators for deflection as required in Table 1 of this specification. Elastomeric friction pads used in conjunction with Type E mounts for chillers and cooling towers shall be of bridge-bearing quality neoprene, as described in Paragraph on ELASTOMER REQUIREMENTS. Isolators shall be Mason model SLR, Amber-Booth model CT, Kinetics model FLS or approved equal.

2.11 TYPE F: ELASTOMERIC HANGER

A. Shall be a neoprene-in-shear element mounted in a hanger box. The neoprene element shall be molded with a rod isolation bushing that prevents the rod from contacting the hanger box. Size and select isolators for deflection as required in Table 1 of this specification. Isolators shall be Mason model HD, WHD, Amber-Booth model BRD, Kinetics model RH or approved equal.

2.12 TYPE G: SPRING AND NEOPRENE IN SERIES ISOLATOR HANGERS

A. Shall contain a steel spring and elastomeric element in series. Size and select isolators for deflection as required in Table 1 of this specification. Neoprene elements shall be molded

with a rod isolation bushing that passes through the hanger box that prevents the rod from contacting the hanger box. The diameters of the spring and the hole in the mounting box shall allow for 15-degree misalignment from vertical before mechanical short circuit occurs. Isolators shall be Mason model 30N, Amber-Booth model BSRA, Kinetics model SRH or approved equal.

2.13 TYPE J: THRUST RESTRAINTS

A. Shall be in sets of two or more and shall be springs in series with neoprene. Deflection shall be equal to deflection of isolators supporting the unit being restrained. Provide thrust restraints complete with rods and adjustment nuts, plus angle brackets and backing plates for attachment to the unit being restrained and anchor supports. Thrust restraints shall be Mason model WB or approved equal.

2.14 TYPE K: SWAY BRACES

A. Shall be in sets of two or more and shall consist of aircraft cable, neoprene elements, or neoprene and spring assemblies. Braces shall keep the equipment stable without restricting the free motion of the vibration isolators. Submit shop drawings for approval prior to installation.

2.15 TYPE L: INERTIA BASES

A. Concrete inertia bases shall be formed of stone-aggregate concrete (150 PCF) and appropriate steel reinforcing cast between perimeter structural steel channels.

B. Inertia bases shall be built to form a rigid base, which will not twist, deform, deflect, or crack in any manner that would negatively affect the operation of the supported equipment or the vibration isolation mounts. Inertia bases shall be adequately sized to support basic equipment units and motors plus any associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. The vibration isolator manufacturer shall supply the steel frame and reinforcement. The General Contractor shall provide concrete.

C. Inertia base shall weigh a minimum of two times the weight of the supported equipment and shall be a minimum of 6 inches thick. Spacing between isolators supporting the inertia base shall be a maximum of ten times the thickness of the inertia base. Bases shall have a minimum operating clearance of 2 inches above floor or housekeeping pad. Use height saving brackets as required to maintain proper clearances.

2.16 TYPE M: STEEL BASES

A. Steel bases shall consist of structural steel sections sized, spaced, and connected to form a rigid frame which will not twist, rack, deform, or deflect in any manner to negatively affect the operation of the supported equipment or the vibration isolation mounts. Bases shall be adequately sized to support basic equipment and motors plus any associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. Steel bases shall be at least 6 inches thick. Spacing between isolators supporting the steel base shall be a maximum of ten times the thickness of the base. Bases shall have a

minimum operating clearance of 2 inches above floor or housekeeping pad. Bases shall include side-mounting brackets for attachment to vibration isolators.

2.17 TYPE N: STEEL RAILS

A. Steel rail bases shall consist of structural steel sections sized to provide a rigid beam which will not twist, deform, or deflect in any manner which will negatively affect the operation of the supported equipment or the vibration isolation mounts. Rails shall include end-mounting brackets for attachments of vibration isolators. Rails shall have a minimum operating clearance of 2 inches above the floor or housekeeping pad.

2.18 TYPE P: CAPTIVE NEOPRENE WALL MOUNT ISOLATORS

A. Shall be Mason model RBA, RCA, Kinetics model RQ, or approved equal.

2.19 TYPE Q: ROOF ISOLATION CURBS

A. Shall be Mason model RSC or approved equal. Curb shall provide continuous support for equipment and be constructed to resiliently resist wind and seismic forces. Construction of curb shall not enable rigid connection between vibrating equipment and building structure. Curb construction shall be water-resistant and equipped with flashing to prevent water infiltration. Seismic restraint calculations shall be provided for all connections of equipment to the structure.

2.20 FLEXIBLE NEOPRENE PIPING CONNECTORS

A. Shall be twin spherical type (flanged), or single sphere type (threaded), manufactured of Kevlar cord with a Peroxide-cured EPDM cover. Connectors shall be able to accept elongation, compression and axial and transverse movement. Connectors shall be selected to suit the system temperature, pressure and fluid type. No rods or cables shall be used to control extension of the connector unless required due to temperature and pressure requirements. Any control rods shall be separated from isolator with complete neoprene grommets (not just washers) as described in Paragraph on ELASTOMERIC GROMMETS. Connectors shall be Mason "Safeflex" model SFDEJ, SFDCR, SFU or approved equal. Straight wall connectors are not acceptable.

2.21 FLEXIBLE DUCTWORK CONNECTORS

A. Prefabricated, closely woven 30-ounce glass fabric, coated on both sides with neoprene and secured by double lock seams to 26 gauge minimum galvanized steel connectors on ends. Connectors shall be not less than 6 inches long. Material shall be UL approved and similar to "Ventglas" manufactured by Ventfabrics, Inc. or approved equal.

2.22 FLEXIBLE CONDUIT

A. Refer to Section 26 05 48: Vibration Isolation of Electrical Systems.

2.23 ELASTOMERIC GROMMETS

A. May be a combination of neoprene washer and bushing, Mason models HLW and HLB or approved equal. Otherwise they shall be E.A.R. (Indianapolis, Indiana) Isodamp, C-1000, ring bushing and washer combination or approved equal. Elastomer shall be 40 durometer

maximum. Grommets shall be formed to prevent bolts from directly contacting the secured item.

2.24 BUILDING ISOLATION JOINTS

A. Use a flexible duct connection, a flexible piping connection, a flexible conduit, or a flexible conduit connector at every location where a duct, pipe, or conduit crosses a building expansion or isolation joint.

2.25 VIBRATION ISOLATION SELECTION TABLE (TABLE 1)

A. Vibration isolation for all equipment shall be provided in accordance with the following Table 1 except as otherwise noted in Section 3 of this section. When floor span is greater than 30 feet, the project Acoustics Consultant shall be contacted for advice prior to placement of any orders. References in Notes column refer to paragraphs in Part 3 of this specification section.

TABLE 1: VIBRATION ISOLATION SELECTION TABLE

			EQUIPMENT LOCATION									
Equipment Type	Horsepower & Other	RPM	Slab on Grade			Up to 20′ Floor Span			20-30′ Floor Span			Notes
			Base	Isolator or Hanger	Min. Defl. (in.)	Base	Isolator or Hanger	Min. Defl. (in.)	Base	Isolator or Hanger	Min. Defl. (in.)	
Chillers:												
Screw	All	All	None	A/B	0.11	None	E	0.75	None	E	1.50	3.16 **Error! Reference source not found.**
Pumps	HP											
Close-Coupled	Up to 7.5	All	M/N	B	0.25	L	D	0.75	L	D	0.75	3.15 3.16
	10 and up	All	L	D	0.75	L	D	0.75	L	D	1.50	3.15 3.16
Large In-line	5 to 25	All	None	D	0.75	None	D	1.50	None	D	1.50	3.16 3.23
	30 and up	All	None	D	1.50	None	D	1.50	None	D	1.50	3.16 3.23
End Suction & Split Case	Up to 40	All	L	D	0.75	L	D	0.75	L	D	1.50	3.15 3.16
	50 to 125	All	L	D	0.75	L	D	0.75	L	D	1.50	3.15 3.16
	150 and up	All	L	D	0.75	L	D	1.50	L	D	2.50	3.15 3.16

			EQUIPMENT LOCATION									
Equipment Type	Horsepower & Other	RPM	Slab on Grade			Up to 20′ Floor Span			20-30′ Floor Span			Notes
			Base	Isolator or Hanger	Min. Defl. (in.)	Base	Isolator or Hanger	Min. Defl. (in.)	Base	Isolator or Hanger	Min. Defl. (in.)	
Boilers												
	All	All	None	A/B	0.11	M/N	E	0.75	M/N	E	0.75	3.21
Axial Fans, Fan Heads, Cabinet Fans, Fan Sections												
≤ 22 in. dia.	All	All	None	D/G	0.75	None	D/G	0.75	None	D/G	0.75	3.14
≥ 24 in. dia.	≤ 2″ s.p.	<300	M/N	D/G	2.50	L	D/G	3.50	L	D/G	3.50	3.14
	≤ 2″ s.p.	301-500	M/N	D/G	0.75	M/N	D/G	1.50	L	D/G	2.50	3.14
	≤ 2″ s.p.	>500	M/N	D/G	0.75	M/N	D/G	1.50	M/N	D/G	1.50	3.14
	> 2″ s.p.	<300	L	D/G	2.50	L	D/G	3.50	L	D/G	3.50	3.14
	> 2″ s.p.	301-500	L	D/G	1.50	L	D/G	1.50	L	D/G	2.50	3.14
	> 2″ s.p.	>500	L	D/G	0.75	L	D/G	1.50	L	D/G	1.50	3.14
Centrifugal Fans (not including Smoke Evacuation or Emergency Stair Pressurization Fans												
≤ 22 in. dia.	All	All	M/N	D/G	0.75	M/N	D/G	0.75	M/N	D/G	0.75	3.20
≥ 24 in. dia.	≤ 40	<300	M/N	D/G	2.50	M/N	D/G	3.50	M/N	D/G	3.50	3.20
		301-500	M/N	D/G	1.50	M/N	D/G	1.50	M/N	D/G	2.50	3.20
		>500	M/N	D/G	0.75	M/N	D/G	0.75	M/N	D/G	0.75	3.20
≥ 24 in. dia.	> 40	<300	L	D/G	2.50	L	D/G	3.50	L	D/G	3.50	3.20
		301-500	L	D/G	1.50	L	D/G	1.50	L	D/G	2.50	3.20
		>500	L	D/G	0.75	L	D/G	1.50	L	D/G	1.50	3.20
Propeller Fans												
Wall Mounted	All	All	None	D/G	0.75	None	D/G	0.75	None	D/G	0.75	
Roof Mounted	All	All	None	D/G	0.75	None	D/G	0.75	M/N	D/G	1.50	
Heat Pumps												
	All	All	None	D/G	0.75	None	D/G	0.75	None	D/G	0.75	
Condensing Units												

			EQUIPMENT LOCATION									
Equipment Type	Horsepower & Other	RPM	Slab on Grade			Up to 20' Floor Span			20-30' Floor Span			Notes
			Base	Isolator or Hanger	Min. Defl. (in.)	Base	Isolator or Hanger	Min. Defl. (in.)	Base	Isolator or Hanger	Min. Defl. (in.)	
	All	All	None	A/B	0.11	None	E	0.75	None	E	1.50	
Package Units Without Any Internal Isolation (AH, AC, H, V)												
	>10 hp, > 4" s.p.	<300	M/N	D/G	0.75	L	D/G	3.50	L	D/G	3.50	3.10 3.11
		301-500	M/N	D/G	0.75	L	D/G	1.50	L	D/G	2.50	3.10 3.11
		>500	M/N	D/G	0.75	L	D/G	1.50	L	D/G	1.50	3.10 3.11
Package Rooftop Equipment												
	All	All	None	A	0.11	Q	D/G	0.75	Consult acoustical consultant			
Rotating Equipment (Small Fans, Fan-Powered Boxes, Fan Coil Units)												
	≤ 600 cfm	All	None	D/G	0.50	None	D/G	0.50	None	D/G	0.50	3.14
	> 600 cfm	All	None	D/G	0.75	None	D/G	0.75	None	D/G	0.75	3.14
Engine-Driven Generators												
	All	All	None	D/G	0.75	L	D/G	1.50	L	D/G	2.50	
Factory-Assembled Air Handling Units with Approved Internal Isolation												
	All	All	None	A	0.11	None	A	0.11	None	A	0.11	3.10 3.11
Curb-Mounted Rooftop Fans												
	All	All	n/a	n/a	n/a	n/a	Q	1.0	n/a	Q	1.0	

2.26 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti, Inc.
5. Kinetics Noise Control.
6. Loos & Co.; Cableware Division.
7. Mason Industries.
8. TOLCO Incorporated; a brand of NIBCO INC.
9. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES, or an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized or ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

G. Resilient Isolation Washers and Bushings: One-piece, molded, oil and water-resistant neoprene, with a flat washer face.

H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 GENERAL

A. Resiliently mount equipment, ductwork, piping and other equipment on or suspended from approved foundations and supports, with isolation mounts, hangers, and pads as specified herein and as shown on drawings. Install seismic restraints in strict conformance with the certified shop drawings. Select locations of isolation equipment for ease of inspection and

adjustment as well as for proper operation. Contractor shall cooperate with the Architect and project Acoustics Consultant to replace, at no additional cost to the Owner, any isolators that need to be upgraded from what is shown on the drawings when equipment operation results in resonance with building natural frequencies.

3.2 MOUNTS AND HANGERS

A. Align vibration isolators squarely above or below mounting points of the supported equipment.

B. For equipment with bases, locate isolators on the sides of the base that are parallel to the equipment shaft.

C. When a housekeeping pad is provided, isolator base plates shall rest entirely on the pad.

D. Position vibration isolation hangers as high as possible in the hanger rod assembly but not in contact with the building structure. Provide 1 inch minimum to 3 inches maximum clearance between hanger housing and structure above. Provide side clearance for hanger housings to allow a full 360-degree rotation about the rod axis without contacting any object.

E. Parallel pipes may be hung together on a trapeze that is isolated from the structure. Isolator deflections shall equal the greatest deflection for those pipes when isolated individually. Do not mix isolated and non-isolated pipes on the same trapeze.

F. Limit stops shall be out of contact during normal operation.

G. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.

H. To simplify installation, Contractor may elect to use Type E isolators instead of Type D isolators, or Type H isolators instead of Type G isolators.

3.3 PROVIDE CONCRETE INERTIA BASES and required steel reinforcing under this section.

A. Pour dense aggregate concrete (150 PCF) within structural frames under the supervision of the contractor responsible for the work of this section.

3.4 FLOOR CLEARANCES

A. For floor-mounted equipment, provide a minimum operating clearance of 2 inches between the bottom of the equipment or inertia base and the floor or housekeeping pad. Check to ensure that this space is completely clear after installation is complete. Provide height saving brackets as needed. Where housekeeping pads are provided, coordinate isolator locations with size of housekeeping pads especially where outboard mounts are used with height saving brackets.

3.5 DEFLECTIONS

A. Design vibration isolation systems to have deflections equal or greater than indicated on drawings and in Table 1 of this specification section. Where multiple deflection requirements apply to a single isolator, the greater deflection shall prevail. Isolators supporting equipment with center of gravity that is asymmetrical in plan shall be selected for nearly equal

deflection under actual load. Vibration isolation manufacturer shall determine number and size of mountings. Install isolators in accordance with manufacturer's instructions.

3.6 THRUST RESTRAINTS

A. Maximum motion shall be ¼ inch under start-up or shut-down conditions for each floor or ceiling supported piece of equipment. Restrain greater motions by approved thrust restraints, Type J, attached at the centerline of the thrust, and arranged symmetrically on the unit. Anchor the restraints to fixed supports of stiffness greater than the thrust to be countered and not to resiliently supported ductwork. Adjust according to manufacturer's instructions. Submit shop drawings and manufacturer's installation instructions for thrust restraints for approval prior to installation.

3.7 ISOLATED SYSTEMS SHALL BE INDEPENDENT

A. Do not hang or support piping, ductwork, conduit or mechanical equipment on other equipment, pipes or ductwork installed on vibration isolators. Maintain 2 inches clearance between isolated equipment and walls, ceilings and other equipment. Do not allow drain piping connected to vibration-isolated equipment to contact the building structure or other non-isolated systems unless it is resiliently mounted.

3.8 STABILIZE ALL ISOLATED EQUIPMENT

A. Provide resilient sway bracing to solid anchor points to stabilize all resiliently supported equipment and piping in accordance with all requirements of state and local codes.

3.9 TREAT ALL ISOLATION SYSTEMS FOR CORROSION RESISTANCE

A. Repair coatings damaged during installation.

3.10 FACTORY ASSEMBLED AIR HANDLING UNITS

A. When fan/motor base is not isolated, mount entire unit on open spring floor mount isolators Type D or hang from spring and neoprene hangers Type G. Where units are furnished with internal structural frames and external lugs are of suitable strength and rigidity, mount isolators directly to unit. Otherwise furnish additional structural frames and install isolators to maintain cabinet integrity and bearing alignment. On units with approved internal isolation for fan/motor base, provide Mason "Super-W" or approved equal neoprene pads under the unit. For units supported by load bearing sleepers, provide neoprene pads with load-distributing steel shims to the extent specified by the neoprene manufacturer's representative or engineer. Sleeve or grommet with neoprene bolts or snubbers used to keep the pads securely in place and secure with a neoprene washer to prevent rigid metal-to-metal contact. Secure piping connections with a flexible connector as described in Paragraph on FLEXIBLE PIPING CONNECTORS. Provide thrust restraints in accordance with Paragraph on THRUST RESTRAINTS when required.

3.11 PACKAGED EQUIPMENT

A. Do not use package air handling units and package air conditioning units with factory supplied vibration isolation in conjunction with external vibration isolators described in this specification section. Air handling units mounted on open spring isolators, which have been supplied with factory installed internal vibration isolation elements, shall have these internal

elements rigidly bridged by tightening the shipping bolts, or by other means as necessary. On units with approved internal isolation, provide Mason "Super-W" or approved equal neoprene pads under the unit. For units supported by load bearing sleepers, provide neoprene pads with load-distributing steel shims to the extent specified by the neoprene manufacturer's representative or engineer. Sleeve or grommet with neoprene bolts or snubbers used to keep the pads securely in place and secure with a neoprene washer to prevent rigid metal-to-metal contact. Secure piping connections units with flexible connectors as described in section Paragraph on FLEXIBLE PIPING CONNECTORS. Provide thrust restraints in accordance with Paragraph on THRUST RESTRAINTS when required.

3.12 EQUIPMENT MOUNTED ON ISOLATION ROOF CURBS

A. Shall be installed on seismically rated vibration isolation roof curb per manufacturer's installation instructions. All duct connections shall be made with flexible connectors. All piping connections shall be made with flexible connectors per Paragraphs on FLEXIBLE NEOPRENE PIPING CONNECTORS and FLEXIBLE PIPING CONNECTORS.

3.13 DX UNIT REFRIGERANT LINES

A. Install flexible stainless steel metal pipe connectors in two planes 90 degrees to each other in refrigerant lines. Flexible connectors shall have a burst pressure of four times operating pressure. Furnish pipe sizes through 2 inch I.D. with hex male nipple fittings, and furnish pipe sizes 2-1/2 inches I.D. and larger with fixed steel flanges both sides.

3.14 CEILING SUPPORTED FANS, FAN-POWERED BOXES, AND FAN COILS

A. See Table 1.

B. When equipment to be mounted is not furnished with integral structural frames and external mounting lugs of suitable strength and rigidity to prevent excessive flexing during operation, provide structural sub-base to support equipment and to which hangers shall be attached.

C. Provide thrust restraints Type J in accordance with Paragraph on THRUST RESTRAINTS.

D. Provide flexible duct connections in accordance with Paragraph on FLEXIBLE DUCT CONNECTORS.

E. Provide flexible piping connectors in all piping connected to vibration-isolated equipment. Install these connectors between the equipment and the first associated pipe support or hanger.

3.15 CENTRIFUGAL PUMPS

A. See Table 1.

B. Pipe between each pump and first associated flexible pipe connection shall mount on the concrete inertia base.

C. Support inertia base with open spring floor mount isolators Type D.

3.16 FLEXIBLE PIPING CONNECTORS

A. Provide flexible neoprene piping connectors in all piping where it is connected to vibration-isolated equipment. Install these connectors between the equipment and the first associated pipe support or hanger, except where supports connect to an inertia base common to the equipment. Install straight-through connectors parallel to the axis of rotation of the shaft of the isolated equipment. Follow manufacturer's instructions for proper installation of flexible connectors including pre-extension of twin-sphere type. Install connectors in easily visible locations for inspection and replacement purposes.

B. Use flexible metallic hoses instead of flexible neoprene piping connectors only where temperature and pressure conditions exceed the service limitations of neoprene type connectors.

3.17 PIPING ISOLATION

A. All piping connected to rotating or reciprocating equipment shall be vibration isolated according to Table 2 unless specifically excluded by the Acoustical Consultant.

B. The installation or use of vibration isolators shall not cause any change of position of piping which will result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, maintain equipment and piping in a rigid position during installation. Do not transfer the load to the isolators until the installation is complete and under full operational load.

C. As used in this section the term "Equipment Room" means any space containing pumps 3 HP or larger, chillers, air-handlers 3 tons or larger, fans handling 1,200 CFM or more, boilers, or elevator equipment.

TABLE 2: PIPING ISOLATION TABLE

PIPING	SUPPORTED FROM	WHERE ISOLATORS ARE REQUIRED	ISOLATOR TYPE	STATIC DEFLECTION
Piping less than 12″ i.d. connected to equipment isolated with springs	CEILING	First three hangers	Type G	At least equal to that of the isolators supporting the equipment, up to 2″.
	FLOOR	First three mounts	Type D	
Piping connected to equipment isolated with springs	CEILING	From (and including the) fourth hanger to leaving Equipment Room or to 50 feet pipe length from equipment, whichever is greater	Type G	0.75″ minimum.
	FLOOR	From (and including the) fourth mount to leaving Equipment Room or to 50 feet pipe length from equipment, whichever is greater	Type D	

PIPING	SUPPORTED FROM	WHERE ISOLATORS ARE REQUIRED	ISOLATOR TYPE	STATIC DEFLECTION
Piping connected to equipment isolated with pads or neoprene mounts	CEILING	Within Equipment Room or within 50 feet pipe length from equipment, whichever is greater	Type F	At least equal to that of the pads or neoprene mounts supporting the equipment.
	FLOOR	Within Equipment Room or within 50 feet pipe length from equipment, whichever is greater	Type B	

3.18 FLEXIBLE DUCT CONNECTORS

A. Install at all duct connections to fan units unless noted otherwise. Install between the fan unit and the first duct support. Use a flexible connector where ductwork crosses a building expansion or isolation joint. Maintain 3 inches minimum separation between mated duct segments. Seal joints and seams airtight.

3.19 DUCTWORK ISOLATION:

A. All ductwork shall be vibration isolated in accordance with Table 3.

B. Provide flexible duct connections in accordance with Paragraph on FLEXIBLE DUCT CONNECTORS.

C. Ductwork lagging (shown on the drawings) shall be supported with separate framing and should not be supported by the duct hangers.

D. As used in this section the term "Equipment Room" shall mean any space containing pumps 3 HP and larger, chillers, air-handlers 3 tons and larger, fans 1,200 CFM or more, boilers, or elevator equipment.

TABLE 3: DUCTWORK ISOLATION TABLE

DUCTWORK	SUPPORTED FROM	WHERE ISOLATORS ARE REQUIRED	ISOLATOR TYPE	STATIC DEFLECTION
Ductwork connected to equipment isolated with springs	CEILING	First three hangers	Type G	At least equal to that of the isolators supporting the equipment, up to 2”.
	FLOOR	First three mounts	Type D	
Large or heavy-gage ductwork	CEILING	First three hangers	Type H	At least equal to that of the isolators

DUCTWORK	SUPPORTED FROM	WHERE ISOLATORS ARE REQUIRED	ISOLATOR TYPE	STATIC DEFLECTION
connected to equipment isolated with springs	FLOOR	First three mounts	Type E	supporting the equipment, up to 2". Transfer load to the springs after installation is complete and any required lagging has been installed.
Ductwork connected to equipment isolated with springs	CEILING	From (and including the) fourth hanger to leaving Equipment Room or to 50 feet duct length from equipment, whichever is greater	Type F	0.20" minimum.
	FLOOR	From (and including the) fourth mount to leaving Equipment Room or to 50 feet duct length from equipment, whichever is greater	Type B	
Ductwork connected to equipment isolated with pads or neoprene mounts	CEILING	Within Equipment Room or within 50 feet duct length from equipment, whichever is greater	Type F	Equal to that of the pads or neoprene mounts supporting the equipment
	FLOOR	Within Equipment Room or within 50 feet duct length from equipment, whichever is greater	Type B	

3.20 CENTRIFUGAL FANS (not including smoke evacuation or emergency stair pressurization fans)

A. See Table 1.

B. Provide thrust restraints Type J as scheduled or required to limit motion to ¼ inch maximum under fan operating, start-up and shut-down conditions.

3.21 BOILERS, AIR SEPARATORS AND EXPANSION TANKS

A. See Table 1.

B. Fan aspirated boilers require isolation, using Type A neoprene pad isolators of bridge bearing quality or approved equal neoprene pads under the unit. For units supported by load bearing sleepers, provide neoprene pads with load-distributing steel shims to the extent specified by the neoprene manufacturer's representative or engineer.

C. Where vibration isolated piping is connected to an expansion tank or air separator, make connection with a flexible connector.

3.22 FLEXIBLE CONDUIT

A. Use to isolate vibration from all equipment requiring vibration isolation per this specification section. Flexible conduit shall be a minimum length of 12 inches with 25 percent greater length than the separation between the isolated equipment and the termination of rigid conduit. Install the flexible conduit to be slack and not to exceed the manufacturer's minimum recommended bending radius. For conduit sizes greater than 2 inches diameter, use pre-manufactured flexible conduit connectors instead of flexible conduit. Refer to Section 26 05 48: Vibration Isolation for Electrical Systems for further information.

3.23 IN-LINE PUMPS

A. See Table 1.

B. Install neoprene double sphere pipe connectors on suction and discharge.

3.24 CONDENSATE DRAIN LINES

A. Condensate drain lines shall not connect rigidly to structure. Place a section of flexible transparent tubing in the drain line between the connection to the equipment and the point of connection to structure.

3.25 APPLICATIONS

A. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

B. Strength of Support and Seismic-Restraint Assemblies: Select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.26 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:
1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, or an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:
1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, or an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Attachment to Structure: When specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

G. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer when reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.27 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

3.28 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
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 post connection 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 four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. When a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.29 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.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Valve tags.
   5. Warning tags.

1.3 ACTION 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 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 LETTERING AND GRAPHICS

A. Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown pre-existing, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (for example: Boiler No. 1; AHU-1; etc.).

2.2 EQUIPMENT LABELS

A. Metal Labels for Equipment:
1. Material and Thickness: [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. 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.
6. For all equipment located above lay-in ceilings, provide indicators at ceiling grid attached with screws. Labels shall show:
a. Box # or Unit #

B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch or 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: Yellow.
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 5 inches x 4 inches.
6. Minimum Letter Size: 1/4 inch for principal lettering; include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's unique equipment number, areas served (use actual room numbers used at the facility – not architectural room numbers, extended warranty period, number and size of filters and capacity. The following are examples of labeling to be used:
1. Air Handling Units:

AHU-1 (Classrooms #212, 213, 214 & 215)
S.C.D.: 06/01/2011
Filters: 4(24x24x2 inch)
2(24x12x2 inch)
Capacity: 4000 CFM @ 1.0 inch ESP

2. Condensing Units:

CU-1 (Office #202 & 203)
S.C.D.: S.C.D.: 06/01/20011 (5 years Comp. Warranty)
Capacity: 3 Tons

3. Use similar protocol for Chillers, Boilers, Pumps, Fans, and VFD's.

D. A phenol tag (3" x 2") shall visually identify all VAV boxes with the box number engraved on it, permanently attached by screws to the ceiling grid directly under the VAV box.

E. A phenol tag (3" x 2") shall visually identify all HVAC hydronic system isolating valves, permanently attached by screws to the ceiling grid directly under the valves.

F. 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.

2.3 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch > thick, and having predrilled holes for attachment hardware.

B. Letter Color: Comply with ANSI A13.1, except where another color selection is indicated.

C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. 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.

F. Fasteners: Stainless-steel self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
   1. Dielectric unions shall be labelled.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to [partially cover] [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.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, polished finish, minimum 19-gauge, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Solid brass chain (wire link or beaded type); size as required for attaching tags.
3. Tag Size: 1-1/2-inch diameter, except as otherwise indicated.

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. Valve schedule shall be mounted in Boiler Room in frame on wall.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.
1. Major mechanical equipment shall include:
a. VAV Boxes
b. Air Handlers
c. All AC units and heat pump units (split or packaged, water or air cooled)
d. Chillers
e. Boilers
f. Pumps
g. Fans
h. Expansion Tanks
i. Air Separators

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting".

B. 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 10 feet> along each run. On piping above removable acoustical ceiling spaced at maximum intervals of 25 feet. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:
   1. Chilled-Water Piping:
      a. Background Color: Black
      b. Letter Color: White
   2. Heating Water Piping:
      a. Background Color: Black
      b. Letter Color: White
   3. Refrigerant Piping:
      a. Background Color: Black
      b. Letter Color: White

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; 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. Refrigerant: 1-1/2 inches round
      c. Hot Water: 1-1/2 inches round
      d. Gas: 1-1/2 inches round
   2. Valve-Tag Color:
      a. Chilled Water: Blue
      b. Refrigerant: Green
      c. Hot Water: Red
      d. Gas: Yellow
   3. Letter Color:
      a. Chilled Water: White
      b. Refrigerant: White
      c. Hot Water: White
      d. Gas: White

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.6 PIPE TRACE

A. All non-accessible, non-metallic piping shall be detectable by means of tracer wire or marking tape buried 18-inches above the piping. Turn marker tape up at the building foundation toward the finish grade.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section 1.2.A through C below are CMS requirements.

B. Section Includes:
1. Testing all mechanical equipment by TAB Specialist to determine that performance is in compliance with requirements of the contract documents, and adjusting and balancing of systems so that fluid quantities are delivered to locations as required by the contract documents and that the temperature, humidity, and volume may be controlled in accordance with design intent and space requirements.
2. Testing all instructional and performance spaces and report acoustical performance information.
3. Coordination and enabling of testing and balancing activities by Contractor and Mechanical Installer.
4. TAB work shall not imply a guarantee of Mechanical system, nor shall it relieve Contractor or equipment manufacturers of their responsibilities under the contract documents.
5. Balancing Air Systems:
    a. Constant-volume air systems.
    b. Variable-air-volume systems.
    c. Multizone systems.
    d. Induction-unit systems.
    e. Exhaust systems
6. Balancing Hydronic Piping Systems:
    a. Constant-flow hydronic systems.
    b. Variable-flow hydronic systems.
    c. Primary-secondary hydronic systems.

C. The Owner will hire an independent Commissioning Agent to commission the Work; however, this shall not relieve the Contractor of his responsibilities. Refer to commissioning plan portion of the specifications. Contractor shall provide all required labor and/or material to comply with the commissioning plan.

D. Work in this section shall be contracted directly by the Contractor. The Mechanical Installer shall coordinate work with the TAB Specialist.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30days of Contractor's Notice to proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Instrument calibration reports, to include the following:
1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. Qualifications: Testing and balancing shall be performed by certified, independent firm approved by Owner, specializing in testing and balancing of mechanical systems that is acceptable to Owner, employing full time employees qualified to perform work of this Section. TAB Specialist shall be a member of the Associated Air Balance Council or NEBB.

B. TAB Specialist's Supervising Engineer: Qualified professional engineer who is a full-time employee of TAB Specialist firm and experienced in supervising work required by this Section.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 PROJECT CONDITIONS

A. Testing and balance shall not begin until the system has been completed and is in full working order. The Mechanical Installer shall put all heating, ventilating, and air conditioning systems and equipment into full operation and shall continue the operation of same during each working day of testing and balancing.

1.8 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Engage TAB Specialists approved by Owner, or submit qualifications of proposed TAB Specialist prior to bid in accordance with requirements of Division 00 Bidding Requirements.

3.2 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 systems for installed 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 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 used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 “Metal Ducts” and 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 filters and verify that bearings are greased, belts are aligned and tight, 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 are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of 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.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Upon completion of items of work required and prior to the commencement of TAB, the mechanical contractor shall thoroughly clean all dirt and debris from equipment, ducts, piping systems, fixtures, strainers, and other accessories.
1. All bearings, gear boxes, wearing surfaces, or other equipment components requiring lubrication shall be properly serviced as recommended by the equipment manufacturer, and shall be tagged with the date of service and type of lubricant used. All specified cleaning and protective devices shall then be installed in equipment, piping, plenums, ductwork, etc., and systems shall be placed in continuous operation.
2. All fans shall have been in operation for at least twenty-four hours prior to the start of testing and balancing so that initial stretch of drive belts will have taken place, and all other mechanical equipment, including temperature and operating control devices shall have been adjusted and calibrated for complete and functional operating service.

C. Provide the TAB Specialist copies of all approved equipment, specialties, and control submittal data, together with a set of contract plans and specifications.

D. Provide all thermometer wells, pressure gauge connections, capped duct thermometer openings, as required by the Testing and Balancing Agent. The TAB Specialist shall assist the Mechanical Installer in locating these devices as the job progresses.

E. Provide sufficient time from the complete installation of all systems to the final established completion date of this project so that testing and balancing can be accomplished.

F. Complete system-readiness checks and prepare reports. Verify the following:
1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.

4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 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" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
   1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

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 plastic plugs.
   2. After testing and balancing, install duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
   3. 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.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the 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 and note the locations of the pressure switches on all hydronic systems.

N. Verify motor rotation on all 3 phase motors.

3.6 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. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
   2. Measure fan static pressures as follows to determine actual static pressure:
      a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      a. Report the cleanliness status of filters and the time static pressures are measured.
   4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
   5. 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.
   6. Obtain approval from Engineer 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.
   7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure airflow of submain and branch ducts.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Balance variable-air-volume systems the same as described for constant-volume air systems.
   2. Set terminal units and supply fan at full-airflow condition.
   3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
   4. Readjust fan airflow for final maximum readings.
   5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
   6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
   7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
      a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
   8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
      a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
   2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
   3. Set terminal units at full-airflow condition.
   4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
   5. Adjust terminal units for minimum airflow.
   6. Measure static pressure at the sensor.
   7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check liquid level in expansion tank.

3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.9 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Engineer and comply with requirements in Section 232123 "Hydronic Pumps."
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
a. Monitor motor performance during procedures and do not operate motors in overload conditions.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

B. Determine DP set point for pump VFD controller at minimum pressure able to satisfy the worst case valve pressure requirement.

3.11 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

B. Determine DP set point for pump VFD controller at minimum pressure able to satisfy the worst case valve pressure requirement.

3.12 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. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.13 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator [and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.

6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.14 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.15 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.16 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: minus 5 percent to plus 10 percent.
2. Outside air: zero to plus 10 percent
3. VAV boxes: plus or minus 5 percent
4. Air Outlets and Inlets: Plus or minus 10 percent
5. Pressurized rooms (positive): supply plus 5 percent, exhaust/return minus 5 percent (room offset tolerance plus 10 percent)
6. Pressurized rooms (negative): supply minus 5 percent, exhaust/return plus 5 percent (room offset tolerance plus 10 percent)
7. Heating-Water Flow Rate: Plus or minus 5 percent
8. Cooling-Water Flow Rate: Plus or minus 5 percent.

3.17 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.

3.18 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.

B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.

4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; 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 contractor.
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 air flow 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 o.c.
   f. Make and model number.
   g. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
   a. Air flow 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. Gas- Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
   1. Unit Data:
      a. System identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer's serial number.
      f. Fuel type in input data.
      g. Output capacity in Btu/h.
      h. Ignition type.
      i. Burner-control types.
      j. Motor horsepower and rpm.
      k. Motor volts, phase, and hertz.
      l. Motor full-load amperage and service factor.
      m. Sheave make, size in inches, and bore.
      n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   2. Test Data (Indicated and Actual Values):
      a. Total air flow rate in cfm.
      b. Entering-air temperature in deg F.
      c. Leaving-air temperature in deg F.
      d. Air temperature differential in deg F.
      e. Entering-air static pressure in inches wg.
      f. Leaving-air static pressure in inches wg.
      g. Air static-pressure differential in inches wg.
      h. Low-fire fuel input in Btu/h.
      i. High-fire fuel input in Btu/h.
      j. Manifold pressure in psig.
      k. High-temperature-limit setting in deg F.
      l. Operating set point in Btu/h.
      m. Motor voltage at each connection.
      n. Motor amperage for each phase.
      o. Heating value of fuel in Btu/h.

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 sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow 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 sq. ft.
2. Test Data (Indicated and Actual Values):
a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water 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.
e. Flowmeter type.
2. Test Data (Indicated and Actual Values):
a. Air flow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.

e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.
2. Test Data (Indicated and Actual Values):
a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

M. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.19 INSPECTIONS

A. Final Inspection:
1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Commissioning Authority.
2. Commissioning Authority 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.

3. 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."
4. 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.

B. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. 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 contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

C. Prepare test and inspection reports.

3.20 ADDITIONAL TESTS

A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following duct services:
   a. Indoor, concealed supply, return, and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Outdoor, exposed outdoor air supply.

B. Related Sections:
   a. Division 23 Section "HVAC Piping Insulation."
   2. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field-applied when required).

B. Qualification Data: For qualified Installer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 agency.
   a. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation 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. Flexible Elastomeric Insulation: Closed-cell, sponge or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials, minimum 3.0 PCF density.
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    b. Armacell LLC; AP Armaflex with field-applied jacket or Armacell ArmaTuff with factory-applied jacket.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket, aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    b. CertainTeed Corp.; SoftTouch Duct Wrap.
    c. Johns Manville; Microlite.
    d. Knauf Insulation; Friendly Feel Duct Wrap.
    e. Manson Insulation Inc.; Alley Wrap.
    f. Owens Corning; SOFTR All-Service Duct Wrap.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
b. CertainTeed Corp.; Commercial Board.
c. Fibrex Insulations Inc.; FBX.
d. Johns Manville; 800 Series Spin-Glas.
e. Knauf Insulation; Insulation Board.
f. Manson Insulation Inc.; AK Board.
g. Owens Corning; Fiberglas 700 Series.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
b. Aeroflex USA, Inc.; Aeroseal.
c. Armacell LLC; Armaflex 520 Adhesive.
d. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
e. K-Flex USA; R-373 Contact Adhesive.
f. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive that complies 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," including 2004 Addenda.
a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
b. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
c. Eagle Bridges - Marathon Industries; 225.
d. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
e. Mon-Eco Industries, Inc.; 22-25.
3. Use adhesive that complies 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," including 2004 Addenda.

B. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
b. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
c. Eagle Bridges - Marathon Industries; 225.
d. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
e. Mon-Eco Industries, Inc.; 22-25.
f. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Use adhesive that complies 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," including 2004 Addenda.

C. PVC Jacket Adhesive: Compatible with PVC jacket.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   b. Dow Corning Corporation; 739, Dow Silicone.
   c. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
   d. P.I.C. Plastics, Inc.; Welding Adhesive.
   e. Speedline Corporation; Polyco VP Adhesive.
   f. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive that complies 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," including 2004 Addenda.

2.3 MASTICS
   a. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   c. Vimasco Corporation; 749.
   d. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   b. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
   c. Eagle Bridges - Marathon Industries; 501.
   d. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
   e. Mon-Eco Industries, Inc.; 55-10.
   f. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

b. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
c. Eagle Bridges - Marathon Industries; 570.
d. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
e. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F.
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
b. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
c. Eagle Bridges - Marathon Industries; 550.
d. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.
g. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.4 LAGGING ADHESIVES

a. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.
d. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
b. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
c. Eagle Bridges - Marathon Industries; 405.
d. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
e. Mon-Eco Industries, Inc.; 44-05.

f. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Use sealants that 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," including 2004 Addenda.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
b. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
c. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Use sealants that 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," including 2004 Addenda.

2.6 FIELD-APPLIED JACKETS

A. Self-Adhesive Outdoor Jacket: 15.5-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed aluminum-foil facing.
a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
b. Venture Tape, 1579CW-E.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
b. ABI, Ideal Tape Division; 428 AWF ASJ.
c. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
d. Compac Corporation; 104 and 105.
e. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
f. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.

6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   b. ABI, Ideal Tape Division; 491 AWF FSK.
   c. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   d. Compac Corporation; 110 and 111.
   e. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
   f. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.8 SECUREMENTS

A. Bands:
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   b. ITW Insulation Systems; Gerrard Strapping and Seals.
   c. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
   d. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:
   a. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inchdiameter shank, length to suit depth of insulation indicated.
   b. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.
   c. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inchdiameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   d. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) AGM Industries, Inc.; CHP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.

e. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
f. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
    2) GEMCO; Perforated Base.
    3) Midwest Fasteners, Inc.; Spindle.
g. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
h. Spindle: Copper or zinc-coated, low-carbon steel, aluminum, stainless steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
i. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
j. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
k. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
    2) GEMCO; Peel & Press.
    3) Midwest Fasteners, Inc.; Self Stick.
l. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
m. Spindle: Copper or zinc-coated, low-carbon steel, aluminum, stainless steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
n. Adhesive-backed base with a peel-off protective cover.
o. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
p. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    1) AGM Industries, Inc.; RC-150.
    2) GEMCO; R-150.
    3) Midwest Fasteners, Inc.; WA-150.
    4) Nelson Stud Welding; Speed Clips.
q. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
r. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
s. 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) GEMCO.
    2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

D. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.
   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:
   b. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   a. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

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 INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during storage, application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   a. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   a. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
   b. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
4. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   a. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   a. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.

4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
   a. Comply with requirements in Division 07 Section "Penetration Firestopping "firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:
   a. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   a. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches and smaller, place pins 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, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
      c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not over compress insulation during installation.
      e. Impale insulation over pins and attach speed washers.
      f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
      g. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or

field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

h. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

i. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

j. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

4. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

a. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins 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 pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not over=compress insulation during installation.

e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

f. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

g. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

h. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

i. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

4. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where jackets are indicated, install as follows:
   a. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

3.8 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:
   a. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   a. Indoor, concealed supply, return, and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Outdoor, exposed outdoor air supply.

B. Items Not Insulated:
   a. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed (installed above ceilings), rectangular, round and flat-oval supply air duct insulation shall be mineral-fiber blanket, 2 inches thick and 1.5 PCF nominal density, 2.2 inches thick and 0.75 PCF nominal density, or 1" thick fiberglass duct liner where indicated on the drawings.

B. Exposed, rectangular, round and flat-oval supply air duct insulation shall be flexible elastomeric, 1 inch thick, black.

C. Return Air Ducts, concealed (installed above ceilings):
1.
2. 1" thick fiberglass duct liner.

D. Exposed Supply and Return Ductwork in Air Conditioned, Occupied Spaces, and Exhaust Air Ductwork:
1.
2. None.

E. Exposed Supply and Return Ductwork exposed in Air Conditioned Utility Spaces (Conditioned Mechanical Rooms or Mechanical Rooms used as Return Air Plenums) and Exposed in Non-Air Conditioned Spaces (Boiler Rooms, et. Al):
1.
2. Mineral-Fiber Board Insulation: 2 inches thick and installed R-5.0.
3. Mineral-fiber blanket, 2 inches thick and 1.5 PCF nominal density or 2.2 inches thick and 0.75 PCF nominal density.
4.

F. Outside-Air Ducts:
1. Mineral-Fiber Blanket: 2 inches thick and installed R-5.0.

G. Type-I Commercial Kitchen Hood Exhaust Ducts:
1. None.

H. Type-II Commercial Kitchen Hood and Dishwasher Exhaust Ducts:
1. None.

I. Kitchen Hood Make-Up Air Ducts:
1. Mineral-Fiber Blanket: 2 inches thick and installed R-5.0.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts, Plenums, and Piping, concealed (installed above ceilings) and Exposed in Air Conditioned Occupied Spaces:
1. None.

D. Ducts, Plenums, and Piping, exposed in Air-Conditioned Utility Spaces (Conditioned Mechanical Rooms and Mechanical Rooms used as Return Air Plenums):

1. 8-ounce canvas with lagging adhesive.
2. White PSK facing for mineral-fiber blanket duct wrap.
3.

E. Ducts, Plenums, and Piping, Exposed in Non-Air-Conditioned Spaces (Boiler Rooms, et. al.):
   1. PVC: 20 mils thick (N/A if installed in a return air plenum).
   2. Aluminum, Smooth: 0.016 inch thick.

F. Equipment, concealed (installed above ceilings):
   1. None.

END OF SECTION

SECTION 230716 - HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following HVAC equipment that is not factory insulated:
   1. Chilled-water and condenser pumps.
   2. Heating water pumps.
   3. Expansion and compression tanks.
   4. Air separators.

B. Related Sections:
   1. Division 23 Section "Duct Insulation."
   2. Division 23 Section "HVAC Piping Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field-applied when applicable).

B. Qualification Data: For qualified Installer.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing 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 agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. 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.

C. Flexible Elastomeric Insulation: Closed-cell, sponge or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Sheet and K-FLEX LS.

2.2 ADHESIVES
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Use adhesive that complies 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," including 2004 Addenda.

2.3 MASTICS
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Foster Brand, Specialty Construction Brands, Inc., a business of H.B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
   b. Eagle Bridges - Marathon Industries; 501.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
   d. Mon-Eco Industries, Inc.; 55-10.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
   b. Eagle Bridges - Marathon Industries; 570.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
   b. Eagle Bridges - Marathon Industries; 550.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
   d. Mon-Eco Industries, Inc.; 55-50.
   e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
   b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
   c. Vimasco Corporation; 713 and 714.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Permanently flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 100 to plus 300 deg F.
   4. Color: White or gray.
   5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   6. Use sealants that 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," including 2004 Addenda.

2.6 SECUREMENTS

A. Bands:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. ITW Insulation Systems; Gerrard Strapping and Seals.
      b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
   2. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
   3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
   4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

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.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Hand-holes.
6. Cleanouts.

3.4 INSTALLATION OF EQUIPMENT, TANK AND VESSEL INSULATION

A. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

B. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, aluminum or stainless steel, at least 0.050 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.5 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: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the

"Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.6 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below.

B. Insulate indoor and outdoor equipment that is not factory insulated.

C. Chilled-water pumps, chilled-water air separators, chilled-water expansion and compression tank insulation shall be the following:
1. Flexible Elastomeric: 1 inch thick.

D. Hot-water pumps, hot-water air separators, hot-water expansion and compression tank insulation shall be the following:
1. Flexible Elastomeric: 1 inch thick.

END OF SECTION

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Condenser water piping insulation.
   2. Condensate drain piping insulation.
   3. Refrigerant suction and hot-gas piping insulation.

1.3 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Aeroflex
   2. Armacell
   3. Certain Teed Corp.
   4. Johns Manville
   5. Knauf Insulation
   6. Owens Corning
   7. Pittsburg Corning Corp.
   8. Dyplast Products

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to 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 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation 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. Flexible Elastomeric Insulation: Closed-cell materials. Comply with ASTM C 534, Type I for tubular materials.

G. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

H.

2.2 INSULATING CEMENTS

A. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive 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."

C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive 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."

D. PVC Jacket Adhesive: Compatible with PVC jacket.
1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive 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."

2.4 MASTICS
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.5 LAGGING ADHESIVES
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. Joint Sealants:
1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
   b. Eagle Bridges - Marathon Industries; 405.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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."

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
   4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
   5. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
   6. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
   7. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
   8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Adhesive: As recommended by jacket material manufacturer.
   2. Color: Color-code jackets based on system. Color as selected by Architect.
   3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:
1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
a. [Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size].
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: [1-mil-thick, heat-bonded polyethylene and kraft paper] [3-mil-thick, heat-bonded polyethylene and kraft paper] [2.5-mil-thick polysurlyn].
d. Moisture Barrier for Outdoor Applications: [3-mil-thick, heat-bonded polyethylene and kraft paper] [2.5-mil-thick polysurlyn].
e. Factory-Fabricated Fitting Covers:
1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Width: 2 inches.
   2. Thickness: 6 mils.
   3. Adhesion: 64 ounces force/inch in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches.
   2. Thickness: 3.7 mils.
   3. Adhesion: 100 ounces force/inch in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
   1. Width: 3 inches.
   2. Film Thickness: 4 mils.
   3. Adhesive Thickness: 1.5 mils.
   4. Elongation at Break: 145 percent.
   5. Tensile Strength: 55 lbf/inch in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
   1. Width: 3 inches.
   2. Film Thickness: 6 mils.
   3. Adhesive Thickness: 1.5 mils.
   4. Elongation at Break: 145 percent.
   5. Tensile Strength: 55 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, [1/2 inch] [3/4 inch] wide with [wing seal] [or] [closed seal].
   2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with [wing seal] [or] [closed seal].
   3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches] [4 inches] o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating

cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

E.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof

sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:
1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.8 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 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 pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to [three] <Insert number> locations of straight pipe, [three] <Insert number> locations of threaded fittings, [three] <Insert number> locations of

welded fittings, [two] <Insert number> locations of threaded strainers, [two] <Insert number> locations of welded strainers, [three] <Insert number> locations of threaded valves, and [three] <Insert number> locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: [1 inch] thick.
b. Polyolefin: 1 inch
2. Condenser Water Supply & Return
a. None
b.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:
1. All Pipe Sizes: Insulation shall be the following:
a. Flexible Elastomeric: 1 inch thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: [2 inches] thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: [2 inches] thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Exposed:
1. Aluminum, Smooth0.024 inch thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Exposed:
   1. Aluminum, Smooth0.024 inch] thick.

END OF SECTION

SECTION 230900 – ENERGY MANAGEMENT SYSTEM AND BUILDING AUTOMATION

SYSTEM CONTROL FOR HVAC AND LIGHTING

PART 1 - GENERAL

1.1 INSTRUCTIONS TO VENDORS

A. Vendor is cautioned that the Owner reserves the right to reject any Vendor, which in the Owner's sole judgment, takes meaningful deviation or exception to Division 23 Direct Digital Control (DDC) Standards. The Charlotte-Mecklenburg Schools' (CMS) Energy Manager and/or designated representative of the Energy Management Department (EMD) shall review all vendor substitution submittals. Vendor substitution approval/disapproval shall be returned via the project architect in writing from Charlotte-Mecklenburg Schools' Energy Manager and designated EMD Project Manager.

B. The existing system at the buildings shall be removed in its entirety and replaced with a new system compliant with these specifications.

C. The overriding requirement is the use of the DDC Control System to maintain design occupant comfort with optimal minimized energy consumption while maximizing equipment, component, and system design function integrity and life.

1.2 RELATED DOCUMENTS

A. Drawings (both mechanical and electrical project manual drawings) and general provisions (within Divisions 23, 26, 27) of the Contract, including General Conditions apply to this Section.

B. The provisions of the General Conditions, Supplementary Conditions, and the Sections included under Division 1, General Requirements, are included as a part of this Section as through bound herein.

C. Sections within Division 23 Mechanical and Division 26 Electrical apply, including though not limited to

D. 1. 23 09 01 – BAS Graphical User Interface Guidelines

E. 2. 23 09 02 – BAS Point Naming and Tagging Guideline

F. 3. 23 29 23 – Variable-Frequency Motor Controllers

G. 4. 23 52 23 – Cast Iron Sectional Boilers

H. 5. 23 64 26 – Air Cooled Water Chillers

I. 6. 23 08 00 – Commissioning of HVAC and BAS

J. 7. 26 08 00 - Commissioning of Electrical Systems

K. 9. 23 09 93 – Sequences of Operation for HVAC controls

1.3 SUMMARY

A. This Section includes Energy Management and Remote Automated Computer Control Systems for HVAC and Lighting systems and components, including control components for terminal heating and cooling units including approved integration with factory-wired controls. The work of this section 23 09 00 shall be provided by the Building Automation Systems controls contractor.

B. The Building Automation System (BAS) Controls shall be comprised of a Direct Digital Control (DDC) network of interoperable, stand-alone digital controllers communicating on a BACnet communication network over IP across the CMS network to CMS owned virtual server hosting the Web Supervisor(s).

C. The system 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 and field devices as shown on the drawings and as specified.

D.

1.4 ABBREVIATIONS AND ACRONYMS

A. AHU: Air Handling Unit

B. AI: Analog Input

C. ANSI: American National Standards Institute

D. AO: Analog Output

E. ASC: Application Specific Controller

F. ASHRAE: American Society of Heating, Refrigerating, and Air Conditioning Engineers

G. ASPE: American Society of Plumbing Engineers

H. ASME: American Society of Mechanical Engineers

I. ASTM: American Society for Testing and Materials

J. ATC: Automatic Temperature Control System

K. AWG: American Wire Gauge (Standard)

L. BACnet/IP, BACnet/MSTP: Acceptable Communication Protocols across the EMS/BAS Controls Network.

M. BAS: Building Automation System

N. BI: Binary Input

O. BMS: Building Management System

P. BO: Binary Output

Q. CAD: Computer Aided Design

R. CCC: Central Communications Controller

S. CCU: Central Control Unit

T. CPU: Central Processing Unit

U. Not Used

V. DALI: Digital Addressable Lighting Interface

W. DCP: Digital Control Panel

X. DDC: Direct Digital Controls

Y. DI: Discrete Input

Z. DMA: Direct Memory Access

AA. DMZ: Demilitarized Zone Network

BB. DO: Discrete Output

CC. EMS/BAS: Energy Management System / Building Automation System

DD. FAC LAN: Facility Local Area Network

EE. FACP: Fire Alarm Control Panel

FF. FCC: Fire Command Center

GG. FCIP: Fire Fighters' Control and Indicating Panel

HH. FMS: Facility Management System

II. GUI: Graphical User Interface

JJ. HTML5: Hyper Text Markup Language 5

KK. HVAC: Heating Ventilating and Air Conditioning

LL. I/O: Input/output.

MM. IP: Internet Protocol

NN. ISA: Intelligent Sensor or Actuator

OO. MS/TP: Master Slave/Token Passing

PP. MSCP: Mass Storage Control Protocol

QQ. MSI: Master System Integrator

RR. NC: Network Controller

SS. NCP: Network Control Panel

TT. NEC: National Electric Code

UU. NI: Network Integrator

VV. NIC: Not in Contract

WW. NPBI; Needle Point Bipolar Ionization

XX. NFPA: National Fire Protection Association

YY. NSS: Network Services Server

ZZ. NSI: Network Services Interface

AAA. OS: Operating System

BBB. PCU: Programmable Control Unit

CCC. PID: Proportional Integral Derivative

DDD. PRV: Pressure Reducing Valve

EEE. RAM: Random Access Memory

FFF. ROM: Read Only Memory

GGG. RTD: Resistance temperature detector

HHH. SCADA: Supervisory Control and Data Acquisition System

III. SI: Systems Integrator

JJJ. SNVT: Standard Network Variable Type

KKK. SPACE; A complete ventilation path as defined by ASHARE

LLL. TCP/IP: Transmission Control Protocol / Internet Protocol

MMM. THHN: Thermoplastic High Heat Resistant Nylon Coated-Cable Coating

NNN. TP: Twisted Pair

OOO. UL: Underwriters Laboratory

PPP. UML: Unified modeling Language

QQQ. UPS: Uninterruptible Power Supply

RRR. VAV: Variable Air Volume

SSS. VCS: Voice Communication System

TTT. VFD: Variable Frequency Drive

UUU. XML: Extensible Markup Language

VVV.

WWW.

XXX.

1.5 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:
   1. Graphic Display: Display graphical information at the present day fastest refresh interval capable by the most current updated graphical software revisions within the confines of the firmware of the connected equipment.
   2. Graphic Refresh: Display information at the fastest refresh interval of the most recent graphical software revision within parameters of the workstation.
   3. Object Command: Reaction time shall be at the fastest refresh interval with the most current up-to-date graphical software version within the firmware capabilities of the connected equipment. In no case shall that be more than two seconds between operator command of a binary object and device reaction.
   4. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
   5. Reporting Accuracy and Stability of Control: Report values and maintain measured variables to within industry standards and tolerances no greater than those as follows:
      a. Space Temperature: Plus or minus 1 deg F.
      b. Ducted Air Temperature: Plus or minus 1 deg F.
      c. Outside Air Temperature: Plus or minus 2 deg F.
      d. Dew Point Temperature: Plus or minus 3 deg F.
      e. Temperature Differential: Plus or minus 0.25 deg F.
      f. Relative Humidity: Plus or minus 5 percent.
      g. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
      h. Airflow (Terminal): Plus or minus 10 percent of full scale.
      i. Air Pressure (Space): Plus or minus 0.01-inch wg.
      j. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
      k. Carbon Monoxide: Plus or minus 5 percent of reading.
      l. Carbon Dioxide: Plus or minus 50 ppm.
      m. Electrical: Plus or minus 5 percent of reading.

1.6 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, options provided,

finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
2. Control System Software: Include technical data for operating system software, operator interface, color graphics, programming, sequence of operations, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and specific location and size of each assembly and field connection.

1. See paragraph 2.3.A.2 for digital storage of controls shop drawings as-builts and product data sheets.
2. Bill of materials of equipment indicating quantity, manufacturer, and model number.
3. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
4. Wiring Diagrams: Power, signal, and point to point control wiring.
5. Details of control panel faces, including controls, instruments, and labeling.
6. Written description of sequence of operation for each system and component.
7. Schedule of dampers including size, leakage, and flow characteristics.
8. Schedule of valves including flow characteristics.
9. DDC System Hardware:
    a. Wiring diagrams for control units with enumerated termination numbers matching components.
    b. Schematic diagrams and floor plans depicting geographic location for field sensors and control hardware.
    c. Schematic diagrams for point-to-point control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
10. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, pdf links, and operator notations.
11. Controlled Systems:
    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically and geographically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagrams in pdf to be embedded on graphical screens.
    d. Points list with corresponding controller ID’s and settings.
12. Submittal of graphical interface and graphical representations of each component.

C. Operation and Maintenance Data: For HVAC instrumentation and control system 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. Maintenance instructions and lists of spare parts for each type of control device.

2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.
6. Normal, range and failsafe position for each device.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative, who is trained and approved for installation of system components required for this Project, and who employs only factory trained personnel, with minimum experience as follows:
   1. Firm: Ten years.
   2. Project Manager: Five years.
   3. Project Engineer, Application Engineering Staff: Three years.
   4. Electronic Technicians: Two years.

B. Approved manufacturers shall have minimum three full-time factory trained and certified service personnel located within twenty-five miles travel distance of CMS Building Services.

C. Comply with ANSI/ASHRAE Standard 135-1995 for DDC system components for BACnet MSTP at the unit controller level.

D. Controls equipment and components shall meet or exceed the following standards: UL-916; Energy Management Systems (EMS).

E. Preinstallation Conference: Including Architect, Owner's representative, and affected Installers, to review approved submittals and installation strategies.

1.8 QUALIFICATION REQUIREMENTS

A. The EMS/BAS controls contractor must have a minimum of 10 years of experience manufacturing and installing the controls system similar in performance to that specified herein and shall be prepared to evidence this history as condition of acceptance and approval prior to bidding.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Delivery of material shall not be considered complete until installed. Components shall be protected from detrimental environmental conditions until mounted at the component’s final location.

B. Storage shall be at the contractor’s risk and responsibility in collaboration with the Owner.

C. All material handling shall remain the contractor’s responsibility.

D. 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.

1.10 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with owner, plans and room details before installation. All field installed components shall remain accessible for maintenance and repair.

B. Coordinate equipment with Division 26 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system. Provide externally field mounted LED RIB Relays or approved devices at controlled equipment starter for demarcation between 3rd party systems. Label all devices with function.

C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

D. Coordinate equipment with Electrical requirements Section "Panelboards" to achieve compatibility with starter coils, VFD's, Lighting Controls and annunciation devices. Provide field mounted LED RIB Relays or approved devices at controlled equipment for demarcation between 3rd party systems. Label all devices with function.

E. Global site controllers shall have dedicated power circuits, with UPS and Emergency Generator backup.

F. All work with trades for 3rd party devices and equipment that are to be supplied and or interfaced "by others.".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers approved as listed below, each having critically defined data made available and integrated via BACnet/IP to CMS's frontend:
1. Automated Logic's (ALC) WebCTRL as provided by Automated Logic – North Carolina, Charlotte, NC.
2. Alerton Compass as provided by mfr.'s local representative, Hoffman Building Technologies (HBT) in Charlotte, NC.
3. Trane Tracer Ensemble as provided by Carolina Trane in Charlotte, NC.
4. Johnson Controls Metasys as provided by Johnson Controls (JCI) in Charlotte, NC
5. Niagara N4 with Schneider Electric IA as provided by Schneider Electric, Charlotte, NC
6. Niagara N4 with (Tridium) as provided by Platinum Building Automation
7. Niagara N4 with Honeywell as provided by United Automation Controls, Charlotte, NC

B. Comply with qualification requirement in above sections 1.7 and 1.8.

C. Pre-approval does not relieve the manufacturer from compliance of 23 09 00.

2.2 CONTROL SYSTEM

A. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems. System must be hardwired controllers, and field devices, or IP addressable when approved.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on BACnet network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 GENERAL

A. The Building Automation System (BAS) shall include but not be limited to the following components.
   1. The BAS Operator Interface shall be accessible from any internet browser using HTML5 current technology via Windows 10 or greater OS from Microsoft Edge, Google Chrome, and/or Mozilla Firefox, and/or a mobile app. The BAS Operator Interface consists of hardware and software that allows full user monitoring, adjustment and trending of system parameters, fault detection and diagnostic capabilities. The systems shall support an unlimited number of passwords protected concurrent users, if view only, and shall be individually identifiable if provided with command and control.
   2. Digital storage of as-built control drawings and product data sheets including sequences of operation, and relevant project manual mechanical as-built drawings/information shall be in pdf format; stored on the virtual server; and made accessible from the site front page via a navigation link. BAS Drawings and product data sheets pdf are to be stored in the BAS by the building automation controls contractor. Drawings and other project information electronic pdf are to be provided by others and stored and made accessible in the BAS by the Controls Contractor.
   3. System Level Controllers shall manage the Energy and Building Management capabilities of the automation system as well as facilitate remote communications and central monitoring.
   4. Application Specific Controllers shall provide distributed, pre-engineered control, specific to the mechanical equipment specified.
   5. Custom Application Controllers with distributed custom programming capability shall provide control for nonstandard control sequences.
   6. The Data Communications capability shall allow data to be shared between the various controllers in the architecture.
   7. The system software shall include system software for global application functions, application software for distributed controllers, and operator interface software.
   8. End devices such as sensors, actuators, dampers, valves, and relays. AI/AO DI/DO's must be compatible and afforded isolation/protection from 3rd party devices.
   9. All 3rd party controllers read, write, AV/BV values shall be BACnet compatible. All non-vendor specific controllers shall be preapproved by CMS.

B. The failure of any single component shall not interrupt the control strategies of other operational devices. Integrated controllers and field devices downstream of each equipment controller shall reside on the same trunk.

C. Hard wired Safety circuit end of line devices shall reside in the same controller as the equipment being protected.

D. All Controllers shall automatically reboot and retain system properties programming and settings in the event of a power failure.

2.4 DDC EQUIPMENT

A. Only CMS authorized and configured computers by Building Services Support Services Technology Group are permitted. All required software for the BAS Controls and DDC system diagnostics shall be available from the server. All necessary operational and utility software to operate, configure, maintain, program, trend, perform diagnostics, override control points, and edit graphics shall be provided and reside on the server. No annual renewal fees shall be required on any software.

B. Building Controls Contractor shall coordinate with Owner's IT department to interface with the local demilitarized zone (DMZ) network. The DMZ subnetwork is logistically located between the public internet and private networks. The contractor shall be responsible to coordinate the security of the Building Automation System's network.

2.5 BUILDING AUTOMATION FUNCTIONS

A. System Graphics. The BAS panel shall serve up HTML5 type data and standard equipment graphics pages arranged alphabetically by school/facility. No special software on any remote computer shall be required to view/edit the graphics. IT connectivity shall be provided by Owner. The BAS GUI shall also have a navigation tree. Provide a standardized and consistent method in conjunction with existing navigation for the operator to easily move between graphic displays. See section 230901 for information on Graphical User Interface and Tree and Branch Layouts.

B. Data on web pages must be returned and updated on a given web page at the maximum interval the control processor can deliver but no less than 5 seconds.

C. System Applications. Provide the following applications:
1. Area Control: Area application coordinates HVAC equipment for a specific area of the building. The application shall assign unit controllers, binary outputs, and binary values to be members of a common area to efficiently perform a single operation (such as changing a setpoint, creating a schedule, performing an override) and apply it to all members of the area. In addition, the area application shall use algorithms, along with area temperatures and humidity inputs, to make an economizing decision. The application shall also include optimal start/stop, humidity pulldown, night purge, occupied/unoccupied heating/cooling, occupied/unoccupied dehumidify, and timed override functions.
2. The Variable Air Systems: (VAS) application coordinates air-handling units, variable-air-volume (VAV) boxes, and ventilation within a building. VAV units are assigned to the air-handling unit that supplies air to them. The VAS application coordinates the start-up and shut-down of the system to ensure proper static pressure control.
3. Integration: Energy-saving applications, including static pressure optimization and ventilation optimization, are required features. Control sequences of dedicated primary pumps shall be provided by the dedicated primary system served, (e.g. Boilers, Chillers, etc.) BAS DDC functionality can be supplemented with BACnet connections for feedback provided stand alone and local capabilities, and Safety sequences are not compromised. Safety circuits should not be wired through the BAS, only monitored.
4. Reports features: The contractor shall provide a reporting package that allows the operator to select reports. Standard reports for equipment shall be generated initially by the contractor and made available from the BAS.
5. Report types shall include: Site reports, VAS commissioning reports, All Points in Alarm Report: Provide an on demand report showing all current alarms, All Points in Override

Report: Provide an on demand report showing all overrides in effect, Points report: Provide a report that lists the current value of all points, the operator interface shall provide a reporting package that allows the operator to select reports, the operator interface shall provide the ability to schedule reports to run at specified intervals of time. The operator interface shall allow a user to export reports and logs from the building controller in a format that is readily accessible by other standard software applications including spreadsheets and word processing.

6. System Diagnostics: The BAS shall automatically continuously monitor and report the operation and condition of all network connections, building management panels, and controllers. CMS sites will be listed in alphabetical order and have the following summarized notification of 3 critical alarms:
    a) Network Comm/Site's BAS Controller Down,
    b) Site Mechanical Plant Chiller, Boiler, Ancillary Equipment Down,
    c) NPBI Module Non-Functional
7. Override Point Control: Provide a tracked method for a user to view, override, and edit if applicable, the status of any object and property in the system. The point status shall be available by menu, on graphics or through custom programs. A summary log of all Overrides, the point(s) overridden, by whom, when, for how long shall be on the BAS front end, and all override shall have a default "TEMPORARY-TIMED-OPTION" with an automatic return to the designed setting parameter. Permanent operator overrides shall only be assigned with high level password access.
8. Override Owners: The system shall convey to the user the owner of each override for all priorities that an override exists. Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.
9. Datalogs; Provide Data logs for each major piece of equipment (chillers, boilers, air handling units, rooftop units, and pumps) by School. Temperature sensors in IDF/MDF rooms shall also be trended. Logs shall be capable of being viewed in real-time, or at a later time (historical data) in graphical and tabular format. They shall also be capable of being printed and saved. With the proper security access, system users can configure (create, delete, and update) and manage (clear, enable, and disable) data logs in the system. Each point in the data log should clearly be delineated by color and key in a multiple simultaneous per data log capability. The operator interface shall allow a user to export trend log data in CSV or PDF format for use by word processing and spreadsheet packages such as Microsoft Office Word and Excel. Data logs shall be able to be stored for up to three years.
10. Scheduling: Schedules by ventilation space (e.g. AHU, RTU, DX) and/or groups of zones (e.g. Multiple Buildings, Schools, Event sites, etc.) shall be programmed into the system at owner turnover, confirmed during owner training. A user shall be able to perform the following tasks utilizing the operator interface: Edit an existing schedule; Create a new schedule; Defining the default values, events and membership; Create exceptions to a schedule for any given day, and/or hours within a day; Apply an exception that spans a single day or multiple days, independent or consecutive; View a schedule by day, week and month with exceptions, schedules, and holidays characterized and shown clearly a calendar format. Modify the schedule events, members and exceptions. Scheduling should be able to be deployed and integrated to by facility-type (ES, MS, HS, Admin, et al), basis from the BAS. Overlapping schedules shall be clearly indicated and displayed.
11. Alarm/Event Notification: An operator shall be notified of new alarms/events as they occur while navigating through any part of the system via an alarm icon. A display of the last Alarm and counter of the same previous alarms in history is preferred.
12. Alarm/Event Log: The operator shall be able to view all logged system alarms/events from any operator interface. The operator shall be able to sort and filter alarms from

events. Alarms shall be sorted in a minimum of 4 categories based on severity. Alarm/event messages shall use full language, easily recognized and consistent descriptors. An operator with the proper security level may acknowledge and clear alarms/events. All alarms/events that have not been cleared by the operator shall be stored by the building controller. The alarm/event log shall include a comment field for each alarm/event that allows a user to add specific comments associated with any alarm.

13. Alarm Processing: Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system. If an alarm exists, an alarm shall be uniquely visible in the GUI. The data displayed in the log includes when and where the event occurred and whether the operator is required to acknowledge it. An operator shall also have the capability to use the log to add comments about events. Column headings can be used to sort and filter events. They shall also be available to be removed or exported from the log.
14. Alarms and Events: log shall contain multiple categories that can be used to sort and filter them. Sorting shall be based, for example, on severity level. Filtering shall be used to view only the alarms from a specific piece of equipment, or space, or those received at a specific time or from a specific alarm category.
15. Security: Each operator shall be required to login to the system with a unique username and password to view, edit, add, or delete data. Multiple User Profiles shall be provided to restrict the user to only the objects, applications, and system functions as assigned by the system administrator. User logon/logoff attempts shall be recorded. The system shall protect itself from unauthorized use by automatically logging off after a predetermined adjustable time following the last keystroke. The delay time shall be administrator definable by log in.
16. Pre-defined Profiles: The system shall include pre-defined profiles that allow a system administrator to quickly assign levels of permissions to a user or group of users.
17. Help; Provide a context sensitive, online help system to assist the operator in navigation and configuration of the system. On-line help step by step shall be available for all system functions and shall provide the relevant data for each particular screen.
18. Network Monitoring: The system shall automatically monitor the operation of all network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operators and geographically depict the fault location.
19. The building automation system (BAS) shall provide the ability to initiate the auto-commissioning/auto-calibration command directly from the user interface. Special service tools shall not be required. The terminal boxes shall allow the operator to perform on an individual or group basis auto-commissioning report for the VAV box which contains the results of the auto-commissioning/auto-calibration tests which is printable and remain in memory until the next auto-commissioning test is initiated. This report shall contain, at a minimum, the following information for each VAV box in the system. Name and location of terminal box. Date and time the terminal box was tested. Presence of any alarms. Space temperature and set-point. Active airflow (in CFM). Air valve/damper position when the terminal box reaches 40 percent of the maximum cooling airflow set-point. Air valve / damper position when the terminal box reaches 100 percent of the maximum cooling airflow set-point. Discharge air temperature (if specify on points list) of the terminal box when the terminal local fan is off. Discharge air temperature of the terminal box when the terminal local fan is on. Discharge air temperature of the terminal box when the hot heat is active.
20. Controls contractor shall provide commissioning agent all controls software at no additional cost.

2.6 ARCHITECTURE/COMMUNICATIONS

A. This project shall be comprised of a high-speed Ethernet network utilizing BACnet/IP communications between System Server, Controllers and Workstations. Communications between System Controllers and sub-networks of Custom Application Controllers and/or Application Specific Controllers shall utilize BACnet/IP communications.
   1. Each System Controller shall perform communications to a network of Custom Application and Application Specific Controllers using BACnet protocol as prescribed by the BACnet standard. Each System Controller shall function as a BACnet Router to each unit controller providing a unique BACnet Device ID for all controllers within the system.

2.7 SYSTEM LEVEL CONTROLLERS

A. System level controller shall reside on the CMS enterprise-Wide Area Network (WAN). The enterprise WAN is provided by the owner and supports the Internet Protocol (IP). Local Area Network connections for the Building Controllers shall be provided by the controls contractor on ISO 8802-3 (Ethernet). Each Building Controller shall also perform routing to a network of Custom Application and Application Specific Controllers. Each Building Controller shall perform communications to a network of Custom Application and Application Specific Controllers using BACnet MSTP. Each System Controller shall be listed as a Building Controller (B-BC) by the BACnet Testing Lab.

B. System level controller shall support hardwire communications to equipment level direct digital controllers. Multiplexing of receivers and transmitters is not acceptable.

C. Each System Level Controller shall function as a BACnet Router to each unit controller providing a unique BACnet Device ID for all BACnet/MSTP controllers within the system.

D. The System Level Controller shall have ample memory to support its operating system, database, and programming requirements. All trending history shall be stored at the system level controller for 48 hours and then automatically downloaded to the CMS server.

E. The System Level Controller shall store database and programming files.

F. The operating system of the System Level Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.

G. Data shall automatically be shared between System Level Controllers when they are networked together. All System Controllers shall have a real time clock.

H. The database and custom programming routines of remote System Level Controllers shall be editable from a single operator station.

I. The System Level Controllers shall have the capability of being remotely monitored over LAN. Additional capabilities shall include automatically sending out alarms, gathering alarms, reports and logs, programming and downloading databases.

J. The controller shall continually check the status of all processor and memory circuits. If a failure is detected, the controller shall:
   1. Assume a predetermined fail-safe failure mode.

2. Emit an alarm condition, displaying visually on graphics and/or audibly, and/or via email or SMS.
3. Create a retrievable file of the state of all applicable memory locations at the time of the failure unless latched.
4. Automatically reset the System Controller to return to a normal operating mode.
5. Automatically reboot with all programming and memory function intact upon a voluntary or involuntary power cycle.

K. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure and shall be rated for operation at -40 C to 50 C [-40 F to 122 F].

2.8 EMS/BAS APPLICATION SPECIFIC CONTROLLERS

A. Application Specific Controllers shall be stand-alone, microprocessor based Direct Digital Controllers with sufficient memory to handle its operating system, database, and programming requirements of the BAS. These controllers are assumed to be used for air handling units, chillers, etc.

B. The Application Specific Controller shall be pre-programmed, tested, and factory mounted on the mechanical equipment to ensure reliability. Where factory mounting is not possible, the controllers shall be factory programmed and tested prior to shipment to the jobsite. The controllers shall be clearly labeled as to controller type, where it is to be installed, and software address (if applicable). The controller shall be fully tested upon installation to ensure that it is properly matched to the equipment it is controlling.

C. The controller shall communicate with other devices on the communication network and be fully integrated with the other system components.

D. BACnet Application Specific Controller (ASC) shall provide I/O points based on the points list to fulfill the sequence of operation section of this specification manual. BACnet Unitary application specific controllers shall provide I/O points based on the points list in the sequence of operation section of this specification manual. The controller shall include, as required by the points list or sequence of operation, two of each additional AI/AO/BI/BO points beyond what is shown on the points list. Universal points shall be counted as only one point substitution for each spare point category.

E. The hardware shall be suitable for the anticipated ambient conditions.
1. Controllers used outdoors or in wet ambient shall be mounted within waterproof enclosures, and shall be rated for operation at minus 40 to 155 degrees F.
2. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32 to 120 degrees F.

F. The ASC unit controller shall be dedicated for each ASC unit, with one single processor to handle all points specified.

2.9 EMS/BAS CUSTOM APPLICATION CONTROLLERS

A. The Custom Application Controllers shall provide stand-alone control and require no additional system components for complete operation. It shall have sufficient memory to support its operating system, database, and programming requirements. The controller shall communicate

with other devices on the communication network and be fully integrated with the other system components. All controllers shall be BACnet BTL listed communications MSTP.

B. BACnet Programmable controller shall have built-in I/O points based on the points list in the sequence of operation section of this specification manual. All programming required for operation shall be memory resident and shall be retained in permanent memory.

C. The Custom Application Controller shall be configured such that the Portable Operator Interface can be plugged directly into it or within sight for programming, editing, and other operator functions.

D. Controller hardware shall be suitable for the anticipated ambient conditions.
1. Controllers used outdoors or in wet ambient shall be mounted within waterproof enclosures, and shall be rated for operation at minus 40 to 155 degrees F.
2. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32 to 120 degrees F.

2.10 CONTROLLERS SOFTWARE PROGRAMMING, CONFIGURATION, SERVICE TOOL

A. Provide five copies of software programming and service tools that are specifically compatible with the BACnet unit level controllers. This software shall be registered in perpetuity and shall be property of the Owner at project completion. This software tool shall not have installer license restriction that prevents the Owner or his servicing agent from use of the tool. The software tool shall not require annual subscription or renewal fees.

B. The software service tool shall be installed on Owner's provided computer and transferrable to any other CMS.computer.

C. The software service tool shall have the ability to perform the following tasks:
1. View Controller status.
2. View status of points and alarms.
3. Create, edit and override points.
4. Configure and commission System, Application Specific and Custom Programmable controllers.
5. View data logs.
6. Download configuration files, logic program files, and firmware.
7. Upload programs.
8. Backup and restore firmware, configuration files, and logic program files.
9. Create and edit graphics.
10. Modify existing control program.
11. Add new points and edit database.

2.11 INPUT/OUTPUT INTERFACE

A. Hardwired inputs and outputs may tie into the system through System Application, Custom Application, or Application Specific Controllers. Slave devices are also acceptable. Any critical points requiring immediate reaction shall be tied directly into the controller hosting the control software algorithm for the critical function.

B. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall be compatible with commonly available control devices. All status points shown on

the point list shall be positive proof differential pressure, directly wired (e.g. VFD), or current sensing binary switches.

C. Analog inputs shall allow the monitoring of low voltage, current, or resistance signals and shall have a minimum resolution of 0.1 percent of the sensing range. Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

D. Binary outputs shall provide a continuous low voltage signal for on/off control of remote devices.

E. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 MA signal as required to provide proper control of the output device.

F. Universal inputs shall meet the requirements of the particular configuration chosen in A through E above. Pulsed inputs and outputs shall not be installed.

G. System architecture shall allow for point expansion in one of the following ways:
1. The addition of input/output cards to an existing System Application Controller.
2. A slave controller may be used to expand point capacity.

2.12 AUXILIARY CONTROL DEVICES

A. Motorized dampers: Ruskin or approved equal, unless otherwise specified elsewhere, shall be as follows.
1. The Building Automation System supplier shall provide all automatic control dampers not specified to be supplied integral to the HVAC equipment.
2. Dampers shall be high velocity low leakage as specified in the sequence of operations. All proportional dampers shall be opposed blade type. Two position dampers may be opposed or parallel blade type.
3. Damper frames and blades shall be galvanized steel and a minimum of 16 gauge. Blade width shall not exceed 8 inches. Dampers and seals shall be suitable for temperature ranges of minus 50 to 250 degrees F.
4. High Velocity Low Leakage Dampers; All dampers shall be low leakage dampers. Field replaceable edge and end seals shall be installed along the top, bottom, and side of the frame and each blade. Seals and bearings shall be suitable for temperature ranges from minus 40 to 200 degrees F. Leakage shall not exceed 6 CFM/SF at 4 inches WC differential. High Velocity Low Leakage dampers shall be Ruskin, Model CD60 or equal.
5. End of shafts shall be scored to show blade position.

B. Electric damper actuators: Belimo.
1. Damper actuators shall be electronic, spring return, low voltage (24VAC) and shall be properly sized so as to stroke the damper smoothly and efficiently throughout its range. Actuator response shall be linear in response to sensed load. End of each damper rod shall be permanently-scored so as to indicate physical position of damper blades. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
2. 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. Unless noted in the sequence of operation or utilized for VAV box, Unit Ventilators, Fan Coil Units or terminal units, floating actuator fail in place is permitted. VAV boxes may be as provided

by controls MFG if direct replacement Belimo actuator is integrated into the MFG's controller provided parts are fully interchangeable.

3. Outside air dampers shall fail close. Return air damper shall fail open. Exhaust/Relief damper shall fail close.
4. All Outside Air, Relief Air and Return Air damper actuators associated with units that have static safety pressure switches shall have position proving switches or blade switches.
5. All dampers shall be equipped to allow manual override.

C. Control Valves: Belimo,
1. Control valves shall be full port, two-position for isolation or fully modulating service as scheduled or shown. Valves 1/2" through 2" shall be forged brass body, stainless steel ball and stem, PTFE seat, EPDM packing, equal percentage flow. Valves 2-1/2" and larger shall be cast iron body, bronze seats, stainless steel stem, bronze plug, no lip packing, ANSI class 125, leakage class III, flanged end fitting.
2. Body, trim style and materials shall be per manufacturer's recommendations for design conditions and service shown.
3. Two-position pulsed modulating valves shall not be used.

D. Chilled water valves shall fail to 50% open except as allowed in paragraph D.6 below. Hot water valve shall fail open except as allowed in paragraph D.6 below. Electric valve actuators: Belimo, fully integrated into actuator.
1. Valve actuators shall be electronic, low voltage (24VAC), and properly selected for the valve body and service. Actuator shall have clutch or gear operator for manual operation.
2. No more than one pipe size body reduction shall be permitted for hydronic coils.
3. 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 with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
4. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
5. Actuators shall be provided with a conduit fitting and a minimum 3 foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
6. Unless noted in the sequence of operation, for VAV box, Unit Ventilators, Fan Coil Units or terminal units, floating actuator fail in place is permitted. Primary-secondary plant three-way valves shall fail to the building on four pipe systems. Chiller three-way valves shall fail to the Chiller on two pipe systems.

E. Temperature Sensors: Kele, or non-propriatory approved equal
1. Temperature sensors shall be Thermistor type 10kohm as dictated by the requirements of this specification. Thermistors are acceptable for space temperature sensors and other monitoring only points.
2. AHU unit sensors shall be averaging as specified in the sequence of operations. Averaging sensors shall be a minimum of 6 feet in length. For existing application or where installed ductwork exterior to the AHU, duct sensor 12" probe is acceptable.
3. Averaging sensors shall be 3x3 sq-ft per linear foot of sensor.
4. Immersion sensors shall be provided with a separable stainless steel well. Immersion sensor probe length shall be sized to meet pipe diameter requirements. MFG Thermal lubricant shall be provided.
5. Space sensors in offices and conference rooms shall be equal to ALC ZS Pro digital readout zone sensors, with setpoint limits between 68 and 75 degrees F. Space sensors

in common areas shall be flat-plate type sensors. Accuracies shall be plus or minus 1 degree F.

F. Flow and Status Switches: Kele, Veris
1. Current sensing relays may be used for flow sensing or terminal devices, as shown. Current-operated switches shall be self-powered, solid state with adjustable trip current. The current switches shall be selected to match the current and electrical characteristics of the equipment being monitored and the application and output requirements of the DDC system.
2. Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 Type enclosure unless otherwise specified.
3. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 Type enclosure, with scale range and differential suitable for intended application, or as specified.
4.
5.

G. High Limit Thermostats: Kele, or approved equal High limit thermostats shall be manual reset type set at 120 degrees F.

H. Low Limit Thermostats and Line Voltage Thermostat: Kele, or approved equal.
1. Safety low limit thermostats shall be vapor pressure type with 1 sq-ft coil area per foot of capillary. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be DPDT manual reset only rated for the application
3. Where required multiple low limit thermostats shall be installed.
4. Low-Voltage Space Thermostats shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
5. Line-Voltage Space Thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
6. Where thermostats other than wall plate sensors are exposed to students or staff, a vandal resistant tamper proof cover with security screws shall be provided.

I. Carbon Dioxide (CO2) Sensors: E+E Elektronik, or approved equal
1. Carbon Dioxide sensors shall measure CO2 in PPM in a range of 0-2000 ppm. Accuracy shall be +/- 3% of reading with stability within 5% over 3 years. Sensors shall be outside, duct or space mounted as indicated in the sequence of operation.
2. Where sensors are exposed to students or staff, a vandal resistant tamper proof cover with security screws shall be provided.

J. Interface High Voltage/Current Control Relays: RIB or approved equal
1. Control relays shall be UL listed. Contact rating, configuration, and coil voltage suitable for application.
2. Control relays shall be provided with LEDs to indicate status of the coil and a conduit connection with a NEMA 1 housing. Enable and safety relays shall reside at the starter.
3. Current sensing relays shall be split core with auto sensing calibration.
4. Time delay relays shall be UL listed dry contact input. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration,

and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

K. Static/Differential Pressure Sensors: Kele, Veris or approved equal
1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 mA output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 mA output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.
5. Air static or differential pressure sensor shall have range appropriate for their application.
6. Wet Differential Pressure Sensors and transducers shall be installed with full port isolation valves and gauge test ports and made fully accessible either in a mechanical room or within 24" of an accessible ceiling.
7. Water Differential Pressure Switches located in mechanical rooms shall be installed with full port isolation valves and gauge test ports and made fully accessible or piped to an area where access is afforded without the use of a ladder, scaffolding, or a lift.

L. Humidity Sensors: Kele, or approved equal
1. Duct and room sensors shall have a sensing range of 20% to 80% with accuracy of ±3% R.H. Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. It shall be suitable for ambient conditions of -40° F to 170° F.
2. Duct sensors shall be dedicated duct-mounted probe type.
3. Humidity sensor's drift shall not exceed 1% of full scale per year.
4. Where sensors are exposed to students or staff, a vandal resistant tamper proof cover with security screws shall be provided.
5.

M. Water Flow Metering - Onicon or approved equal
1. Magnetic Water flow measuring sensor shall be Onicon F-3500 series dual turbine.

N. Air Flow Station for Fan Air Flow Measuring Stations – Onicon OAM II
1. Airflow Station: plus/minus 5% accuracy in the velocity range of 150 to 2400 feet per minute. Air flow station to be provided by building automation supplier. Provide air flow station only if shown on controls flow diagram, drawing details or if required by sequence of operation.
2. Remote indication is not required if CFM can be displayed on the building automation system.

O. Air Flow Station for Single Probe Air Flow Measuring Sensor – Ebtron Gold Series or approved equal
1. Airflow Station: plus/minus 5% accuracy down to 15% nominal flow. Air flow station to be provided by building automation supplier. Provide air flow station only if shown on controls flow diagram, drawing details or if required by sequence of operation.
2. The single probe airflow-measuring sensor shall be duct mounted with an adjustable sensor insertion length of up to eight inches. The transmitter shall produce a 4-20 mA or 0-10 VDC signal linear to air velocity. The sensor shall be a hot wire anemometer and utilize two temperature sensors and a heater element temperature. The other sensor

shall measure the downstream air temperature. The temperature differential shall be directly related to airflow velocity.

3. Remote indication is not required if CFM can be displayed on the building automation system.

P. Air Flow Station for Duct Air Flow Measuring Stations - – Ebtron Gold Series or approved equal

1. Airflow Station: plus/minus 5% accuracy down to 15% nominal flow. Air flow station to be provided by building automation supplier. Provide air flow station only if shown on controls flow diagram, drawing details or if required by sequence of operation.
2. Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.
3. Airflow measuring stations shall be fabricated of 14-gauge galvanized steel welded casing with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air directionalizer and parallel cell profile suppressor (3/4" maximum cell) across the entering air stream and mechanically fastened to the casing in such a way to withstand velocities up to 6000 feet per minute. This air directionalizer and parallel cell honeycomb suppressor shall provide 98% free area, equalize the velocity profile, and eliminate turbulent and rotational flow from the air stream prior to the measuring point.
4. Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.
5. Remote indication is not required if CFM can be displayed on the building automation system.

Q. Transformers and Power Supplies.

1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with resettable over-current protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection. Unit shall be UL recognized.
3. Controller Power supplies shall be conditioned and not loaded more than 75% of rated capacity.
4. Controller Power supply shall not provide power to auxiliary devices.

R. Integrated Boiler Controls.

1. Shall be BACnet compatible and interfaced to the BAS with sufficient capabilities to satisfy the control sequences of the equipment served.
2. Binary Values (BV) shall be provided for monitoring system status and fault indication.
3. Integration of systems to BAS for Class II circuits over 50 volts shall be provided by LED RIB Relays.
4. Each Rib Relay shall be clearly identified and mount externally at boiler controls.
5. All integral internal and external safety circuits for Boiler protection shall be internal to Boiler controls. All safety circuit wiring shall be direct from safety devices to equipment controller.

S. Integrated Chiller Controls.

1. Shall be BACnet compatible and interfaced to the BAS with sufficient capabilities to satisfy the control sequences of the equipment served.
2. Binary Values (BV) shall be provided for monitoring system status and fault indication.
3. Integration of systems to BAS for Class II circuits over 50 volts shall be provided by LED RIB Relays.
4. Each Rib Relay shall be clearly identified and mounted externally at chiller controls.
5. All integral internal and external safety circuits for Chiller protection shall be internal to Chiller controls. All safety circuit wiring shall be direct from safety devices to Chiller controller.

T. Integrated VFD' Controls.

1. Shall be BACnet compatible and interfaced to the BAS with sufficient capabilities to satisfy the control sequences of the equipment served.
2. Binary Values (BV) shall be provided for monitoring system status and fault code indication.
3. Integration of systems to BAS for Class II circuits over 50 volts shall be provided by LED RIB Relays.
4. Each Rib Relay shall be clearly identified and mounted at VFD.
5. All integral internal and external safety circuits for connected equipment protection shall be internal to VFD controls.
6. For multiple motors powered from a single VFD, Manual Motor Starters and CT's shall be provided for each motor in an array and integrated into the VFD.

2.13 ENERGY MANAGEMENT SYSTEMS (EMS) SOFTWARE

A. The following Energy Management capabilities shall be furnished standard as part of the Building Automation System Panel.

B. Trend Log Application.
1. Trend log data shall be sampled and stored on the System Controller panel and shall capable of being archived to a BACnet Workstation for longer term storage.
2. Trend logs shall include interval, start-time, and stop-time.
3. Trend log intervals shall be configurable as frequently as 1 minute and as infrequently as 1 year.
4. The system controller shall automatically create trend logs for defined key measurements for each controlled HVAC device and HVAC application.
5. The automatic trend logs shall monitor these parameters for a minimum of 7 days at 15 minute intervals. The automatic trend logs shall be user adjustable.
6. The controls contractor shall setup all trends and logs.

C. Trend log shall be maintained for three years.

D. Optimum Start/Stop
1.
1. An optimum start/stop program shall determine the required equipment start/stop timing by applying inside/outside temperature information to the user's time of day schedule.
2. The optimum start/stop program shall run independently for each controlled load or zone. Simultaneous starts of AHUs, pumps, and compressors without VFD's shall be coordinated and avoided.

3. The program shall automatically make adjustments to itself based on historical data, limited to 4 hours.
4. Global setpoints for system parameters shal be as follows:
   a. Unoccupied temperature, heating – 62° F (adj.)
   b. Occupied temperature, heating - 70° F (adj.)
   c. Unoccupied temperature, cooling - 82° F (adj.)
   d. Occupied temperature, cooling - 74° F (adj.)

E. Alarm/Event Log.
1. Any object in the system shall be configurable to generate an alarm when transitioning in and out of a normal or fault state.
2. Any object in the system shall allow the alarm limits, warning limits, states, and reactions to be configured for each object in the system.
3. An alarm/event shall be capable of triggering any of the following actions: Route the alarm/event to one or more alarm log, route an e-mail message to an operator(s), Log a data point(s) for a period of time, Run a custom control program.
4. All alarms shall be initially setup by the controls contractor.

F. Chilled Water System. An operator shall be able to view and control (where applicable) the following parameters via the operator interface:
1. System mode of the chiller plant.
2. Chiller enable/disable status.
3. System supply water setpoint.
4. System supply and return water temperature for each chiller and circuit.
5. System Chilled water pump status for each chiller and circuit.
6. Operator description as to when an additional chiller will be added or removed from operational sequence.
7. Chiller or support system failure information.
8. Chiller pump rotation information (status/enable/fault).
9. Override capabilities to force an added chiller, subtract a chiller, or change of sequence.
10. Control to remove a chiller from a sequence temporarily for service purposes.
11. In addition to system flow graphics, provide a system operator information screen.
12. System Pressure.

G. Heating Hot Water System. An operator shall be able to view and control (where applicable) the following parameters via the operator interface:
1. System mode of the boiler plant.
2. Boiler enable/disable status.
3. System supply water setpoint.
4. System supply and return water temperature for each boiler and circuit.
5. System Hot water pump status for each boiler and circuit.
6. Operator description as to when an additional boiler will be added or removed from operational sequence.
7. Boiler or support system failure information.
8. Boiler pump rotation information (status/enable/fault).
9. Override capabilities to force an added boiler, subtract a boiler, or change of sequence.
10. Control to remove a boiler from a sequence temporarily for service purposes.
11. In addition to system flow graphics, provide a system operator information screen.
12. System Pressure.

H. Variable Volume Air System. An operator shall be able to view and control (where applicable) the following parameters via the operator interface:

1. System Mode.
2. System Occupancy.
3. Space Temperature.
4. RTU/Air Handler Static pressure setpoint.
5. RTU/Air Handler Static pressure status.
6. RTU/Air Handler occupancy status.
7. RTU/Air Handler Supply air cooling and heating set points.
8. RTU/Air Handler minimum, maximum and nominal static pressure setpoints.
9. VAV box minimum and maximum flow.
10. VAV box occupancy status.
11. VAV box Airflow to space.
12. VAV box supply temperature (with coils)
13. Average space temperature.
14. Minimum space temperature.
15. Maximum space temperature.
16. Discharge air temperature.
17. Damper positions.
18. Unit mode.
19. Fan start/stop and status.
20. OA flow.
21. RA temp.
22. CO2 Parameters

I. Air handling unit freeze stat(s), high static pressure, or other safety device(s) shall be identified, and factory mounted in a location readily accessible by the technician for operation and repair, with manual reset option only.

J. Duct Static Pressure Optimization must be application complying with ASHRAE 90.1-2010 energy saving requirements at a minimum, the screen shall display airflow graphics and duct pressure readings.

K. Demand Control Ventilation must be application complying with ASHRAE 62.1-2004 ventilation requirements. At a minimum, the screen shall display airflow graphics, CO2 readings, OSA damper position, and exhaust/relief information including auxiliary exhaust fans.

L. Totalizing.
1. A totalizing program shall be provided to enable the building operator to monitor and totalize any user-defined flow such as water flow, electricity, and natural gas.
2. A minimum of 64 totalizing equations shall be provided.

M. Expanded Messages.
1. The user shall be able to define a minimum of ten 40 character messages for automatic printing in the event of system alarm and/or run time and maintenance events.
2. A minimum of 64 totalizing equations shall be provided.

N. Diagnostics.
1. The building operator shall be provided with a report containing common symptom and diagnostic trouble shooting guides for HVAC system equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that duct and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

A. Each equipment shall have a dedicated new DDC controller and must be mounted in an enclosure at respective equipment or in unit mechanical room for ease of maintenance.

B. Interlock wiring cable shall be yellow color or as coordinated with other trade not to conflict.

C. Smoke detector interlock shutdown wiring cable shall be red color or as coordinated with other trade not to conflict.

D. All network cabling shall be purple color with yellow stripe.

E. Safety interlock devices shall be directly wired fail safe to the controlled equipment. The BAS indication of the interlock activation shall also be wired fail safe.

F. All electrical work performed in the installation of the BAS/ATC system as described in this specification shall be per the National Electrical Code (NEC) and per applicable state and local codes. All wiring shall be installed in electric metallic tubing conduit except as allowed below. Where exposed, conduit shall be run parallel to building lines properly supported and sized at a maximum of 40 percent fill. In no cases shall field installed conduit smaller than ½ inch trade size be allowed. All electrical work shall comply with Electrical requirements of these specifications.

G. If not indicated on the electrical drawings to be provided by the Electrical Contractor, the Automatic Temperature Controls contractor shall be responsible for dedicated ATCS power to closest electrical panel that can support a 120 volt 20 ampere breaker.

H. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except where UL Listed for the purpose of interfacing the two (e.g. relays and transformers.)

I. All wire-to-device connections shall be made at a terminal blocks or terminal strip and clearly identified. All wire-to wire connections shall be at a terminal block. All wiring within enclosures shall be neatly bundled and anchored with ends clearly identified to permit access and prevent restriction to devices and terminals.

J. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device with each conductor clearly identified.

K. Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation, CMS color code and NEC.

L. Control and status relays are to be attached to equpimet. These relays may also be located adjacent to packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures unless UL Listed for the purpose, and LED display must be visible to operators.

M. Adhere to Electrical requirements for installation of raceway.

N. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3 feet in length and shall be supported at each end. Flexible metal conduit less than ½ inch electrical trade size shall not be used.

O. Mount laminated controls drawings, wiring diagrams, and operational sequences next to the main controller.

P. Mount the panel specific labelled wiring diagrams inside the main controller. Provide specific termination labeled wiring diagram for each controller. Laminate and adhere to the inside of each individual panel door.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Electrical requirements.

B. Install building wire and cable according to Electrical requirements Section "Low-Voltage Electrical Power Conductors and Cables."

C. Connect manual-reset limit controls independent of manual-control operational switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

D. Connect hand-off-auto selector switches to override BAS interlock controls when switch is in hand position.

E. Provide laminated engraved tags for every box and cabinet containing devices, controllers, transformers, or equipment.

F. Identify raceway junction box covers containing Network Cables with the color purple.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. 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 each point through its full operating range to verify that safety and operating control set points are as required.
4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
5. Test each system for compliance with sequence of operation.
6. Test software and hardware interlocks.

7. Provide seasonal testing while building is occupied in August/September for cooling mode, and December/January for heating mode.
8. Inspect all field equipment for proper DDC tagging wire identification and labeling.

C. DDC Verification:
1. Verify that instruments are installed before calibration and testing.
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 temperature instruments and material and length of sensing elements.
5. 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 sequence of operation functional performance.
6. Verify that the systems control, and sequence of operations can be accessed from the graphical interface via the embedded pdf. File per specification section 230901.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:
1. After completion of the installation, perform final checkout and adjustments of the equipment provided under this contract and supply services incidental to the proper performance of the ATC and BAS system under warranty below.
2. Adjust initial temperature and other set points.
3. See sequence of operation for initial temperature/pressure setpoint values.

B. Provide final time schedule programming during Owner's training.

3.6 INTEGRATION OF NON-HVAC BUILDING SYSTEMS

A. See Sequence of Operation section 23 09 93 for miscellaneous integration or monitoring requirements to be connected to BAS.

B. HVAC equipment, generators, and electrical smart meters shall be provided with protocol capability as stated in Sequence of Operation section 23 09 93. The work to provide, install, and valid functions of these system shall be provided by the Division 26 Electrical Contractor. The Division 26 Electrical Contractor shall provide the objects points list to the BAS contractor so integration to BAS.

C. The work to provide, install, and validate functions of the lighting system shall be provided by the Division 26 Electrical Contractor.

D. All the classrooms, offices, storage rooms, and similar spaces will have vacancy sensors which will turn the lights off automatically. All other spaces (hallways, corridors, gym, locker rooms, cafeteria, multipurpose room, electrical & mechanical rooms, and similar spaces) having manual switches will not have occupancy sensors and will be scheduled and controlled by the Building Automation System (BAS). The BAS lighting control shall be on a separate schedule from the HVAC.

E. Lights will be zoned into logical areas, each controlled by a zone contactor. An output from the BAS drives each zone contactor and is wired in a fail-safe manner that causes the lighting contactors to close (normal state) if any part of the BAS fails.

F. Provide output signal to each electrical room with a lighting panel for lighting control through the BAS. There will be an override bypass switch/timer for each lighting zone (electrical room). To accommodate school activities that may occur outside these hours, a bypass timer will be provided by the Electrical Contractor for each lighting zone. These timers will provide an input to the BAS while they are timing and have a maximum setting of 4 hours. They will be grouped at the front office. If a timer is activated, it will bypass the normal time schedule for the set hours and close the lighting contactor. When the timer times out, it will cause the contactor state to revert to whatever is specified in the time base. Five minutes before the timer is to time out, it will cause the contactor to drop out for an instant as a warning that if additional time is desired, the timer needs to be reset. Controls Contractor to provide and install low voltage wiring from timers to BAS.

G. There shall be a burglar alarm override of the BAS lighting control.

H. Provide input to the BAS indicating when the security system is armed. If the input is ON, the building is assumed to be unoccupied and the contactors are opened immediately regardless of the state of the normal time base or the bypass timers. If the security system is unarmed, the contactors revert to whatever state is called for by the time base or bypass timers. Controls Contractor to provide and install wiring from the security panel to the BAS.

I. The Controls Contractor shall provide zone contactors. The Electrical Contractor will provide the lighting contactors. See Electrical Drawing Details for Interior Lighting Control Wiring Diagram.

J. An ON-OFF-AUTO switch will be provided by the Electrical Contractor. The Controls Contractor shall wire the switch to interface to the BAS to function as follows:
1. AUTO: BAS control of lights. Enabled with burglar alarm and bypass switch/timer overrides enabled.
2. ON: BAS control of lights enabled with burglar alarm and bypass switch/timer overrides disabled.
3. OFF: BAS control of lights disabled with burglar alarm and bypass switch/timer overrides disabled. Lights under local switch control only.

K. The Controls Contractor shall demonstrate an operational lighting control system to the owner upon completion of the project. Demonstration shall include the following:
1. BAS time based control of ON/OFF
2. Security override of time based control. Check armed and unarmed state.
3. Bypass switch/timer functionality.
4. ON-OFF-AUTO switch/timer function.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's Energy Management Staff (PM's and EMS Control Specialists) in two phases. to adjust, operate, and maintain HVAC instrumentation and controls. Provide a site walk-thru to view the layout and placement of the EMS/BAS System controllers, equipment controlled, integration to equipment, and sensor locations as marked. Provide 24 hours of technical classroom training of the BAS Vendor's system "live," on site or another suitable location to be determined by CMS over a multi-day/week time period. The agenda will be defined to include remote access to the completed

project's GUI, exercises using diagnostics utilizing all the software and hardware capabilities of the BAS, programming, graphical editing, editing/addition of tags, labels and hyperlinking of points and pdf's.

3.8 SPARE PARTS LIST

A. Controls contractor shall provide spreadsheet bill of materials for each specific component used on the project. Spreadsheet shall be provided as a hyperlink on the BAS front end.

3.9 WARRANTY REQUIREMENTS

A. TWO YEAR WARRANTY: Provide all labor, material, and equipment necessary to maintain beneficial performance of the entire control system for a period of two (2) years after DELIVERY OF THE COMPLETED FLAWLESS GRAPHICAL USER INTERFACE as accepted by no less than two EM/EMS staff members. The controls subcontractor at no charge to the Owner shall promptly correct any defects in workmanship or material during the warranty period. All work shall be accomplished during normal working hours M-F if possible. Precaution shall be taken to minimize disruption of facility operations.
   1. Provide an alternate price to extend this warranty to five (5) years.

D OF SECTION

SECTION 230901 – BUILDING AUTOMATION SYSTEM GRAPHICAL USER INTERFACE

PART 1 - GENERAL

1.1 INSTRUCTIONS TO VENDORS

A. Vendor is cautioned that the Owner reserves the right to reject any Vendor, which in the Owner's sole judgment, takes meaningful deviation or exception to Division 23 Direct Digital Control (DDC) Standards. The Charlotte-Mecklenburg Schools' (CMS) Energy Manager and/or designated representative of the Energy Management Department (EMD) shall review all vendor substitution submittals. Vendor substitution approval/disapproval shall be returned via the project architect in writing from Charlotte-Mecklenburg Schools' Energy Manager and designated EMD Project Manager.

1.2 RELATED DOCUMENTS

A. Drawings (both mechanical and electrical project manual drawings) and general provisions (within Divisions 23, 26, 27) of the Contract, including General Conditions apply to this Section.

B. The provisions of the General Conditions, Supplementary Conditions, and the Sections included under Division 1, General Requirements, are included as a part of this Section as through bound herein.

C. Sections within Division 23 – Mechanical and Division 26 – Electrical apply, including though not limited to

D. 1. 23 09 00 – Energy Management System (EMS) and Building Automation System (BAS) Control for HVAC and Lighting

E. 2. 23 09 02 – BAS Point Naming and Tagging Guideline

F. 3. 23 09 93 – Sequences of Operation for HVAC controls

1.3 SUMMARY

A. This Section includes the proposed structure of the Charlotte Mecklenburg Schools Building Automation System Graphical User Interface.

1.4 ABBREVIATIONS AND ACRONYMS

A. AHU: Air Handling Unit

B. GUI: Graphical User Interface

C. IP: Internet Protocol

D. PC: Personal Computer

1.5 SYSTEM PERFORMANCE

A. The GUI shall be accessible by entering individual unique user ID's and passwords with varying levels of administrator functionality from any IP connected user device without the need for special software or a dedicated PC.

B. Navigation shall be via point and click mouse selection and keyboard entry by personnel requiring little or no formal training.

C. A navigation tree shall be provided for selection of Graphics being pulled up by School name, listed in descending Alphabetical Order with an initial Summery Graphic at the top of the Tree Listing all Schools by Grade. Subgroups by grade and/or building function shall also be provided.

D. Selecting subsequent branches for each school shall depict the individual Schools GUI Summery Page showing the Site Plan for the School's entire Campus Buildings in a dynamic key plan to allow the user to drill down to further levels of zoom and sub-branches from the tree.

E. Zoom of plan GUI screens shall be either mouse wheel or subsequent point-n-click levels of plan drawings to provide the sufficient level of details. The layout and structure for all equipment and subsequent devices should be consistent for both enumeration and format regardless of vendor.

F. All GUI plan drawings shall be oriented so that the front of the school's main entrance is at the bottom of the page. All subsequent levels of zoom for floor plans shall retain the same orientation.

G. All GUI screens shall be titled on every page in sequence by the School Courier Code; Formal assigned Name; and further branches down the tree by Type of major piece of equipment; Individual Device; separated by hash marks. Each Schools initial Summery page shall also provide the US Postal Address of the building in its entirety and an orientation indicator to due North

H. School summary page should also show Primary Central Plant equipment status and primary AHU's general status with site wide combined selected high-level alarms status. Hyperlinks shall be provided to allow for global parameters to be set, monitored, and modified.

I. Subsequent branches down from the school summary page shall depict the Building(s,) then Floor Plans from lowest elevation to the highest elevation, including lofts and Mezzanines. The geographic location of every major monitored, and controlled piece of equipment placed in its physically installed position shall be shown on overlays of the site/floorplan and/or riser/line diagrams by School. The building overall floor plans shall also show each individual controlled spaces temperature with relevant thermographic color infills depicting controlled spaces actual temperature in relation to setpoints. Green within range, Blue cooler than rage, Red warmer than range. Colors out of range shall show in 2-degree gradients. Deeper colors of Red and Blue shall show the greatest range deviations from setpoints.

J. All building floor plans used for GUI base drawings must show all fixed structural elements, doors, room designations, stairs, and shaft ways. Mechanical background drawings showing equipment locations such as AHU, VAV, and associated ductwork are preferred.

K. Subsequent branches drilling down into major pieces of equipment shall depict sub-component and end of line devices in their geographic position within a room and/or in proper alignment

on equipment pictographs as installed over layered on one line flow diagrams, mechanical floorplan details, or the detailed equipment graphics.

L. Tree Layout. The navigation tree consists of tabs that contain nodes, legible display text, graphical links, and icons. It shall be assembled and built by choosing display text for nodes, arranging the nodes, and assigning associated graphics to them.

M. Branch Layout. Shall be arranged first by School Site, then by Building, then by Floor and further, if necessary, by Room. Branches shall also be provided for diagnostic and programming tables for individual equipment for use by technicians.

N. All branches shall be constructed in a consistent logical, flow and format as follows:

O. a) First Branch; The CMS name and courier address of the campus grouped by grade in descending alphabetical order; (Linked to sites Summery Page /Campus Overview)

P. b) Second Branches; ALL Sub-buildings number/letter within a Campus (where applicable); (Linked to Ground Level Elevation of the selected building.)

Q. c) Third Branches; ALL Individual elevations of the building including Roof Elevations, (Links to specific elevation.)

R. d) Fourth Branch; Spaces (by Room number based on the designation from the architectural plans.)

S. e) Subsequent Branches; Sub-branches of Central Plants, grouped equipment and components with navigation links to upstream/downstream system components; Relevant links to troubleshooting aids, setpoints and pdf's. (Linked to individual specific components and/or Central Plants)

T. BAS Global Navigation Task Bar. Provide task bar for Global Set Points, Alarm, User, Admin and Help Functions queries. Global Navigation shall be at the top of the tree and transfer data to and from all subsequent branches of the tree.

U. System Navigation Links: Provide links to point's status, graphics, data logs, alarms and events, equipment, spaces, systems, points, schedules, reports, tools
1.

V. All equipment ID's shall be enumerated based on a sequence starting from left to right with the major equipment type abbreviation, floor elevation, then the specific units building zone and/or room number. Dedicated pumps and fans shall be enumerated with the same numerical designation as the major equipment upstream the pump or fan serves. If more than one of the same types of pumps or device exists in parallel an alpha character shall also be sub-assigned to differentiate each device. Where multiple rooms are served by a single piece of equipment, the area containing the controlling device shall dictate primary upstream equipment's unique enumeration.

W. All equipment down to the end line devices shall be clearly identified with sufficient branches, zoom and scale to make it clear to the operator specifically where in a building or room the equipment is physically located relevant to the building drawings.

X. All relevant documentation derived from installation, including operational design parameters, sequences, point to point wiring diagrams, device catalogue cuts, plan mechanical drawings,

riser drawings, device details, maintenance manuals and repair procedures shall be segregated then embedded with a point-n-click navigation from the Site Summery Page and/or the lowest zoom level where the device depicted resides.

Y. For each piece of equipment, a GUI screen hyperlink shall be provided to display a drill down screen showing the technical parameters of the device for troubleshooting and diagnostics.

Z. The layout for every GUI screen shall be consistent for each like piece of equipment regarding positioning of relevant information. The One Line diagram and flow of Central plant piping shall be as close as possible to a direct representation of actual field conditions.

AA. The grouping of GUI parameters for each screen shall be consistent throughout all similar screens for ALL schools.

1.6 SUBMITTALS

A. Product Data: Include manufacturer's examples of graphics for each type of system indicated.
   1. Control System Software: Include technical data for operating system software, operator interface, color graphics, programming, sequence of operations, and other third-party applications.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 WARRANTY REQUIREMENTS

A. TWO YEAR WARRANTY: Provide all labor, material, and equipment necessary to maintain beneficial performance of the entire control system for a period of two (2) years after DELIVERY OF THE COMPLETED FLAWLESS GRAPHICAL USER INTERFACE as accepted by no less than two EM/EMS staff members. The controls subcontractor at no charge to the Owner shall promptly correct any defects in workmanship or material during the warranty period. All work shall be accomplished during normal working hours M-F if possible. Precaution shall be taken to minimize disruption of facility operations.
   1. Provide an alternate price to extend this warranty to five (5) years.

END OF SECTION

SECTION 230902 – BAS POINT NAMING AND TAGGING GUIDELINE

PART 1 - GENERAL

1.1 INSTRUCTIONS TO VENDORS

A. Vendor is cautioned that the Owner reserves the right to reject any Vendor, which in the Owner's sole judgment, takes meaningful deviation or exception to Division 23 Direct Digital Control (DDC) Standards. The Charlotte-Mecklenburg Schools' (CMS) Energy Manager and/or designated representative of the Energy Management Department (EMD) shall review all vendor substitution submittals. Vendor substitution approval/disapproval shall be returned via the project architect in writing from Charlotte-Mecklenburg Schools' Energy Manager and designated EMD Project Manager.

B. The overriding requirement is the use of the DDC Control System to maintain design occupant comfort with optimal minimized energy consumption while maximizing equipment, component, and system design function integrity and life.

1.2 RELATED DOCUMENTS

A. Drawings (both mechanical and electrical project manual drawings) and general provisions (within Divisions 23, 26, 27) of the Contract, including General Conditions apply to this Section.

B. The provisions of the General Conditions, Supplementary Conditions, and the Sections included under Division 1, General Requirements, are included as a part of this Section as through bound herein.

C. ASHRAE Standard 135 (latest version)

D. Sections within Division 23 – Mechanical and Division 26 – Electrical apply, including though not limited to:

1. 23 09 00 - Instrumentation and Control for HVAC
2. 23 09 01 – BAS Graphical User Interface Guidelines
3. 23 09 93 – Sequences of Operation
4. 23 29 23 – Variable Frequency Motor Controllers
5. 23 52 23 – Cast-iron Boilers
6. 23 64 26 – Air Cooled Water Chillers
7. 23 08 00 – BAS & HVAC Commissioning
8. 26 08 00 - Electrical Commissioning

1.3 SUMMARY

A. An individual piece of equipment should have the same name convention regardless of where in the system the points may be defined. There should be one and only one standard point name for each distinct point and type. Abbreviations of complete point names will be permitted for GUI displays when the points geographic location is obvious on the graphic depicted.

B. An equipment point name combination should uniquely identify the piece of equipment and its geographic location in a building with the complete and unambiguous context of the point.

1.4 EQUIPMENT

A. Equipment names should be unique-and sequenced to follow a consistent logical flow and order based on its geographic location within a School; The order of the equipment name shall be; Three digit School courier number – Building/Elevation-Room number - Equipment Type - Specific Connected Device Identification

1) Example; (XXX-A1-CR123-AHU-01-SF) XXX=School Courier Code, A1=Building "A" First Floor, CR123 = ClassRoom123, AHU-01=Air Handler Unit #1, SF= Supply Fan

2) Example; (XXX-M2-CR208-FC-01) XXX=School Courier Code, M2=Building "M" Second Floor, CR208=Classroom 208, FC-01=Fan Coil Unit #1

3) Example; (XXX-MSB-BR20-BL-01-PriPmp-01) XXX=School Courier Code, MSB=Building "M" Sub-Basement, BR20=Boiler Room 20, PriPmp01=Primary Pump #1.

B. Equipment represented by a device on a bus should have a unique folder name in the BMS path. The School Courier Code and full name shall be used if possible.

D. Equipment sequence numbers should always be at the end of the equipment name with no additional underscore. Dedicated pumps for upstream Equipment such as Boilers and Chillers shall maintain the same designation as the Boiler or Chiller served. Dedicated Equipment VAVs connected to AHU's shall be enumerated with the same designation as the upstream equipment hyphenated by the room served designation.

1) Example; (XXX-MSB-BR20-BL-01-PriPmp-01) XXX=School Courier Code, MSB="M" building Sub-Basement, BR20=Boiler Room#20, Boiler "#1" shall have the Primary Pump designated PriPup "#1."

2) Example; (XXX-A1-CR123-VAV-01-123A) XXX=School Courier Code, A1="A" Building 1st Floor, Classroom 123, VAV in Room 123 is fr**o**m AHU-01.

E. Trailing Sequential Alphabetic characters should be placed at the end of the sequence number for uniquely identifying multiple parallel equipment that services the same VAV or piece of equipment.

1) Example, (XXX-MSB-BR20-BL-01-PriPmp-01A) and (XXX-MSB-BR20-BL-01-PriPmp-01B) represent two pumps in parallel servicing the Primary Loop for Boiler #1.

2) Example, (XXX-A1-CR123-VAV-01-123A) and (XXX-A1-CR123-VAV-01-123B) represent two VAV's in Room 123 supplied from AHU 01

F. Equipment software points defined in separate control routines should use the same unique name at the beginning of the point name followed by an underscore.

G. Equipment names should follow the standard abbreviations with hyphen between unique sequential characters (See STANDARD ABBREVIATIONS Tables). If more than ten units of the same equipment ID number are utilized a preceding zero shall be used;

1. Example: AHU-01, AHU-10.

2. Example: Blr-01, Chlr-02

3. Example: CHP-1A, HWP-1A, BCHP-1A, BHWP-1A

4. Example: VAV-(AHU#)-(Room number served by the VAV)

a. If multiple rooms are served by the VAV, use the room number in which the thermostat is located.

b. If multiple VAV's serve the same room, add an alpha character to designate (VAV-8-215A/B).

5. Example: FCU-(Room number served by the FCU).

a. If multiple rooms are served by the FCU, use the room number in which the thermostat is located.

b. If multiple FCU's serve the same room, add an alpha character to designate (FCU-215A/B).

1.5 POINTS:

A. Point names should follow the standard abbreviations.

B. Point name compounds should progress from left to right, most general to the left and most specific to the right.

1. Example: SaTemp, SaTempSp, SaPress, SaPressSp, RaHum, RaDeHumidifySp, RaHumidifySp

1.6 HISTORIES:

A. History names should be generated using the Niagara Bformat strings %parent.name% whenever possible.

B. History names should progress from left to right, most general to the left and most specific to the right.

C. The general format is: 3 digit Courier ID XXX, EquipName_SubEquipName_PointNamePointAttribute

1. Example: XXX_AHU01_SaFanCmd, AHU01_SaFanSpd, AHU01_SaFanSts

2. Example: XXX_AHU02_ChWVlvPos,

3. Example: XXX_Blr01_BlrEnab, XXX_Blr01_BlrIsoVlvCmd, XXX_Blr01_BlrCPCmd, XXX_Blr01_BlrETemp, XXX_Blr01_BlrLTemp

4. Example: XXX_Chlr01_ChlrEnab, XXX_Chlr01_ChlrIsoVlvCmd, XXX_Chlr01_ChlrCPCmd, XXX_Chlr01_ChlrETemp, XXX_Chlr01_ChlrLTemp

5. Example: XXX_CHWS_SupTemp, XXX_CHWS_RetTemp, XXX_CHWS_ChWP01_ChWPCmd, XXX_CHWS_ChWP01_ChWPVFDSpd, XXX_CHWS_ChWP02_ChWPSts

6. Example: XXX_MZ01_Zn03_SpcTemp, XXX_MZ01_Zn03_SpcTempEffSp

7. Example: XXX_HWS_SupTemp, XXX_WS_SupTempSp, XXX_HWS_HWRetTemp, XXX_HWS_HWP01_HWPCmd, XXX_HWS_HWP01_HWPSpd

1.6 STANDARD TERMS

A. Circulation (Pump): A pump typically within the plant that circulates a fluid through an individual piece of equipment such as a chiller, boiler, domestic water heater, cooling tower or heat exchanger. Associated with primary, secondary or recirculation hydronic loops.

B. Chilled Water System: A hydronic cold water loop with various BAS controls to provide constant or variable temperatures where global points related to the overall chilled water plant are defined. Points would include; loop entering/leaving temperatures, setpoints, loop pumps, valves, differential pressures and other global points not necessarily located within the Central Plant. This should match Hot Water System

C. Command: Indicates a piece of equipment, valve, damper, or fan has been command to a Boolean value of on/off or open/close. (See Enabled, Status and Position for related points)

D. Effective: Indicates the current temperature or pressure setpoint target given the current mode of operation. For a temperature or flow set point this value would change as a piece of equipment moves between occupied and unoccupied and heating and cooling modes.

E. Enabled/Disabled: A Boolean software point indicating an equipment's local/embedded controller is being enabled and should provide a physical output change in state to start/stop local control. It does not indicate a piece of equipment is running or not running. Points within the local controller must be monitored to indicate the actual running state. Enabled/Disabled should never be used to indicate the commanding of a point or piece of equipment on or off. (See Command and Status for related points)

F. Energy: Tracks the consumption of a unit of energy (kWh, btu, etc.). Always an accumulated value with a totalized tag.

G. Exhaust: Indicates undesired air leaving the building due to contaminants or other undesirable components like excess heat or humidity. Common areas would include bathrooms, mechanical areas, dryers, pools and laboratories.

H. History Intervals: Numeric history intervals for new projects with newer controllers and adequate memory should be 10 minutes or Change Of Value. Retrofit work should correspond with the existing intervals. In all cases the history interval should be the same for all points on a piece of equipment so that histories align on the same time boundaries.

I. Frequency: Frequency is a range of numeric values either commanding or sensing a VFD running at a specific Hz during a slice in time. See Speed for VFD percent control.

J. Hot Water System: A hydronic hot water loop with various BAS controls to provide constant or variable temperatures. Points would include: loop entering/leaving temperatures, setpoints, loop pumps, valves, differential pressure sensors, enabling values and other global points. not necessarily located within the Central Plant.

K. Pumps should be designated as either Primary, Secondary, or Recirculation. "Loop" designation should not be used as it is uncommon and non-specific.

L. Makeup Air Unit: An air handler that takes in outside air and heats, cools, humidifies, or dehumidifies for deliver to the building with no recirculation. May be a preheat unit to an AHU or general discharge into the building.

M. Mixed Air Damper: Mixed air damper should only be used when there is a specific third damper controlling mixed air separate from the outside air damper and the return air damper. An electronically linked two damper configuration of outside and return air dampers should never name the two dampers as a mixed air damper.

N. Mode: A software point indicating the current operating intent of a piece of equipment. Used to understand the current system mode (i.e. Occupancy, Humidify, Dehumidify, Economizing, IAQ, Heating, Cooling, etc.) when analyzing related points.

O. Occupancy: A state of physical presence within a building space that is detected by a device or produced by a Boolean point indicating a unit is in occupied or unoccupied mode.

P. Phase: Indicates electrical attributes (amps, volts, power or energy) as measured across an individual phase. A string value containing A, B, C, AB, BC, AC, AN, BN, CN.

Q. Power: Tracks the instantaneous value of power (kW, btu/h, etc.).

R. Position: A numeric value indicating a valve or damper open position between 0% (Closed) and 100% (Open)

S. Preheat: Preheat indicates heating coils and valves intended to heat outside air to prevent the freezing of cooling coils. Often seen in cold climates with minimum outside air damper positions or large outside air requirements.

T. Primary: The primary tag is always used in the context of the site. Primary refers to piping, valves, pumps and sensors within the heating/cooling plant that moves water between a specific piece of equipment in the central plant. Common primary equipment includes individual chillers, boilers, heat exchangers, isolation valves, pumps and sensors.

U. Radiant: Indicates hot or cold water radiant heating or cooling systems

V. Relief: Indicates a point at which excess air is leaving the building to maintain overall building static pressure and/or indoor air quality. Most commonly associated with the air handling units.

W. Room: A specific area referenced based on architectural floor plans. This term should not be used. Use "Space" instead to represent any specific area ventilated by mechanical equipment derived from the architectural floor plans.

X. Secondary: The secondary tag is always used in the context of the site. Secondary refers to equipment or points moving air or fluids away from ~~a~~ one or more individual primary source(s) to another area for use. Common sources may include chilled water or hot water plants within a building or a central or district plant on a campus. Common uses may include campus distribution of chilled water, hot water, or steam; or chilled, hot, domestic water loops which are not passing directly through primary equipment within a building. (e.g. Secondary Dual Temperature Pumps)

Y. Space: Space is the general term used to define an airtight compartmentalized indoor area ventilated by mechanical equipment such as AHU's, VAV's, UV's, FC's including ancillary Supply and Exhaust Fans and influencing ventilated equipment such as Boilers drawing air from a space. The term "Room" or "Zone" should not be used.

Z. Speed: A numeric value commanding a fan or pump to run at a percentage of capacity from 0% (Stopped) to 100% (Full speed.)

AA. Status: A Boolean point indicating proof a commanded action happened. Typically based on an input measure of flow (air, water, current) resulting from the change in state of a field devices physical reaction. Boolean Status should never be used to indicate the commanding of a point on or off. (See Command and Enabled for related points)

BB. Zone: While "zone" is the haystack tag for a space or room, point naming should use the term "space". See Space.

CC. Total Indicates the total power or energy across all phases of electricity.

1.7 SUBMITTALS

A. Provide summary list of BAS Controls Points following the requirements of this specification.

1. Summary list shall follow format noted in Part 2 of this specification.

PART 2 - PRODUCTS

1.

2.1 STANDARD ABBREVIATIONS

Term	Abbreviation
Air	Air/a
Air HandlerUnit (equip)	AHU
Alarm	Alrm
Average	Avg
Current (Amps)	Amp
Backdraft Damper	BDD
Boiler (equip)	Blr
BTU	BTU
Building	Bldg
Bypass	Byp
Cabinet Unit Heater	CUH
Central Exhaust Fan (equip)	CEF
Carbon Dioxide	CO2
Carbon Monoxide	CO
Chilled Water	ChW
Chilled Water System	CHWS
Chiller (equip)	Chlr/Chl/Chr
Circulation Pump (individual equipment)	CP
Cold Deck	CD
Command (Open/Closed/On/Off)	Cmd
Condenser Water	CW
Cooling Coil	CC
Cooling Tower (equip)	CT
Change of Value	COV
Damper	Dmpr
Day	Day
Dedicated Outside Air System	DOAS
DeHumidify (setpoint/enabled/mode)	DeHumidify
Dew Point	DewP
Differential Pressure	DP
Differential Temperature	DT
Discharge Air	Da
Discharge Air Fan	DaFan
Domestic Hot Water System	DHW
Dryer	Dryer
Dryer Exhaust Fan (equip)	DEF

Duct	Duct
Economize (enabled/mode)	Econ
Effective	Eff
Enable	Enab
Entering	Ent
Enthalpy	Enth
Exhaust Fan (equip)	EF
Exhaust Air	Ea
Exhaust Air Fan	EaFan
Evaporative Unit	EVAP
Fan (use pre qualifier: Sa, Ra, Ea)	Fan
Fan Coil Unit (equip)	FCU
Filter	Fltr
Flow	Flow
Freeze	Frz
Frequency	Freq
Fuel Oil	FO
Gallons	Gal
Glycol	Gly
Heat Exchanger (use qualifiers: Stm, ChW)	Hx
Heat Recovery Unit (equip)	HRU
Heating Coil Hydronic	HC
Heating Coil Electric	HCE
High	High/Hi
Hot Deck	HD
Hot Water	HW
Hot Water System	HWS
Hour	Hr
Humidify (setpoint/enabled/mode)	Humidify
Humidity (assumed relative)	Hum
Indoor Air Quality (mode)	IAQ
Interval	INT/int
Isolation	Iso
Kilowatts (power)	kW
Kilowatt Hours (energy)	kWh
Leaving	L/Lv
Level	Lvl
Limit	Lmt
Load	Load

Low	Low/Lo
Makeup Air Unit (equip)	MAU
Maximum	Max
Medium	Med
Millions BTU	MBTU
Minimum	Min
Mixed Air	Ma
Mixing (Valve)	Mix
Mode	Mode
Month	Mo
Multi Zone (equip)	MZ
Occupancy/Occupied	Occ
Outside Air	Oa
Perimeter	Per
Phase	Ph A/B/C
Position (%)	Pos
Power Factor	PF
Preheat (equip)	Preheat
Preheat (points)	PH
Preheat Coil	PHC
Pressure (assumed static)	Press
Primary	Pri
Pump	Pmp
Radiant Heat	Rad
Reheat	Reheat/RH
Relief / Return Relief	Rlf
Return	Ret
Return Air	Ra
Return Air Fan	RaFan
Room	Rm
Rooftop Unit	RTU
Runtime	Run
Secondary	Sec
Setpoint	Sp
Space	Spc
Speed	Spd
Stage(s)	Stg(s)
Standby	Stby
Start/Stop	S/S

Static Pressure	Press
Status	Sts
Steam	Stm
Supply	Sup
Supply Air	Sa
Supply Air Fan	SaFan
Temperature	Temp/T
Tons	Ton
Tons Refrigerant	TonRef
Total	Tot
Unit Heater (equip)	UH
Unit of Measure	UoM
UnOccupied	Unocc
VAV (equip)	VAV
VAV Cooling Only	VAVCO
VAV Heating Only (Dual Duct)	VAVHO
VAV with Reheat	VAVRH
Valve	Vlv/V
Variable Frequency Drive	VFD
Variable Refrigerant Flow/Volume	VRF
Ventilator Fan (equip)	VF
Volts	Volt
Volume	Vol
Water	Wtr/W
Week	Wk
Year	Yr
Zone (multi zone equip)	Zn

Specific Tags can be formulated from using multiple grouped abbreviations from above starting with the equipment type designation then using underscores to drill down to the specific device function (VAV_102_Spc_Temp)

The below charts are examples of compliant configurations for systems. Follow the latest version of ASHRAE Standard 135 for values derived from Data Communication Protocol for Building Automation and Control Networks.

2.2 AHU

With Return Air

Equip, hvac, ahu

[rtu],
[elecHeat, hotWaterHeat, steamHeat, gasHeat, noHeat],
[chilledWaterCool, dxCool, noCool],
[directZone, vavZone, chilledBeamZone, multiZone],
[singleDuct, dualDuct, tripleDuct],
[hotDeck, coldDeck, neutralDeck],
[constantVolume, variableVolume]
[humidification, noHumid],
hotWaterPlantRef, chilledWaterPlantRef

Makeup Air

equip, hvac, ahu, mau

Description	Point Name navName	Tags	Point Type	UoM	History
General Points					
AHU Enabled	AHUEnabled	enabled, cmd	Bool	Enabled/Disabled	COV, 30days
Occupied Command	OccCmd	occupied, cmd	Bool	Occupied/UnOccupied	COV, 30days
Occupied Mode	OccMode	occupied, cmd	Enum/Str		COV, 30days
Building Static Pressure	BldgPress	building, air, pressure, sensor	Num, .01	in w.c.	Int, 5 min
Building Static Pressure Setpoint	BldgPressSp	building, air, pressure, sp, hisMode:cov	Num, .01	in w.c.	COV, 30days
Freeze Stat	FrzStat	freeze, air, temp, sensor	Bool	On/Off	COV, 30days
Filters					
Filter Alarm	FilterAlrm	filter, alarm sensor	Bool	On/Off	COV, 30days
Filter Status	FilterSts	filter, run, sensor	Bool	Ok/Dirty	COV, 30days
Filter Pressure Delta	FilterDP	filter, pressure, delta, sensor	Num, .01	in w.c.	Int, 5 min
Single Direct Zone Points					
Space CO2	SpcCO2	zone, co2, sensor	Num, 0	ppm	Int, 5 min
Space CO2 Setpoint	SpcCO2Sp	zone, co2, sp, hisMode:cov	Num, 0	ppm	COV, 30days
Space Humidity	SpcHum	zone air, humidity, sensor	Num, 0	%	Int, 5 min
Space Pressure	SpcPress	zone, air, pressure, sensor	Num, .01	in w.c.	Int, 5 min
Space Pressure Setpoint	SpcPressSp	zone, air, pressure, sp, hisMode:cov	Num, .01	in w.c.	COV, 30days

Space Temperature	SpcTemp	zone, air, temp, sensor	Num, 1	F	Int, 5 min
Space Temperature Average (multiple spaces)	SpcTempAvg	zone, air, temp, avg, sensor	Num, 1	F	Int, 5 min
Space Temperature Setpoint (effective)	SpcTempSp	zone, air, temp, effective, sp, hisMode:cov	Num, 0	F	Int, 5 min
Occupied Cooling Setpoint	OccCoolSp	zone, air, occ, cooling, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Occupied Heating Setpoint	OccHeatSp	zone, air, occ, heating, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Unoccupied Cooling Setpoint	UnoccCoolSp	zone, air, unocc, cooling, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Unoccupied Heating Setpoint	UnoccHeatSp	zone, air, unocc, heating, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Discharge Air Points - VAV Zones					
DA Fan Command (single or common)	DaFanCmd	discharge, air, fan, run, cmd	Bool	On/Off	COV, 30days
DA Fan Status (single or common)	DaFanSts	discharge, air, fan, run, sensor	Bool	On/Off	COV, 30days
DA Fan Speed (single or common)	DaFanSpd	discharge, air, fan, speed, cmd	Num, 0	%	Int, 5 min
DA Fan Frequency (single or common)	DaFanFreq	discharge, air, fan, freq, sensor	Num, 0	Hz	Int, 5 min
DA Humidity	DaHum	discharge, air, humidity, sensor	Num, 0	%	Int, 5 min
DA Humidity High Limit	DaHumHiLmt	discharge, air, humidity, high, sp, hisMode:cov	Num, 0	%	COV, 30days
DA Pressure	DaPress	discharge, air, pressure, sensor	Num, .01	in w.c.	Int, 5 min
DA Pressure Setpoint	DaPressSp	discharge, air, pressure, sp, hisMode: cov	Num, .01	in w.c.	Int, 5 min
DA Pressure High Limit (Alarm)	DaPressHiLmt	discharge, air, temp, high, limit, sp, hisMode:cov	Num, 0	%	COV, 30days
DA Pressure Low Limit (Alarm)	DaPressLowLmt	discharge, air, temp, low, limit, sp, hisMode:cov	Num, 0	%	COV, 30days
DA Temperature	DaTemp	discharge, air, temp, sensor	Num, 1	F	Int, 5 min
DA Temperature Setpoint (effective)	DaTempSp DaTempEffSp	discharge, air, temp, effective, sp, hisMode:cov	Num, 0	F	COV, 30days
DA Temperature High Limit	DaTempHiLmt	discharge, air, temp, high, limit, sp, hisMode:cov	Num, 0	%	COV, 30days
Cold Deck DA Temp	CDDaTemp	discharge, air, temp, sensor, coldDeck	Num, 1	F	Int, 5 min
Cold Deck DA Temp Setpoint	CDDaTempSp	discharge, air, temp, sp, coldDeck, hisMode:cov	Num, 0	F	COV, 30days
Hot Deck DA Temp	HDDaTemp	discharge, air, temp, sensor, hotDeck	Num, 1	F	Int, 5 min
Hot Deck DA Temp Setpoint	HDDaTempSp	discharge, air, temp, sp, hotDeck, hisMode:cov	Num, 0	F	COV, 30days
Systems with Return Air					
RA CO2	RaCO2	return, co2, sensor	Num, 0	ppm	Int, 5 min
RA CO2 Setpoint	RaCO2Sp	return, co2, sp, hisMode:cov	Num, 0	ppm	COV, 30days
RA Damper Position	RaDmprPos	return, air, damper, cmd, outside,	Num, 0	%	Int, 5 min
RA DeHumidify Setpoint	RaDehumidifySp	return, air, humidity, deHumidify, sp, hisMode:cov	Num, 0	%RH	COV, 30days
RA Enthalpy	RaEnthalpy	return, air, enthalpy, sensor	Num, 1	J/g or kJ/kg	Int, 5 min

RA Humidify Setpoint	RaHumidifySp	return, air, humidity, humidify, sp, hisMode:cov	Num, 0	%RH	COV, 30days
RA Humidity	RaHum	return, air, humidity, sensor	Num, 0	%RH	Int, 5 min
RA Fan Command (single or common)	RaFanCmd	return, air, fan, run, cmd	Bool	On/Off	COV, 30days
RA Fan Status (single or common)	RaFanSts	return, air, fan, run, sensor	Bool	On/Off	COV, 30days
RA Fan Speed (single or common)	RaFanSpd	return, air, fan, speed, cmd	Num, 0	%	Int, 5 min
RA Fan Frequency (single or common)	RaFanFreq	return, air, fan, freq, sensor	Num, 0	Hz	Int, 5 min
RA Pressure	RaPress	return, air, pressure, sensor	Num, .01	in w.c.	Int, 5 min
RA Pressure Setpoint	RaPressSp	return, air, pressure, sp, hisMode: cov	Num, .01	in w.c.	COV, 30days
RA Temperature	RaTemp	return, air, temp, sensor	Num, 1	F	Int, 5 min
RA Temperature Setpoint	RaTempSp	return, air, temp, sp, hisMode: cov	Num, 1	F	Int, 5 min
RA Temperature High Limit (Alarm)	RaTempHiLmt	return, air, temp, high, limit, sp	Num, 1	F	COV, 30days
Systems with Relief Air					
Relief Air Damper Position	RlfDmprPos	relief, air, damper, cmd	Num, 0	%	Int, 5 min
Relief Fan Command (single or common)	RlfFanCmd	relief, air, fan, run, cmd	Bool	On/Off	COV, 30days
Systems with Outside Air					
Outside Air Damper Command (open/closed)	OaDmprCmd	outside, air, damper, cmd	Bool	Open/Closed	COV, 30days
Outside Air Damper Position	OaDmprPos	outside, air, damper, cmd	Num, 0	%	Int, 5 min
Outside Air Enthalpy	OaEnthalpy	outside, air, enthalpy, sensor	Num, 1	J/g or kJ/kg	Int, 10min
Outside Air Fan Command (single or common)	OaFanCmd	outside, air, fan, run, cmd	Bool	On/Off	COV, 30days
Outside Air Fan Status (single or common)	OaFanSts	outside, air, fan, run, sensor	Bool	On/Off	COV, 30days
Outside Air Fan Speed (single or common)	OaFanSpd	outside, air, fan, speed, cmd	Num, 0	%	Int, 10 min
Outside Air Flow	OaFlow	outside, air, flow, sensor	Num, 0	cfm	Int, 10 min
Outside Air Humidity	OaHum	outside, air, humidity, sensor	Num, 0	%RH	Int, 10 min
Outside Air Temperature	OaTemp	outside, air, temp, sensor	Num, 1	F	Int, 10 min
Mixed Air Points					
Mixed Air Temp	MaTemp	mixed, air, temp, sensor	Num, 1	F	Int, 10min
Mixed Air Temp Setpoint	MaTempSp	mixed, air, temp, sp	Num, 1	F	COV, 30days
Mixed Air Damper Position	MaDmprPos	mixed, air, damper, cmd	Num, 0	%	Int, 10min
Mixed Air Damper High Position	MaDmprHiPos	mixed, air, damper, high, sp	Num, 0	%	COV, 30days
Systems with Heating					
Hot Water Coil Circulation Pump Command	HWCPCmd	hot, water circ, pump, run, cmd	Bool	On/Off	COV, 30days
Hot Water Coil Circulation Pump Status	HWCPSts	hot, water circ, pump, run, sensor	Bool	On/Off	COV, 30days

Hot Water Coil Isolation Valve Command	HWCPIsoCmd	hot, water Isolation, valve, cmd	Bool	On/Off	COV, 30days
Hot Water Valve Position	HWVlvPos	hot, water, valve, cmd	Num, 0	%	Int, 5min
Heating Coil Air Leaving Temp	HCAirLTemp	heat, air, temp, leaving, sensor	Num, 1	F	Int, 5min
Heating Coil Air Leaving Temp Setpoint	HCAirLTempSp	heat, air, temp, leaving, sp	Num, 1	F	COV, 30days
Preheat Valve Position	PHVlvPos	preheat, water, valve, cmd	Num, 0	%	Int, 10min
PreHeat Coil Air Leaving Temp	PHCAirLTemp	preheat, air, temp, leaving, sensor	Num, 1	F	Int, 10min
PreHeat Coil Air Leaving Temp Setpoint	PHCAirLTempSp	preheat, air, temp, leaving, sp	Num, 1	F	COV, 30days
Heating Stages	HtgStage1-n	heating, stage, cmd	Bool	On/Off	COV, 30days
Systems with Cooling					
Chilled Water Coil Circ Pump Command	ChWCPCmd	chilled, water, pump, run, cmd	Bool	On/Off	COV, 30days
Chilled Water Coil Circ Pump Status	ChWCPSts	chilled, water, pump, run, sensor	Bool	On/Off	COV, 30days
Chilled Water Coil Isolation Valve Command	ChWCPIsoCmd	chilled water Isolation, valve, cmd	Bool	On/Off	COV, 30days
Chilled Water Valve Position	ChWVlvPos	chilled, water, valve, cmd	Num, 0	%	Int, 5 min
Chilled Water Valve Status	ChWVlvSts	chilled, water, valve, sensor	Num, 0	%	Int, 5 min
Chilled Water Temp Leaving	ChWLTemp	chilled, water, temp, leaving, sensor	Num, 1	F	Int, 5 min
Chilled Water Flow	ChWFlow	chilled, water, flow, sensor	Num, 0	gpm	Int, 5 min
Cooling Coil Air Leaving Humidity	CCAirLHum	cool, air, humidity, leaving, sensor	Num, 1	F	Int, 5 min
Cooling Coil Air Leaving Temp	CCAirLTemp	cool, air, temp, leaving, sensor	Num, 1	F	Int, 5 min
Cooling Coil Air Leaving Temp Setpoint	CCAirLTempSp	cool, air, temp, leaving, sp	Num, 1	F	COV, 30days
Cooling Stage Status	ClgStage(1-n)Sts	cooling, stage, sensor	Bool	On/Off	COV, 30days
Cooling Stages Status	ClgStg	cooling, stage, sensor	Num, 0	None	Int, 5 min
Systems that Economize					
Economize Mode	EconMode	economize, run, cmd	Bool	On/Off	COV, 30days
Minumum Outside Air Setpoint	EconOaMinSp	economize, outside, air, min, sp, hisMode:cov	Num, 0	F	COV, 30days
Systems with Direct Evaporative Cooling					
Direct EVAP Drain Command	DirEvapDrainCmd	directEvap, drain, run, cmd	Bool	On/Off	COV, 30days
Direct EVAP Fill Command	DirEvapFillCmd	directEvap, fill, run, cmd	Bool	On/Off	COV, 30days
Direct EVAP Flush Command	DirEvapFlushCmd	directEvap, flush, run, cmd	Bool	On/Off	COV, 30days
Direct EVAP Pump Command	DirEvapPumpCmd	directEvap, pump, run, cmd	Bool	On/Off	COV, 30days
Systems that Humidify					

Humidify Mode	HumidifyMode	humidify, run, cmd	Bool	On/Off	COV, 30days
Humidifier Enable	HumidifierEnab	humidifier, enable, cmd	Bool	Enabled/Disabled	COV, 30days
Humidifier Command	HumidifierCmd	humidifier, run, cmd	Bool	On/Off	COV, 30days
Humidifier Status	HumidifierSts	humidifier, run, sensor	Bool	On/Off	COV, 30days
Humidifier Valve/Output/Level	HumidifierVlv	humidifier, valve, cmd	Num, 0	%	Int, 5 min
See Return Air Humidity & Humidify Setpoint					
Systems that Dehumidify					
DeHumidify Mode	DehumidifyMode	dehumidify, run, cmd	Bool	Active/Inactive	COV, 30days
See Return Air Humidity & Dehumidify Setpoint					
Systems Managing Indoor Air Quality					
Indoor Air Quality Mode	IAQMode	iaq, run, cmd	Bool	Active/Inactive	COV, 30days
VAV Load and Demand Points					
VAV Damper Position Maximum	VAVDmprPosMax	vav, damper, max, sensor	Num, 0	%	Int, 5 min
VAV Damper Position Minimum	VAVDmprPosMin	vav, damper, min, sensor	Num, 0	%	Int, 5 min
VAV Damper Position Average	VAVDmprAvg	vav, damper, avg, sensor	Num, 0	%	Int, 5 min
VAV Cooling Terminal Load Maximum	VAVCoolTermLoadMax	vav, cooling, terminalLoad, max, sensor	Num, 0	%	Int, 5 min
VAV Cooling Terminal Load Minimum	VAVCoolTermLoadMin	vav, cooling, terminalLoad, min, sensor	Num, 0	%	Int, 5 min
VAV Cooling Terminal Load Average	VAVCoolTermLoadAvg	vav, cooling, terminalLoad, avg, sensor	Num, 0	%	Int, 5 min
VAV Heating Terminal Load Maximum	VAVHeatTermLoadMax	vav, heating, terminalLoad, max, sensor	Num, 0	%	Int, 5 min
VAV Heating Terminal Load Minimum	VAVHeatTermLoadMin	vav, heating, terminalLoad, min, sensor	Num, 0	%	Int, 5 min
VAV Heating Terminal Load Average	VAVHeatTermLoadAvg	vav, heating, terminalLoad, avg, sensor	Num, 0	%	Int, 5 min
Energy Points - Heat Recovery Water		equip, water, meter, hru			
Heat Recovery Water Temp Entering	HRUWEtemp	water, temp, entering, sensor	Num, 1	F	Int, 5 min
Heat Recovery Water Temp Leaving	HRUWLTemp	water, temp, leaving, sensor	Num, 1	F	Int, 5 min
Heat Recovery Water Volumertic Flow	HRUWFlow	water, flow, sensor	Num, 1	gal/min	Int, 5 min
Heat Recovery Water Energy (accumulated)	HRUWEnergy	water, energy, hisTotalized, sensor	Num, 0	MMbtu	Int, 5 min
Heat Recovery Water Power	HRUWPower	water, power, sensor	Num, 0	MMbtu/h	Int, 5 min
Heat Recovery Pump Command	HRUCPCmd	hru, circ, pump, run, cmd	Bool	On/Off	COV, 30days
Heat Recovery Air Leaving Temp	HRUALTemp	hru, air, temp, leaving, sensor	Num, 1	F	Int, 5 min

2.3 VAV
equip, vav, ahuRef,
[fanPowered, series, parallel],
[singleDuct, dualDuct],
[hotWaterReheat, elecReheat, coolOnly]

Description	Point Name navName	Tags	Point Type	UoM	History
Bypass Time	BypTime	bypass, time, sensor	Num, 0	h	Int, 10min
Occupied Mode	Occ	occupied, cmd	Bool	Occ/UnOcc	COV, 30days
HVAC Mode	HVACMode	hvac, sensor	Str	Heating/Cooling/Bypass	COV, 30days
Discharge Air Flow	DaFlow	discharge, air, flow, sensor	Num, 0	cfm	Int, 10min
Discharge Air Flow Setpoint	DaFlowEffSp	discharge, air, flow, effective, sp	Num, 0	cfm	Int, 10min
Damper Position	DmprPos	air, damper, cmd	Num, 0	%	Int, 10min
Reheat Valve	RHVlvlPos	reheat, water, valve, cmd	Num, 0	%	Int, 10min
Discharge Air Temperature	DaTemp	discharge, air, temp, sensor	Num, 1	F	Int, 10min
Space Temperature	SpcTemp	zone, air, temp, sensor	Num, 1	F	Int, 10min
Space Temperature Setpoint (effective)	SpcTempSp	zone, air, temp, effective, sp, hisMode:cov	Num, 0	F	COV, 30days
Occupied Cooling Setpoint	OccCoolSp	occ, cooling, zone, air, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Occupied Heating Setpoint	OccHeatSp	occ, heating, zone, air, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Unoccupied Cooling Setpoint	UnoccCoolSp	unocc, cooling, zone, air, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Unoccupied Heating Setpoint	UnoccHeatSp	unocc, heating, zone, air, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Standby Cooling Setpoint	StbyCoolSp	standby, cooling, zone, air, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Standby Heating Setpoint	StbyHeatSp	standby, heating, zone, air, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Effective Cooling Setpoint	EffCoolSp	cooling, zone, air, temp, effective, sp, hisMode:cov	Num, 0	F	COV, 30days
Effective Heating Setpoint	EffHeatSp	heating, zone, air, temp, effective, sp, hisMode:cov	Num, 0	F	COV, 30days
Space Humidity	SpcHum	zone, air, humidity, sensor	Num, 0	%RH	Int, 10min
Spcae Humidity Setpoint	SpcHumSp	zone, air, humidity, sp, hisMode:cov	Num, 0	%RH	Int, 10min
Space CO2	SpcCO2	zone, air, co2, sensor	Num, 0	ppm	Int, 10min
Space CO2 Setpoint	SpcCO2Sp	zone, air, co2, sp, hisMode:cov	Num, 0	ppm	Int, 10min
Dual Duct Systems					
Cold Deck Damper Position	CDDmprPos	air, damper, cmd, coldDeck	Num, 0	%	Int, 10min

Cold Deck Discharge Air Flow	CDDaFlow	discharge, air, flow, sensor, coldDeck	Num, 0	cfm	Int, 10min
Cold Deck Discharge Air Flow Setpoint	CDDaFlowSp	discharge, air, flow, effective, sp, coldDeck	Num, 0	cfm	Int, 10min
Hot Deck Damper Position	HDDmprPos	air, damper, cmd, hotDeck	Num, 0	%	Int, 10min
Hot Deck Discharge Air Flow	HDDaFlow	discharge, air, flow, sensor, hotDeck	Num, 0	cfm	Int, 10min
Hot Deck Discharge Air Flow Setpoint	HDDaFlowSp	discharge, air, flow, effective, sp, hotDeck	Num, 0	cfm	Int, 10min
Total Discharge Air Flow	TotDaFlow	discharge, air, flow, sensor, coldDeck	Num, 0	cfm	Int, 10min
Commissioning Points					
Single PID Throttling Range	VavPIDTr	vav, pid, throttlingRange, sp	Num, 0	%	COV, 30days
Single PID Integral	VavPIDInt	vav, pid, integral, sp	Num, 0	%	COV, 30days
Cooling Max Flow	CoolMaxFlow	cooling, max, flow, sp	Num, 0	cfm	COV, 30days
Cooling Min Flow	CoolMinFlow	cooling, min, flow, sp	Num, 0	cfm	COV, 30days
Cooling PID Throttling Range	CoolPIDTr	cooling, pid, throttlingRange, sp	Num, 0	%	COV, 30days
Cooling PID Integral	CoolPIDInt	cooling, pid, integral, sp	Num, 0	%	COV, 30days
Cooling Terminal Load	CoolTermLoad	cooling, load, sensor	Num, 0	%	Int, 10min
Heating Max Flow	HeatMaxFlow	heating, max, flow, sp	Num, 0	cfm	COV, 30days
Heating Min Flow	HeatMinFlow	heating, min, flow, sp	Num, 0	cfm	COV, 30days
Heating PID Throttling Range	HeatPIDTr	heating, pid, throttlingRange, sp	Num, 0	%	COV, 30days
Heating PID Integral	HeatPIDInt	heating, pid, integral, sp	Num, 0	%	COV, 30days
Heating Terminal Load	HeatTermLoad	heating, load, sensor	Num, 0	%	Int, 10min

Fan Powered Boxes					
Fan Command	FanCmd	fan, run, cmd	Bool	On/Off	COV, 30days
Fan Speed	FanSpd	fan, speed, cmd	Num, 0	%	Int, 10min
Fan High Speed	FanSpdHigh	fan, speed, high, run, cmd	Bool	On/Off	COV, 30days
Fan Medium Speed	FanSpdMed	fan, speed, med, run, cmd	Bool	On/Off	COV, 30days
Fan Low Speed	FanSpdLow	fan, speed, low, run, cmd	Bool	On/Off	COV, 30days

2.4 FCU
equip, hvac, fcu,
[elecHeat, hotWaterHeat, noHeat]
[chilledWaterCool, noCool]

Description	Point Name navName	Tags	Point Type	UoM	History
Occupied Mode	Occ	occupied, cmd	Bool	Occ/UnOcc	COV, 30days
Chilled Water Valve	ChWVlvPos	chilled, water, valve, cmd	Num, 0	%	Int, 10min
Common Water Valve (Seasonal Chilled/Hot)	ChWHWVlvPos	common, water, valve, cmd	Num, 0	%	Int, 10min
Discharge Air Temperature	DaTemp	discharge, air, temp	Num, 1	F	Int, 10min
Fan Command	FanCmd	fan, run, cmd	Bool	On/Off	COV, 30days
Fan Status	FanSts	fan, run, sensor	Bool	On/Off	COV, 30days
Fan Speed	FanSpd	fan, speed, cmd	enum	Off/Low/Med/High	COV, 30days
Hot Water Valve	HWVlvPos	hot, water, valve, cmd	Num, 0	%	Int, 10min
HVAC Mode	HVACMode	hvac, run, cmd	enum	Heat/Cool	COV, 30days
Space Temperature	SpcTemp	zone, air, temp, sensor	Num, 1	F	Int, 10min
Space Temperature Setpoint (effective)	SpcTempSp	zone, air, effective, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Occupied Cooling Setpoint	OccCoolSp	occ, cooling, zone, air, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Occupied Heating Setpoint	OccHeatSp	occ, heating, zone, air, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Unoccupied Cooling Setpoint	UnoccCoolSp	unocc, cooling, zone, air, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Unoccupied Heating Setpoint	UnoccHeatSp	unocc, heating, zone, air, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
While the four occ/unocc heating/cooling setpoints above rarely change, their histories are needed in analytics to determine when temperatures have drifted too high or low.					

2.5 EF (Exhaust Fans)
equip, exhaust, fan

Description	Point Name navName	Tags	Point Type	UoM	History
Occupancy	Occ	occupied, cmd	Bool	Occ/UnOcc	COV, 30days
Exhaust Fan Enable	EFEnab	enable, cmd	Bool	Enabled/Disabled	COV, 30days
Exhaust Fan Command	EFCmd	fan, run, cmd	Bool	On/Off	COV, 30days
Exhaust Fan Status	EFSts	fan, run, sensor	Bool	On/Off	COV, 30days
Exhaust Fan Speed	EFSpd	fan, speed, cmd	Num, 0	%	Int, 10min
Exhaust Damper Command (open/closed)	EFDmprCmd	damper, cmd	Bool	Open/Closed	COV, 30days
Exhaust Damper Position	EFDmprPos	damper, cmd	Num, 0	%	Int, 10min
Exhaust Damper Status	EFDmprSts	damper, sensor	Bool	On/Off	COV, 30days
Energy Points - Electric		equip, elec, meter, exhaust, fan [siteMeter, submeterOf]			
VFD Energy Total (accumulated)	EFVFDEnergy	exhaust, fan, elec, energy, total, sensor, hisTotalized	Num, 0	kWh	Int, 10min
VFD Power Total	EFVFDPower	exhaust, fan, elec, power, total, active, sensor	Num, 0	kW	Int, 10min

2.6 Chiller
equip, chiller, chilledWaterPlantRef,
[absorption, reciprocal, screw, centrifugal],
[waterCooled, airCooled]

Description	Point Name navName	Tags	Point Type	UoM	History
Chiller Enable	ChlrEnab	chiller, enable, cmd	Bool	Enabled/Disabled	COV, 30days
Chiller Command	ChlrCmd	chiller, run, cmd	Bool	On/Off	COV, 30days
Chiller Status	ChlrSts	chiller, run, sensor	Bool	On/Off	COV, 30days
Chiller Compressor Stage Command	ChlrStg(1-n)Cmd	chiller, stage, cmd	Bool	On/Off	COV, 30days
Chiller Compressor Stage Status	ChlrStg(1-n)Sts	chiller, stage, sensor	Bool	On/Off	COV, 30days
Chiller Compressor Stage	ChlrStg	chiller, stage, sensor	Num, 0		Int, 10min
Chiller Load	ChlrLoad	chiller, load, sensor	Num, 0	%	Int, 10min
Tons	ChlrTons	chilled, water, power, sensor	Num, 0	tonref	Int, 10min
Condenser Water Isolation Valve	CWIsoVlvCmd	condenser, isolation, valve, cmd	Bool	Open/Closed	COV, 30days
Condesner Water Circulation Pump	CWCPCmd	condenser, circ, pump, cmd	Bool	On/Off	COV, 30days
Condenser Water Entering Temperature	CWETemp	condenser, water, entering, temp, sensor	Num, 1	F	Int, 10min
Condenser Water Leaving Temperature	CWLTemp	condenser, water, leaving, temp, sensor	Num, 1	F	Int, 10min
Chilled Water Isolation Valve	ChWIsoVlvCmd	chilled, isolation, valve, cmd	Bool	Open/Closed	COV, 30days
Chilled Water Entering Temperature	ChWETemp	chilled, water, entering, temp, sensor	Num, 1	F	Int, 10min
Chilled Water Leaving Temperature	ChWLTemp	chilled, water, leaving, temp, sensor	Num, 1	F	Int, 10min
Chilled Water Setpoint	ChWSp	chilled, water, leaving, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Chilled Water Pump Command	ChWP(1-n)Cmd	chilled, water, pump, run, cmd	Bool	On/Off	COV, 30days
Chilled Water Pump Speed	ChWP(1-n)Spd	chilled, water, pump, speed, cmd	Num,0	%	Int, 10min
Chilled Water Flow	ChWFlow	chilled, water, flow, sensor	Num, 0	gal/min	Int, 10min
Chilled Water Differential Presssure	ChWDP	chilled, water, delta, pressure, sensor	Num, 0	gal/min	Int, 10min
Oil Temp	ChlrOilTemp	oil, temp, sensor	Num, 1	F	Int, 10min
Oil Heater Command	ChlrOilHeatCmd	oil, heater, run, cmd	Bool	On/Off	COV, 30days
Oil Heater Status	ChlrOilHeatSts	oil, heater, run, sensor	Bool	On/Off	COV, 30days

Energy Points - Electric		equip, elec, meter, chiller			
Current	ChlrAmp	mag, current, sensor	Num, 0	A	Int, 10min
Volts	ChlrVolts	volt, mag, sensor	Num, 0	V	Int, 10min
Energy Total (accumulated)	ChlrEnergyTot	elec, energy, total, sensor, hisTotalized	Num, 0	kWh	Int, 10min
Power Total	ChlrPower	elec, power, total, active, sensor	Num, 0	kW	Int, 10min
Power Factor Total	ChlrPF	pf, total, sensor	Num, 0.01	unitless	Int, 10min

Energy Points - Water		equip, water, meter, chiller			
Chilled Water Temperature Entering	ChWEtemp	water, temp, entering, sensor	Num, 1	F	Int, 10min
Chilled Water Temperature Leaving	ChWLTemp	water, temp, leaving, sensor	Num, 1	F	Int, 10min
Chilled Water Flow	ChWFlow	water, flow, sensor	Num, 1	gal/min	Int, 10min
Chilled Water Volume (accumulated)	ChWVol	water, volume, total, sensor	Num, 0	gal	Int, 10min
Chilled Water Energy (accumulated)	ChWEnergy	water, energy, hisTotalized, sensor	Num, 0	btu	Int, 10min
Chilled Water Power	ChWPower	water, power, sensor	Num, 0	btu/h	Int, 10min

2.7 Boiler
equip, boiler, hotWaterPlantRef,
[condensing, automospheric]
[hot water, steam]
[oil, gas]

Description	Point Name navName	Tags	Point Type	UoM	History
Boiler Enable	BlrEnab	boiler, enable, cmd	Bool	Enabled/Disabled	COV, 30days
Boiler Command	BlrCmd	boiller, run, cmd	Bool	On/Off	COV, 30days
Boiler Status	BlrSts	boiller, run, sensor	Bool	On/Off	COV, 30days
Entering Water Temperature	BlrETemp	entering, water, temp, sensor	Num, 1	F	Int, 10min
Leaving Water Temperature	BlrLTemp	leaving, water, temp, sensor	Num, 1	F	Int, 10min
Boiler Leaving Setpoint	BlrLTempSp	leaving, water, temp, sp, hisMode:cov	Num, 0	F	COV, 30days
Boiler Isolation Valve	BlrIsoVlvCmd	isolation, valve, cmd	Bool	Open/Closed	COV, 30days
Boiler Circulation Pump	BlrCPCmd	pump, circ, run, cmd	Bool	On/Off	COV, 30days
Firing Rate	BlrFiringRate	boiler,firingRate, sensor	Num, 0	%	Int, 10min
Hot Water Pump Command	HWP(1-n)Cmd	hot, water, pump, run, cmd	Bool	On/Off	COV, 30days
Hot Water Pump Speed	HWP(1-n)Spd	hot, water, pump, speed, cmd	Num,0	%	Int, 10min
Systems with Heat Recovery					
Heat Recovery Circulation Pump Command	HRUCPCmd	pump, circ, run, cmd	Bool	On/Off	COV, 30days
Heat Recovery Circulation Pump Status	HRUCPSts	pump, circ, run, sensor	Bool	On/Off	COV, 30days
Energy Points - Gas		equip, gas, meter, boiler			
Gas Flow	BlrGasFlow	gas, flow, sensor	Num, 0	ccf/h	Int, 10min
Gas Volume (accumulated)	BlrGasVol	gas, volume, sensor, hisTotalized	Num, 0	ccf	Int, 10min
Gas Energy (accumulated)	BlrGasEnergy	gas, energy, sensor, hisTotalized	Num, 0	Mmbtu	Int, 10min
Gas Power	BlrGasPower	gas, power, sensor	Num, 0	MMbtu/h	Int, 10min
Energy Points - Water		equip, water, meter, boiler			
Boiler Water Temperature Entering	BlrETemp	water, temp, entering, sensor	Num, 1	F	Int, 10min
Boiler Water Temperature Leaving	BlrLTemp	water, temp, leaving, sensor	Num, 1	F	Int, 10min
Boiler Water Flow	BlrFlow	water, flow, sensor	Num, 1	gal/min	Int, 10min
Boiler Water Volume (accumulated)	BlrVol	water, volume, hisTotalized, sensor	Num, 0	gal	Int, 10min
Boiler Water Energy (accumulated)	BlrWEnergy	water, energy, hisTotalized, sensor	Num, 0	MMbtu	Int, 10min
Boiler Water Power	BlrWPower	water, power, sensor	Num, 0	MMbtu/h	Int, 10min

Energy Points - Heat Recovery Water		equip, water, meter, boiler, hru			
Heat Recovery Water Temp Entering	HRUWEtemp	water, temp, entering, sensor	Num, 1	F	Int, 10min
Heat Recovery Water Temp Leaving	HRUWLTemp	water, temp, leaving, sensor	Num, 1	F	Int, 10min
Heat Recovery Water Flow	HRUWFlow	water, flow, sensor	Num, 0	gal/min	Int, 10min
Heat Recovery Water Volume (accumulated)	HRUWVol	water, volume, hisTotalized, sensor	Num, 0	gal	Int, 10min
Heat Recovery Water Energy (accumulated)	HRUWEnergy	water, energy, hisTotalized, sensor	Num, 0	MMbtu	Int, 10min
Heat Recovery Water Power	HRUWPower	water, power, sensor	Num, 0	MMbtu/h	Int, 10min

2.8 Fans (individual)
Discharge Fan
equip, discharge, fan
Return Fan
equip, return, fan
Exhaust Fan
equip, exhaust, fan
Relief Fan
equip, relief, fan
FCU Fan
equip, fcu, fan
Cooling Tower
equip, coolingTower, fan

Description	Point Name navName	Tags	Point Type	UoM	History
Fan Command	FanCmd	fan, run, cmd	Bool	On/Off	COV, 30days
Fan Status	FanSts	fan, run, sensor	Bool	On/Off	COV, 30days
Fan Speed	FanSpeed	fan, speed cmd, hisMode:cov	enum	Off/Low/Med/High	COV, 30days
Fan VFD Speed	FanVFDSpd	fan, speed, cmd	Num, 0	%	Int, 10min
Fan VFD Frequency	FanVFDFreq	fan, freq, sensor	Num, 0	Hz	Int, 10min
Fan Speed Low	FanSpdLow	fan, speed, low, run, cmd	Bool	On/Off	COV, 30days
Fan Speed Medium	FanSpdMed	fan, speed, medium, run, cmd	Bool	On/Off	COV, 30days
Fan Speed High	FanSpdHigh	fan, speed, high, run, cmd	Bool	On/Off	COV, 30days

VFD Energy Total (accumulated)	VFDEnergy	fan, elec, energy, total, sensor, hisTotalized	Num, 0	kWh	Int, 10min
VFD Power Total	VFDPower	fan, elec, power, total, active, sensor	Num, 0	kW	Int, 10min

Pumps (individual)
Chiller Circ Pump
equip, pump, chiller, circ, primary
ChW Pump
equip, pump, chilled, secondary
Boiler Circ Pump
equip, pump, boiler, circ, primary
HW Loop Pump
equip, pump, hot, secondary
DHW Loop Pump
equip, pump, domestic, hot
GHW Pump
equip, pump, glycol, hot
CT Pump
equip, pump, coolingTower
CW Pump
equip, pump, condenser

Description		Tags	Point Type	UoM	History
Pump Enable	PumpEnab	pump, enable, cmd	Bool	Enabled/Disabled	COV, 30days
Pump Command	PumpCmd	pump, run, cmd	Bool	On/Off	COV, 30days
Pump Status	PumpSts	pump, run, sensor	Bool	On/Off	COV, 30days
Pump VFD Speed	PumpVFDSpd	pump, speed, cmd	Num, 0	%	Int, 10min
Pump VFD Frequency	PumpVFDFreq	pump, freq, sensor	Num, 0	Hz	Int, 10min
Energy Points - Electric		equip, elec, meter, pump			
VFD Energy Total (accumulated)	VFDEnergy	pump, elec, energy, hisTotalized, sensor	Num, 0	kWh	Int, 10min
VFD Power Total	VFDPower	pump, elec, power, active, hisTotalized, sensor	Num, 0	kW	Int, 10min
Energy Points - Water		equip, water, meter, chiller			
Water Temperature Entering	Etemp	water, temp, entering, sensor	Num, 1	F	Int, 10min
Water Temperature Leaving	LTemp	water, temp, leaving, sensor	Num, 1	F	Int, 10min
Water Flow	Flow	water, flow, sensor	Num, 1	gal/min	Int, 10min
Water Volume (accumulated)	Vol	water, volume, hisTotalized, sensor	Num, 0	gal	Int, 10min
Water Energy (accumulated)	WtrEnergy	water, energy, hisTotalized, sensor	Num, 0	MMbtu	Int, 10min
Water Power	WtrPower	water, power, sensor	Num, 0	MMbtu/h	Int, 10min

2.9 Electric Meter
equip, elec, meter,
[siteMeter, submeterOf]

Description	Point Name navName	Tags	Point Type	UoM	History
Energy Points - Electric					
Energy Total (accumulated)	EnergyTot	elec, total, energy, sensor, hisTotalized	Num, 0	kWh	Int, 10min
Power Total	Power	elec, total, power, active, sensor	Num, 0	kW	Int, 10min
Power Factor Total	PF	elec, total, pf, sensor	Num, 0.01unit-less	unitless	Int, 10min
Power Quality Points					
Current A	Current_A	elec, phase, current, sensor	Num, 1	A	Int, 10min
Current B	Current_B	elec, phase, current, sensor	Num, 1	A	Int, 10min
Current C	Current_C	elec, phase, current, sensor	Num, 1	A	Int, 10min
Volts AN	Volts_AN	elec, phase, volts, sensor	Num, 0	V	Int, 10min
Volts BN	Volts_BN	elec, phase, volts, sensor	Num, 0	V	Int, 10min
Volts CN	Volts_CN	elec, phase, volts, sensor	Num, 0	V	Int, 10min
Volts AB	Volts_AB	elec, phase, volts, sensor	Num, 0	V	Int, 10min
Volts BC	Volts_BC	elec, phase, volts, sensor	Num, 0	V	Int, 10min
Volts CA	Volts_CA	elec, phase, volts, sensor	Num, 0	V	Int, 10min
Power Factor A	PF_A	elec, phase, pf, sensor	Num, 0.01	unitless	Int, 10min
Power Factor B	PF_B	elec, phase, pf, sensor	Num, 0.01	unitless	Int, 10min
Power Factor C	PF_C	elec, phase, pf, sensor	Num, 0.01	unitless	Int, 10min
Energy A (accumulated)	Energy_A	elec, phase, energy, sensor, hisTotalized	Num, 0	kWh	Int, 10min
Energy B (accumulated)	Energy_B	elec, phase, energy, sensor, hisTotalized	Num, 0	kWh	Int, 10min
Energy C (accumulated)	Energy_C	elec, phase, energy, sensor, hisTotalized	Num, 0	kWh	Int, 10min
Power A	Power_A	elec, phase, power, active, sensor	Num, 0	kW	Int, 10min
Power B	Power_B	elec, phase, power, active, sensor	Num, 0	kW	Int, 10min
Power C	Power_C	elec, phase, power, active, sensor	Num, 0	kW	Int, 10min

2.10 Gas Meter
equip, gas, meter,
[siteMeter, submeterOf]

Description	Point Name navName	Tags	Point Type	UoM
Gas Flow	GasFlow	gas, flow, sensor	Num, 0	ccf/h
Gas Volume (accumulated)	GasVol	gas, volume, sensor, hisTotalized	Num, 0	ccf
Gas Energy (accumulated)	GasEnergy	gas, energy, sensor, hisTotalized	Num, 0	MMbtu
Gas Power	GasPower	gas, power, sensor	Num, 0	MMbtu/h

2.11 CHWS (Chiller Water System)
equip, chilledWaterPlant

Description	Point Name navName	Tags	Point Type	UoM	History
Chilled Water Flow	ChWFlow	chilled, flow, sensor	Num, 1	gal/min	Int, 10min
Chilled Water Volume (accumulated)	ChWVol	chilled, volume, sensor, hisTotalized	Num, 0	gal	Int, 10min
Chilled Water Supply Temp	ChWSupTemp	chilled, water, leaving, temp, sensor	Num, 1	F	Int, 10min
Chilled Water Supply Temp Setpoint	ChWSupTempSp	chilled, water, leaving, temp, sp	Num, 0	F	COV, 24 hr
Chilled Water Return Temp	ChWRetTemp	chilled, water, entering, temp, sensor	Num, 1	F	Int, 10min
Chilled Water Pressure Delta	ChWDP	chilled, water, pressure, delta, sensor	Num, 0	psi	Int, 10 min
Chilled Water Pressure Delta Setpoint	ChWDPSp	chilled, water, pressure, delta, sp	Num, 0	psi	COV, 24 hr
Energy Points - Water		equip, water, meter, chilledWaterPlant, [siteMeter, submeterOf]			
Chilled Water Temperature Entering	ChWEtemp	chilled, water, temp, entering, sensor	Num, 1	F	Int, 10min
Chilled Water Temperature Leaving	ChWLTemp	chilled, water, temp, leaving, sensor	Num, 1	F	Int, 10min
Chilled Water Flow	ChWFlow	chilled, water, flow, sensor	Num, 1	gal/min	Int, 10min
Chilled Water Volume (accumulated)	ChWVol	chilled, water, volume, sensor, hisTotalized	Num, 0	gal	Int, 10min
Chilled Water Energy (accumulated)	ChWEnergy	chilled, water, energy, sensor, hisTotalized	Num, 0	MMbtu	Int, 10min
Chilled Water Power	ChWPower	chilled, water, power, sensor	Num, 0	MMbtu/h	Int, 10min
Chilled Water Building Loop Pumps		equip, chilled, water, pump, secondary			
Building Loop Pump Enable	ChWPEnab	chilled, water, pump, enable, cmd	Bool	Enabled/Disabled	COV, 30days
Building Loop Pump Command	ChWPCmd	chilled, water, pump, run, cmd	Bool	On/Off	COV, 30days
Building Loop Pump Status	ChWPSts	chilled, water, pump, run, sensor	Bool	On/Off	COV, 30days
Building Loop Pump VFD Speed	ChWPVFDSpd	chilled, water, pump, speed, cmd	Num, 0	%	Int, 10min
Building Loop Pump VFD Frequency	ChWPVFDFreq	chilled, water, pump, freq, sensor	Num, 0	Hz	Int, 10min
Building Loop Return Valve Command	ChWRetVlvCmd	chilled, water, return, isolation, valve, cmd	Bool	Open/Closed	COV, 30days
Building Loop Return Valve Sensor	ChWRetVlvSts	chilled, water, return, valve, sensor	Bool	On/Off	COV, 30days
Energy Points - Electric		equip, elec, meter, chilled, water, pump, [siteMeter, submeterOf]			
VFD Energy Total (accumulated)	ChWPVFDEnergy	chilled, water, pump, elec, energy, total, sensor, hisTotalized	Num, 0	kWh	Int, 10min
VFD Power Total	ChWPVFDPower	chilled, water, pump, elec, power, total, active, sensor	Num, 0	kW	Int, 10min

2.12Chilled Water Heat Exchanger
equip, chilled, water, heatExchanger

Chilled Water Heat Exchanger Enabled	HxChWEnab	enable, cmd	Bool	Enabled/Disabled	COV, 30days
Chilled Water Heat Exchanger Command	HxChWCmd	run, cmd	Bool	On/Off	COV, 30days
Chilled Water Heat Exchanger Runtime	HXChWRun	chilled, water, total, sensor	Num, 1	h	Int, 10min
Chilled Water Entering Temperature	HxChWETemp	chilled, water, entering, temp	Num, 1	F	Int, 10min
Chilled Water Leaving Temperature	HxChWLTemp	chilled, water, leaving, temp	Num, 1	F	Int, 10min
Chilled Water Isolation Valve	HxChWIsoVlvCmd	chilled, water, isolation, valve, cmd	Bool	Open/Closed	COV, 30days
Chilled Water Circulation Pump Command	HxChWCPCmd	chilled, water, circ, pump, run, cmd	Bool	On/Off	COV, 30days
Chilled Water Circulation Pump Status	HxChWCPSts	chilled, water, circ, pump, run, sensor	Bool	On/Off	COV, 30days
Condenser Water Entering Temperature	HxCWETemp	condenser, entering, water, temp	Num, 1	F	Int, 10min
Condesner Water Leaving Temperature	HxCWLTemp	condenser, leaving, water, temp	Num, 1	F	Int, 10min
Condesner Water Isolation Valve	HxCWIsovlvCmd	condenser, isolation, valve, cmd	Bool	Open/Closed	COV, 30days
Condenser Circ Pump Command	HxCWCPCmd	condenser, water, circ, pump, cmd	Bool	On/Off	COV, 30days
Condenser Circ Pump Status	HxCWCPSts	condenser, water, circ, pump, sensor	Bool	On/Off	COV, 30days

2.13 HWS (Hot Water System)
equip, hotWaterPlant,

Description	Point Name navName	Tags	Point Type	UoM	History
Hot Water Flow	HWFlow	hot, water, flow, sensor	Num, 1	gal/min	Int, 10min
Hot Water Volume (accumulated)	HWVol	hot, water, volume, sensor, hisTotalized	Num, 0	gal	Int, 10min
Hot Water Supply Temp	HWSupTemp	hot, water, leaving, temp, sensor	Num, 1	F	COV, 15min
Hot Water Supply Temp Setpoint	HWSupTempSp	hot, water, leaving, temp, sp	Num, 0	F	COV, 24 hr
Hot Water Return Temp	HWRetTemp	hot, water, entering, temp, sensor	Num, 1	F	Int, 10min
Hot Water Differential Pressure	HWDP	hot, water, pressure, delta, sensor	Num, 1	psi	Int, 10 min
Hot Water Differential Pressure Setpoint	HWDPSp	hot, water, pressure, delta, sp	Num, 1	psi	COV, 24 hr
Energy Points - Water		equip, meter, hotWaterPlant, [siteMeter, submeterOf]			
Hot Water Temperature Entering	HWEtemp	hot, water, temp, entering, sensor	Num, 1	F	Int, 10min
Hot Water Temperature Leaving	HWLTemp	hot, water, temp, leaving, sensor	Num, 1	F	Int, 10min
Hot Water Flow	HWFlow	hot, water, flow, sensor	Num, 1	gal/min	Int, 10min
Hot Water Volume (accumulated)	HWVol	hot, water, volume, sensor, hisTotalized	Num, 0	gal	Int, 10min
Hot Water Energy (accumulated)	HWEnergy	hot, water, energy, sensor, hisTotalized	Num, 0	MMbtu	Int, 10min
Hot Water Power	HWPower	hot, water, power, sensor	Num, 0	MMbtu/h	Int, 10min
Building Hot Water Loop Pumps		equip, secondary, hot, water, pump,			
Building Loop Pump Enable	HWPEnab	hot, water, pump, enable, cmd	Bool	Enabled/Disabled	COV, 30days
Building Loop Pump Command	HWPCmd	hot, water, pump, run, cmd	Bool	On/Off	COV, 30days
Building Loop Pump Status	HWPSts	hot, water, pump, run, sensor	Bool	On/Off	COV, 30days
Building Loop Pump VFD Speed	HWPVFDSpd	hot, water, pump, speed, cmd	Num, 0	%	Int, 10min
Building Loop Pump VFD Frequency	HWPVFDFreq	hot, water, pump, freq, sensor	Num, 0	Hz	Int, 10min
Energy Points - Electric		equip, elec, meter, pump, hotWaterPlant, [siteMeter, submeterOf]			
VFD Energy Total (accumulated)	HWPVFDEnergy	hot, water, pump, elec, energy, total, sensor, hisTotalized	Num, 0	kWh	Int, 10min
VFD Power Total	HWPVFDPower	hot, water, pump, elec, power, total, active, sensor	Num, 0	kW	Int, 10min

2.14 Domestic Hot Water
equip, domestic, hotWaterPlant

Description	Point Name navName	Tags	Point Type	UoM	History
Water Flow	DHWFlow	domestic, hot, water, flow, sensor	Num, 0	gal/min	Int, 10min
Water Volume (accumulated)	DHWVol	domestic, hot, water, volume, sensor, hisTotalized	Num, 0	gal	Int, 10min
Supply Temperature	DHWSupTemp	domestic, hot, water, leaving, temp, sensor	Num, 1	F	Int, 10min
Supply Temperature Setpoint	DHWSupTempSp	domestic, hot, water, leaving, temp, sp	Num, 0	F	Int, 10min
Return Temperature	DHWRetTemp	domestic, hot, water, entering, temp, sensor	Num, 1	F	Int, 10min
Differential Pressure	DHWDP	domestic, hot, water, pressure, delta, sensor	Num, 1	psi	Int, 10 min
Differential Pressure Setpoint	DHWDPSp	domestic, hot, water, pressure, delta, sp	Num, 1	psi	COV, 24 hr
DHW Building Loop Pumps		equip, domestic, secondary, hot, water, pump			
Building Loop Pump Enable	DHWPEnab	domestic, hot, water, pump, enable, cmd	Bool	Enabled/Disabled	COV, 30days
Building Loop Pump Command	DHWPCmd	domestic, hot, water, pump, run, cmd	Bool	On/Off	COV, 30days
Building Loop Pump Status	DHWPSts	domestic, hot, water, pump, run, sensor	Bool	On/Off	COV, 30days
Building Loop Pump VFD Speed	DHWPVFDSpd	domestic, hot, water, pump, speed, cmd	Num, 0	%	Int, 10min
Building Loop Pump VFD Frequency	DHWPVFDFreq	domestic, hot, water, pump, freq, sensor	Num, 0	Hz	Int, 10min
Heat Exchanger		equip, domestic, hot water, heatExchanger			
DHW Heat Exchanger Enabled	HxDHWEnab	domestic, heatExchanger, enable, cmd	Bool	Enabled/Disabled	COV, 30days
DHW Heat Exchanger Command	HxDHWCmd	domestic, heatExchanger, run, cmd	Bool	On/Off	COV, 30days
DHW Heat Exchanger Runtime	HxDHWRun	domestic, heatExchanger, total, sensor	Num, 1		Int, 10min
DHW Water Entering Temperature	HxDHWETemp	domestic, heatExchanger, entering, water, temp	Num, 1	F	Int, 10min
DHW Water Leaving Temperature	HxDHWLTemp	domestic, heatExchanger, leaving, water, temp	Num, 1	F	Int, 10min
DHW Water Isolation Valve	HxDHWIsoVlvCmd	domestic, heatExchanger, isolation, valve, cmd	Bool	Open/Closed	COV, 30days
DHW Circulation Pump Command	HxDHWCPCmd	domestic, heatExchanger, water, circ, pump, cmd	Bool	On/Off	COV, 30days
DHW Circulation Pump Status	HxDHWCPSts	domestic, heatExchanger, water, circ, pump, sensor	Bool	On/Off	COV, 30days
HWS Water Entering Temperature	HxHWSETemp	domestic, heatExchanger, primary, entering, water, temp	Num, 1	F	Int, 10min
HWS Water Leaving Temperature	HxHWSLTemp	domestic, heatExchanger, primary, leaving, water, temp	Num, 1	F	Int, 10min
HWS Water Isolation Valve	HxHWSIsoVlvCmd	domestic, heatExchanger, primary, isolation, valve, cmd	Bool	Open/Closed	COV, 30days
HWS Circ Pump Command	HxHWSCPCmd	domestic, heatExchanger, primary, water, circ, pump, cmd	Bool	On/Off	COV, 30days

HWS Circ Pump Status	HxHWSCPSts	domestic, heatExchanger, primary, water, circ, pump, sensor	Bool	On/Off	COV, 30days
Energy Points - Water		equip, water, meter, domestic, hot			
Domestic Hot Water Temperature Entering	DHWEtemp	domestic, water, temp, entering, sensor	Num, 1	F	Int, 10min
Domestic Hot Water Temperature Leaving	DHWLTemp	domestic, water, temp, leaving, sensor	Num, 1	F	Int, 10min
Domestic Hot Water Flow	DHWFlow	domestic, water, flow, sensor	Num, 1	gal/min	Int, 10min
Domestic Hot Water Volume (accumulated)	DHWVol	domestic, water, volume, sensor, hisTotalized	Num, 0	gal	Int, 10min
Domestic Hot Water Energy (accumulated)	DHWEnergy	domestic, water, energy, sensor, hisTotalized	Num, 0	MMbtu	Int, 10min
Domestic Hot Water Power	DHWPower	domestic, water, power, sensor	Num, 0	MMbtu/h	Int, 10min
Energy Points - Heat Recovery Water		equip, water, domestic, meter, hru			
Heat Recovery Water Temperature Entering	HRUWEtemp	domestic, water, temp, entering, sensor	Num, 1	F	Int, 10min
Heat Recovery Water Temperature Leaving	HRUWLTemp	domestic, water, temp, leaving, sensor	Num, 1	F	Int, 10min
Heat Recovery Water Flow	HRUWFlow	domestic, water, flow, sensor	Num, 1	gal/min	Int, 10min
Heat Recovery Water Volume (accumulated)	HRUWVol	domestic, water, volume, total, sensor	Num, 0	gal	Int, 10min
Heat Recovery Water Energy (accumulated)	HRUWEnergy	domestic, water, energy, sensor, hisTotalized	Num, 0	MMbtu	Int, 10min
Heat Recovery Water Power	HRUWPower	domestic, water, power, sensor	Num, 0	MMbtu/h	Int, 10min

2.15 Cooling Tower
equip, coolingTower
[openLoop, closedLoop]

Description	Point Name navName	Tags	Point Type	UoM	History
Cooling Tower Enabled	CTEnab	enable, cmd	Bool	Enabled/Disabled	COV, 24
Condenser Water Entering Temperature	CTCWETemp	condenser, water, entering, temp, sensor	Num, 1	F	Int, 10min
Condenser Water Leaving Temperature	CTCWLTemp	condenser, water, leaving, temp sensor	Num, 1	F	Int, 10min
Sump Temperature	CTSumpTemp	sump, temp, sensor	Num, 1	F	Int, 10min
Sump Heater Command	CTSumpHtrCmd	sump, heating, run, cmd	Bool	On/Off	COV, 24
Sump Heater Status	CTSumpHtrSts	sump, heating, run, sensor	Bool	On/Off	COV, 24
Fan Enabled	CTFanEnab	fan, enable, cmd	Bool	Enabled/Disabled	COV, 24
Fan Command	CTFanCmd	ran, run, cmd	Bool	On/Off	COV, 24
Fan Status	CTFanSts	fan, run, sensor	Bool	On/Off	COV, 24
Fan VFD Speed	CTFanSpd	fan, speed, cmd	Num, 0	%	Int, 10min
Fan VFD Freqency	CTFanVFDFreq	fan, freq, sensor	Num, 0	Hz	Int, 10min
Pump Enabled	CTCPEnab	circ, pump, enable, cmd	Bool	Enabled/Disabled	COV, 24
Pump Command	CTCPCmd	circ, pump, run, cmd	Bool	On/Off	COV, 24
Pump Status	CTCPSts	circ, pump, run, sensor	Bool	On/Off	COV, 24
Pump VFD Speed	CTCPVFDSpd	circ, pump, speed, cmd	Num, 0	%	Int, 10min
Pump VFD Frequency	CTCPVFDFreq	circ, pump, freq, sensor	Num, 0	Hz	Int, 10min
Pump Isolation Valve	CTIsoVlvCmd	isolation, valve, cmd	Bool	On/Off	COV, 24
Bypass Valve	CTBypVlvPos	bypass, valve, cmd	Num, 0	%	Int, 10min
Energy Points - Electric		equip, elec, meter, coolingTower, fan [siteMeter, submeterOf]			
Fan VFD Energy Total (accumulated)	CTFanVFDEnergy	fan, elec, energy, total, sensor, hisTotalized	Num, 0	KWh	Int, 10min
Fan VFD Power Total	CTFanVFDPower	fan, elec, power, total, active, sensor	Num, 0	kW	Int, 10min
Energy Points - Electric		equip, elec, meter, coolingTower, pump [siteMeter, submeterOf]			
Pump VFD Energy Total (accumulated)	CTPVFDEnergy	pump, elec, energy, total, sensor, hisTotalized	Num, 0	KWh	Int, 10min
Pump VFD Power Total	CTPVFDPower	pump, elec, power, total, active, sensor	Num, 0	kW	Int, 10min

PART 3 - EXECUTION

3.1 INTEGRATION

1. Approved Summary list shall be incorporated into the BAS system, including controls logic trees and Graphics User Interface

2.

END OF SECTION

SECTION 230923 - CONTROL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes control valves and actuators for DDC systems.

B. Related Requirements:
1. Section 230900 "Energy Management System and Building Automation System for HVAC and Lighting Control" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 230923.11.
3. Section 230719 "HVAC Piping Insulation" for requirements that relate to valve insulation.

C. Control valves shall not be used as manual isolation or service valves. Use appropriate full port valves for equipment and sectional header isolation.

D. Actuators for Fire Suppression Systems shall be NFPA rated for Fire Service

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Include diagrams for power, signal, and control wiring.
2. Include diagrams for pneumatic signal and main air tubing.

C. Delegated-Design Submittal:
1. Schedule and design calculations for control valves and actuators, including the following:
   a. Flow at project design and minimum flow conditions.
   b. Pressure differentials drop across valve at project design flow condition.
   c. Maximum system pressure differential drop (pump close-off pressure) across valve at project minimum flow condition.
   d. Design and minimum control valve coefficient with corresponding valve position.
   e. Maximum close-off pressure.
   f. Leakage flow at maximum system pressure differential.
   g. Torque required at worst case condition for sizing actuator.
   h. Actuator selection indicating torque provided.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Delegated Design: Engage a qualified professional designer, as defined in Section 014000 "Quality Requirements," to size products where indicated as delegated design.

D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

E. Determine control valve sizes and flow coefficients by ISA 75.01.01.

F. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

G. Insulation Requirements for all valve bodies shall comply with Pipe Insulation under 230719. Insulation on all actuator valve bodies shall be constructed to be water resistant and removable for servicing and repair. The removable section shall be constructed so as not interfere with actuator or linkage operation and provided fasteners for reinstallation without the need for any additional material or tools.

H. Selection Criteria:
   1. Control valves shall be suitable for operation at following conditions:
      a. Chilled Water: 40-60 degrees F. and 50 psig.
      b. Heating Hot Water: <40-200 degrees F and 50 psig.
   2. Fail positions unless otherwise indicated:
      a. Chilled Water: Last position.
      b. Heating Hot Water: Open.
   3. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
   4. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 5 psig at design flow unless otherwise indicated.
   5. Modulating valve sizes for steam service shall provide a pressure drop at design flow equal to lesser of the following:
      a. 50 percent of the valve inlet pressure.
      b. 50 percent of the absolute steam pressure at the valve inlet.
   6. Control valve assemblies shall be provided and delivered from a single manufacturer as a complete assembly.
   7. The manufacturer shall warrant all components for a period of 5 years from the date of production with the first two years unconditional.

2.2 BALL-STYLE CONTROL VALVES

A. Ball Valves with Single Port and Characterized Disk:
   1. Pressure Rating for NPS 1-1/4 and Smaller: Nominal 600 psig.
   2. Pressure Rating for NPS 1-1/4 through NPS 2: Nominal 400 psig.
   3. Pressure Rating for NPS 2-1/2 through NPS 6: In accordance with ANSI 125, Class B.

4. Close-off Pressure NPS 2 and Smaller: 200 psig .
5. Close-off Pressure NPS 2-1/2 through NPS 6: ANSI Class 125B: 175 psid ; ANSI Class 250: 310 psid.
6. Process Temperature Range: Zero to 250 deg F.
7. Body and Tail Piece NPS 2 and Smaller Nickel plated (forged) brass.
8. Body and Tail Piece NPS 2-1/2 through NPS 6: Cast iron GG25.
9. End Connections NPS 2 and Smaller: Threaded (NPT) female ends.
10. End Connections NPS 2-1/2 through NPS 6: Flanged ANSI Class 125B.
11. Ball NPS 3/4 and Smaller: Chrome-plated brass.
12. Ball NPS 1 through NPS 6:- Stainless steel.
13. Stem and Stem Extension:
    a. Material to match ball.
    b. Blowout-proof design.
14. Ball Seats: PTFE (Tefzel), (2) EPDM O-rings.
15. Stem Seal: Lubricated EPDM O-rings (2).
16. Characterizing Disc NPS 2 and Smaller: Tefzel.
17. Characterizing Disc NPS 2 through NPS 6: Stainless steel.
18. Flow Characteristic: Equal percentage.
19. Leakage: 0%.

B. Ball Valves with Two Ports and Characterized Disk:
1. Pressure Rating for NPS 1-1/4 and Smaller: Nominal 600 psig.
2. Pressure Rating for NPS 1-1/4 through NPS 2: Nominal 400 psig.
3. Close-off Pressure: 200 psig (1379 kPa).
4. Process Temperature Range: Zero to 250 deg F.
5. Body and Tail Piece: Nickel plated (forged) brass.
6. End Connections: Threaded (NPT) female ends.
7. Ball NPS 3/4 and Smaller: Chrome-plated brass.
8. Ball: NPS 1 through NPS 6:- Stainless steel.
9. Stem and Stem Extension:
    a. Material to match ball.
    b. Blowout-proof design.
10. Ball Seats: PTFE (Tefzel), EPDM O-rings.
11. Stem Seal: Lubricated EPDM O-rings.
12. Flow Characteristics for A-Port: Equal percentage.
13. Flow Characteristics for B-Port: Modified for constant common port flow.
14. Leakage (control port): 0%.

C. Pressure-Independent Ball Valves NPS 2 and Smaller:
1. Performance:
    a. Pressure Rating for NPS 3/4 and Smaller:360 psig
    b. Pressure Rating for NPS 1 through NPS 6: In accordance with ANSI 125, Class B.
    c. Close-off pressure for NPS 3/4 and Smaller: 75 psig
    d. Close-off Pressure NPS 2 and Smaller: 200 psig.
    e. Close-off Pressure NPS 2-1/2 through NPS 6: ANSI Class 125B: 175 psid; ANSI Class 250: 310 psid.
    f. Process Temperature Range for NPS 3/4 and Smaller: Between 36 to 212 deg F.
    g. Process Temperature Range for NPS 6 and Smaller: Between 14 to 250 deg F.
    h. End Connections NPS 2 and Smaller: Threaded (NPT) female ends.
    i. End Connections NPS 2-1/2 through NPS 6: Flanged ANSI Class 125B.
2.

3. Body for NPS 2 and Smaller: Forged brass, nickel plated, and with threaded ends.
4. Body for NPS 2-1/2 through NPS 6: Cast iron GG25.
5. Ball: Stainless steel.
6. Stem and Stem Extension: Stainless steel, blowout-proof design.
7. Ball Seats: PTFE (Tefzel), EPDM O-rings.
8. Stem Seal: Lubricated EPDM O-rings.
9. NPS 3/4 and Smaller: An integral pressure regulator located upstream of characterized ball to regulate pressure, to maintain a constant pressure differential over the operating pressure differential range of 5 to 50 psig maintaining the flow with an accuracy of +/- 5% due to system pressure fluctuations. Two internal P/T ports shall be incorporated for differential pressure verification. Replaceable cartridges are not permitted.
10. NPS 6 and Smaller: An ultrasonic flow meter (accuracy +/- 2%) shall be integrated with a characterized control valve providing analog flow feedback. The valve shall reposition to maintain the required flow with a +/- 5% accuracy over a pressure differential range of 1 to 50 psig (7 to 350 kPa). The flow meter shall incorporate an algorithm to automatically compensate for the glycol compensation.
11. Control valve shall be equal percentage flow characteristic, other than where noted as a linear flow characteristic. Flow settings shall be field-modifiable, and may be modified inline.
12. Coil Optimization: Two immersion temperature sensors for supply and return coil water temperatures shall be incorporated into the valve assembly. Software shall control the valve to avoid the coil differential temperature from falling below a programmed setpoint. Real-time data and configuration of valve] operating parameters shall be available by BTL listed BACnet MS/TP, BACnet/IP, MODBUS or HTTP. Monitored points shall include inlet and outlet coil water temperatures, absolute flow, absolute valve position, absolute coil power and total heating/cooling energy in BTU/hr. Configuration points shall include valve, flow and power settings. Historical trend data shall be stored for up to 13 months and be retrievable in a standard date-time stamped format.]
13.
14.

2.3 BUTTERFLY-STYLE CONTROL VALVES

A. Commercial-Grade, Two-Way Butterfly Valves:
1. Performance:
   a. Bi-directional bubble tight shutoff at 250 psig.
   b. Comply with MSS SP-67 or MSS SP-68.
   c. Rotation: Zero to 90 degrees.
   d. Linear or modified equal percentage flow characteristic.
2. Body: Cast iron ASTM A126, Class B, ductile iron ASTM A536 or cast steel ASTM A216/A216M WCB fully lugged, suitable for mating to ASME B16.5 flanges.
3. Disc: 316 stainless steel.
4. Shaft: 316 or 17-4 PH stainless steel.
5. Seat: Reinforced EPDM or reinforced PTFE with retaining ring.
6. Shaft Bushings: Reinforced PTFE or stainless steel.
7. Replaceable seat, disc, and shaft bushings.
8. Corrosion-resistant nameplate indicating:
   a. Manufacturer's name, model number, and serial number.
   b. Body size.
   c. Body and trim materials.

d. Flow arrow.

B. Commercial-Grade, Three-Way Butterfly Valves:
1. Arrangement: Two valves mated to a fabricated tee with interconnecting mechanical linkage.
2. Performance:
a. Bi-directional bubble tight shutoff at 250 psig.
b. Comply with MSS SP-67 or MSS SP-68.
c. Rotation: Zero to 90 degrees.
d. Linear or modified equal percentage flow characteristic.
3. Body: Cast iron ASTM A126, Class B, ductile iron ASTM A536 or cast steel ASTM A216/A216M WCB fully lugged, suitable for mating to ASME B16.5 flanges.
4. Disc: 316 stainless steel.
5. Shaft: 316 or 17-4 PH stainless steel.
6. Seat: Reinforced EPDM or reinforced PTFE seat with retaining ring.
7. Shaft Bushings: Reinforced PTFE or stainless steel.
8. Replaceable seat, disc, and shaft bushings.
9. Corrosion-resistant nameplate indicating:
a. Manufacturer's name, model number, and serial number.
b. Body size.
c. Body and trim materials.
d. Flow arrow.

2.4 GLOBE-STYLE CONTROL VALVES

A. General Globe-Style Valve Requirements:
1. Globe-style control valve body dimensions shall comply with ISA 75.08.01.
2. Construct the valves to be serviceable from the top.
3. Reduced trim for one nominal size smaller shall be available for industrial valves NPS 1 (DN 25) and larger.
4. Replaceable seats and plugs.
5. Furnish each control valve with a corrosion-resistant nameplate indicating the following:
a. Manufacturer's name, model number, and serial number.
b. Body and trim size.
c. Arrow indicating direction of flow.
6. Control valve assemblies shall be provided and delivered from a single manufacturer as a complete assembly.
7. The manufacturer shall warrant all components for a period of 5 years from the date of production with the first two years unconditional.

B. Two-Way Globe Valves NPS 2 and Smaller:
1. Globe Style: Single port.
2. Body: Bronze with ANSI Class 250 rating.
3. End Connections: Threaded.
4. Bonnet: Screwed.
5. Packing: EPDM O-ring.
6. Plug, Seat, and Stem: Brass.
7. Process Temperature Range: 20 to 280 deg F.
8. Ambient Operating Temperature: Minus 22 to 122 deg F.
9. Leakage: ANSI Class VI.
10. Equal percentage flow characteristic.

C. Three-Way Globe Valves NPS 2 and Smaller:
1. Globe Style: Mix flow pattern.
2. Body: Bronze with ANSI Class 250 rating.
3. End Connections: Threaded.
4. Bonnet: Screwed.
5. Packing: EPDM O-ring.
6. Plug, Seat, and Stem: Brass.
7. Process Temperature Range: 20 to 280 deg F.
8. Ambient Operating Temperature: Minus 22 to 122 deg F.
9. Leakage: ANSI Class VI.
10. Modified equal percentage flow characteristic.

D. Two-Way Globe Valves NPS 2-1/2 to NPS 6:
1. Globe Style: Single port.
2. Body: Cast iron complying with ASME B61.1, Class 125.
3. End Connections: Flanged, suitable for mating to ASME B16.5, Class 150 flanges.
4. Bonnet: Bolted.
5. Packing: PTFE cone-ring.
6. Plug: Top or bottom guided.
7. Plug, Seat, and Stem: Brass or stainless steel.
8. Process Temperature Rating: 35 to 281 deg F.
9. Leakage: 0.1 percent of maximum flow.
10. Rangeability: Varies with valve size between 6 and 10 to 1.
11. Modified linear flow characteristic.

E. Industrial-Grade Straight-Through Globe Valves NPS 1 and Larger:
1. Globe Style: Single port.
2. Body: Cast iron or cast steel.
3. End Connections for NPS 2: Threaded.
4. End Connections for NPS 2-1/2 and Larger: Raised face flanged.
5. Bonnet: Bolted.
6. Packing: PTFE V-ring.
7. Plug: Cage guided and unbalanced.
8. Plug, Seat, and Stem: 416 stainless-steel plug and seat, 17-4 PH stainless-steel cage and 316 stainless-steel stem.
9. Valve Stem: Thread and pin stem to plug.
10. Valve Stem Finish: Polished to 5 microinches rms or less.
11. Plug and Seat Surfaces: Hardened facing.
12. Process Temperature Range: Zero to 450 deg F.
13. Ambient Operating Temperature: Minus 20 to plus 150 deg F.
14. Leakage: FCI 70-2, Class IV.
15. Flow Characteristic: Equal percentage.

2.5 SOLENOID VALVES

A. Description:
1. Action: Either normally open or normally closed in the event of electrical power failure as required by the application.
2. Size to close against the system pressure.
3. Manual override capable.
4. Heavy-duty assembly.
5. Body: Brass.

6. Seats and Discs: NBR or PTFE.
7. Solenoid Enclosure: NEMA 250, Type 4.

2.6 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

A. Agency Listings: ISO 9001, UL 873 or UL 60730, CE and CSA.

B. The valve assembly (control valve and actuator) shall be provided and delivered froma single manufacturer.

C. The manufacturer shall warrant all components for a period of 5 years from the date of production with the first two years unconditional.

D. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.

E. Actuators for Steam Control Valves: Shutoff against 1.5 times steam design pressure.

F. Position indicator and graduated scale on each actuator.

G. Type: Motor operated, with or without gears, electric and electronic.

H. Voltage: Voltage selection delegated to professional designing control system.

I. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

J. Function properly within a range of 85 to 120 percent of nameplate voltage.

K. Field Adjustment:
   1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
   2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

L. Two-Position Actuators: Single direction, spring return or reversing type.

M. Modulating Actuators:
   1. Operation: Capable of stopping at all points across full range and starting in either direction from any point in range.
   2. Control Input Signal:
      a. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10-V signals. (EMS Prefer to remove this range to standardize range.)
      b. Programmable Multi-Function: (EMS Prefers this option. It will be better data for future AI data analytics for energy savings)
         1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
         2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
         3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.

N. Position Feedback:
1. Where indicated, equip modulating actuators with a position feedback through voltage signal for remote monitoring. (e.g. VAV damper, hydronic valve position, non-safety related indication only applications where other feedback sensors are available.)
2. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

O. Fail-Safe:
1. Where indicated, provide actuator to fail to an end position.
2. Mechanical spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Electronic fail-safe shall incorporate an active balancing circuit to maintain equal charging rates among the Super Capacitors. The power fail position shall be proportionally adjustable between 0 to 100% in 10-degree increments with a 2 second operational delay.

P. Integral Overload Protection:
1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

Q. Valve Attachment:
1. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
2. Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
3. V-bolt dual nut clamp with a V-shaped toothed cradle; directly couple and amount to the valve bonnet stem, or ISO-style direct-coupled mounting pad.

R. Temperature and Humidity:
1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

S. Enclosure:
1. Suitable for ambient conditions encountered by application.
2. NEMA Type 1 for indoor installation in an equipment enclosure.
3. NEMA Type 2 for indoor and protected applications.
4. NEMA Type 4 or Type 4X for outdoor and unprotected applications.
5. Provide actuator enclosure with heater and control where required by application.

T. Stroke Time:
1. Select operating speed to be compatible with equipment and system operation.

PART 3 - EXECUTION

3.1 CONTROL VALVE APPLICATIONS

A. Control Valves:

1. Select from valves specified in "Control Valves" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
2. Unless otherwise noted, select valves as follows,
   a. Pressure-independent ball valves for systems controlled with VFDs.
   b. Ball valves with single port and characterized disk for all NPS 2” and smaller.
   c. Globe valves for all NPS 2-1/2” and larger applications.
   d. Butterfly valves, as required, for sizes larger than NPS 6” or outdoor chiller plant operation.

3.2 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.

D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

F. Fastening Hardware:
   1. Pipe wrenches, pliers, and other grooved tools that will cause injury to or mar surfaces of rods, nuts, and other pa are prohibited for assembling and tightening nuts.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

H. Corrosive Environments:
   1. Use products that are suitable for environment to which they will be subjected.
   2. If possible, avoid or limit use of materials in corrosive environments, including. but not limited to, the following:
      a. Laboratory exhaust airstreams.
      b. Process exhaust airstreams.
   3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
   4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.

5. Where control devices are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 CONTROL VALVES

A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

B. Install flanges or unions to allow drop-in and -out valve installation.

C. Where indicated, install control valve with three-valve bypass manifold to allow for control valve isolation and removal without interrupting system flow by providing manual throttling valve in bypass pipe.

D. Install drain valves in piping upstream and downstream of each control valve installed in a three-valve manifold and for each control valve larger than NPS 4.

E. Install pressure temperature taps in piping upstream and downstream of each control valve larger than NPS 2.

F. Valve Orientation:
   1. Install valves with actuators per manufactures recommendations for the specific application.
   2. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
   3. Install valves in a position to allow full stem movement.
   4. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

G. Clearance:
   1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
   2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.
   3. Assure actuator indicators are visible.

H. Threaded Valves:
1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
2. Align threads at point of assembly.
3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

I. Flanged Valves:
1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

J. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

K. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same cable designation at each end for operators to determine continuity ~~at~~ and also the unique wire designations to match points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

L. Install engraved phenolic nameplate with valve identification on valve.

3.5 CHECKOUT PROCEDURES

A. Control Valve Checkout:
1. Check installed products before continuity tests, leak tests, and calibration.
2. Check valves for proper location and accessibility.
3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. For pneumatic products, verify air supply for each product is properly installed. (retrofit applications only)
5. For pneumatic valves, verify that pressure gauges are provided in each airline to valve actuator and positioner. (retrofit applications only)
6. Verify that control valves are installed correctly for flow direction.
7. Verify that valve body attachment is properly secured and sealed.
8. Verify that valve actuator and linkage attachment are secure.
9. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
10. Verify that valve ball, disc, and plug travel are unobstructed.
11. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.6 ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to zero percent (closed) back to 100 percent open.

B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent open, 50 percent, and zero percent open at proper air pressures. (retrofit applications only)

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS (DX with VAV)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes control sequences for HVAC systems, sub-systems and equipment.

B. Related Sections include the following:

1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. Set-points: In general, stated set-points are intended to be a starting programming value with the final setup adjustable from BAS.

C. BAS: Building Automation System.

1.4 VARIABLE AIR VOLUME RTU AIR SYSTEM – Building 6600

A. The Building Automation System (BAS) shall perform the following RTU Air System (RTU) control strategies, appropriate to the given occupancy mode of the system, as determined by the user-adjustable time-of-day schedule for the system. Optimal start and unoccupied mode applies only to HVACU with time of day scheduled operation. Verify time schedule during Owner's training.

B. Optimal Start Mode:

1. The BAS shall initiate the Optimal Start mode such that the RTU is started and Air terminal units serving the RTU are enabled prior to when the space being served by the RTU is scheduled to be occupied, to allow the zone temperature to reach the pending occupied heating or cooling set-point. The system shall wait as long as possible before starting, so that the temperature in each zone reaches the occupied set-point just in time for scheduled occupancy. Ventilation functions shall be disabled when the RTU is in Optimal Start mode and outside air dampers shall be closed.

2. The BAS shall use a self-adjusting algorithm to calculate the actual time to initiate Optimal Start for the VAV Air System based on the occupied set-point, space temperature, outside air temperature, historical optimal start performance data and the associated heating or cooling optimal start rate.

3. An early start limit shall be provided to prevent the RTU from starting prior to 120 minutes (adjustable) before scheduled occupancy.

4. The RTU shall transition from Optimal Start mode to occupied mode when the current time is equal to the scheduled start time.

    a. Cooling:

        1) The BAS shall initiate the Optimal Start – Cooling mode when Optimal Start mode for the RTU has been initiated and the average temperature of the space is warmer than its occupied cooling set-point. All ventilation functions are disabled while operating in Optimal Start mode and the outside air dampers shall be closed.

        2) The BAS shall determine the length of time required to lower the space temperature to the occupied cooling set-point when the mode of the RTU is cooling and the space temperature is above the occupied cooling set-point.

        3) Each air terminal unit in the VAV Air System shall control to its occupied cooling set-point, and shall modulate box airflow to maintain the space temperature set-point for the zone being served by the Air terminal unit. Auxiliary heat in the Air terminal unit is disabled.

        4) The air handler shall modulate its airflow to maintain the duct static pressure set-point.

    b. Heating:

        1) The BAS shall initiate the Optimal Start – Heating mode, Air terminal unit local heat, when Optimal Start mode has been initiated and the average space temperature is cooler than its occupied heating set-point. All ventilation functions are disabled while operating in Optimal Start mode and the outside air dampers shall be closed.

        2) The BAS shall determine the length of time required to raise the average space temperature to the occupied heating set-point when the mode of the RTU is heating and the average space temperature is below the set-point.

        3) Each Air terminal unit in the VAV Air System shall control to its occupied heating set-point, and shall modulate box airflow to maintain the space temperature set-point for the zone being served by the Air terminal unit. Auxiliary heat in the Air terminal unit is enabled.

        4) The air handler shall modulate its airflow to maintain the duct static pressure set-point.

C. Unoccupied Mode:

1. The BAS shall place the members of the VAV Air System into Off/Standby mode as determined by the user-adjustable time-of-day schedule for the system. The Air terminal units shall control to their individual unoccupied temperature set-points, and all ventilation functions shall be disabled and outside air dampers shall be closed. Air terminal unit local reheat is disabled while the RTU is in unoccupied mode.

2. After the Air terminal units have been commanded to unoccupied, the RTU shall command the associated AHU to Unoccupied mode. Supply fan shall be shut down, heating shall fail to open, cooling shall go to 50%, outdoor air damper shall be closed, and all ventilation functions shall be disabled.

D. Night Setback Mode: During scheduled unoccupied hours, the VAV Air System shall be controlled by the BAS to maintain the unoccupied heating and cooling set-points, as appropriate. Ventilation functions are disabled, the outdoor air damper shall remain closed, unless outdoor air is used for economizing during unoccupied zone cooling. Unless otherwise stated, the RTU supply fan shall operate in the automatic control mode, cycling on only when heating or cooling is needed.

1. Heating:

a. RTU supply fan energized, Air terminal unit local reheat is used.

b. The BAS shall initiate the Night Heating mode when the temperature for the space being served by the RTU is less than 55 degrees F (adjustable) in a minimum of 3 rooms, (adjustable). Night heating shall terminate when the space temperature rises above the Unoccupied Heating set-point plus the unoccupied heating differential (4 degrees F, adjustable).

c. Each Air terminal unit that is associated with the RTU shall control to its unoccupied heating set-point, and shall modulate box airflow to maintain the space temperature set-point for the zone being served by the Air terminal unit.

d. The air handler shall operate to maintain duct static pressure while in Night Heat mode.

e. The Air terminal unit shall control its airflow to its maximum heat set-point.

2. Cooling:

a. RTU supply fan energized

b. The BAS shall initiate the Night Cooling mode when the temperature for the space being served by the RTU is greater than 85 degrees F, (adjustable) for a minimum of three rooms (adjustable). Night cooling shall terminate when the space temperature falls below the Unoccupied Cooling set-point plus the unoccupied cooling differential (4 degrees F, adjustable).

c. Each Air terminal unit that is associated with the RTU shall control to its unoccupied cooling set-point, and shall modulate box airflow to maintain the space temperature set-point for the zone being served by the Air terminal unit.

d. The air handler shall operate to maintain duct static pressure while in Night Cooling mode.

E. Static Pressure Optimization:

1. The building automation system (BAS) shall continuously monitor the damper position of all air terminal units. The discharge duct static pressure shall be sensed 2/3 of the

distance from the discharge of each rooftop/air handling unit. The sensor must be mounted in a non-turbulent location. Label the location of the sensor on the ceiling. The BAS shall also read the status on the supply air sensor and display the pressure reading on the status screen. Provide a high pressure switch at the unit with a setpoint between 4" and 6" (adjustable).

2. The building automation system shall monitor the damper position of all air terminal units and determine each air terminal critical zone VAV terminal (CZ), which is the air terminal unit that is the widest open.

3. When any air terminal damper is more than 75 percent (adj.) open, the supply fan discharge duct static pressure set-point shall be reset upward by 0.3 in W.C. (adj.), at a frequency of 15 minutes (adj.), until no damper is more than 75 percent open or the static pressure set-point has reset upward to the system maximum duct static pressure set-point or the supply fan variable-frequency drive is at the maximum speed setting.

4. When all air terminal dampers are less than 65 percent (adj.) open, the supply fan discharge duct static pressure set-point shall be reset downward by 0.3 in W.C. (adj.), at a frequency of 15 minutes (adjustable), until at least one damper is more than 65 percent open or the static pressure set-point has reset downward to the system minimum duct static pressure set-point.

5. Air terminal units in calibration or auto commissioning mode shall not impact the critical zone calculation.

6. The control bands, set-point increment values, set-point decrement values and adjustment frequencies shall be adjusted to maintain maximum static pressure optimization with stable system control and maximum comfort control.

F. Occupied Mode Cooling Control: The compressors shall energize to maintain the discharge air temperature at the discharge cooling set-point for the RTU. The VAV's shall modulate the air flow to maintain the zone temp per the cooling set point.

G. Occupied Mode Heating Control: Heating during Occupied Mode shall be controlled via the Air Terminal Unit section of this specification.

H. Economizer - Enthalpy Enable:

1. The mixed air temperature set point shall be 2°F (adj.) less than the supply air temperature set point. The controller shall measure the mixed air temperature and modulate the economizer dampers in sequence to maintain this set point.

2. The outside air damper shall close and the return air damper shall open when the unit is off.

3. The economizer shall be enabled whenever:

   a. Outside air temperature is less than 65°F (adj.).

   b. AND the outside air enthalpy is less than 22Btu/lb (adj.)

   c. AND the outside air temperature is less than the return air temperature.

d. AND the outside air enthalpy is less than the return air enthalpy.

e. AND the fan status is on.

4. The economizer shall close to 0% (adj.) whenever:

a. The freezestat is on.

b. OR the mixed air temperature is less than 35°F (adj.).

c. OR on loss of fan status.

5. Alarms shall be provided as follows:

a. High Mixed Air Temp: If the mixed air temperature is 5°F (adj.) greater than set point.

b. Low Mixed Air Temp: If the mixed air temperature is 5°F (adj.) less than set point.

I. Dehumidification:

1. Provide all necessary sensors for dehumidification control at each air handler.

2. The controller shall measure the return air humidity and override the cooling sequence to maintain a return air humidity setpoint of 60% rh (adj.). The dehumidification shall turn off whenever the return air humidity drops below 55% rh (adj.).

a. When dehumidification mode is engaged per the requirements above, the unit shall go to cooling mode with the terminal units providing space temperature control.

3. Dehumidification shall be enabled whenever:

a. Fan status is on

b. Zone humidity exceeds 60% (adj.) relative humidity in unoccupied mode.

4. Alarms shall be provided as follows:

a. High Return Air Humidity: If the return air humidity is 10% rh (adj.) greater than setpoint.

b. Low Return Air Humidity: If the return air humidity is 10% rh (adj.) less than setpoint.

J. Safety Interlock: The following shall de-energize the RTU supply fan: Duct detector, emergency stop button, low limit thermostat activation, high Pressure switch (4”-6” adjustable).

K. Building Pressurization

1. The exhaust/relief damper shall modulate open to maintain a building pressurization of +0.05” (adj.) SP as measured by a space pressurization sensor.

2. There shall be one sensor per air handler.

3. There shall be an alarmed condition for space pressurization rising more than 25% (adj.) above the setpoint and for space pressurization falling more than 25% (adj.) below the setpoint.

L. Demand Control Ventilation

1. Outside air intake shall be provided with a motorized damper. On unit start up, the outside air intake damper shall remain closed until the return air temperature rises above 65° f (adj) or falls below 75° f. (adj). Once return air temperature is satisfied, the outside air damper shall open to the occupied minimum setpoint. Outside air dampers shall modulate as required to maintain minimum outside air flow. the outside air intake damper shall be closed while unit is in the unoccupied mode. BAS shall be capable of opening and closing outside air dampers. CO2 sensor mounted in the return duct shall modulate the outside air damper based on co2 levels in the space. Damper shall modulate open from the occupied minimum setpoint of 800 ppm to design maximum at 1200 ppm. An alarm shall be activated if the space co2 level rises above 1500 ppm. See AHU schedule for minimum and design outside air setpoints.

2.

Variable Air Volume - AHU DX

	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Outside Air Humidity	x								x		x
Outside Air Temperature	x								x		x
Mixed Air Damper		x							x		x
Smoke Detector			x						x	x	x
Building Static Pressure	x								x		x
Exhaust Air Damper		x									x
Supply Fan VFD Speed		x							x		x
Exhaust Air Damper Status			x						x		x
High Static Shutdown			x						x	x	x
Supply Fan VFD Fault			x							x	x
Supply Fan Start/Stop				x					x		x

Economizer Mixed Air Temp Setpoint					x				x		x
Exhaust Air Damper Failure										x	
High Return Air Carbon Dioxide Concentration										x	
High Return Air Humidity										x	
High Supply Air Temp										x	
High Zone Carbon Dioxide Concentration										x	
Supply Fan Failure										x	
Supply Fan in Hand										x	
Monitoring Points											
Mixed Air Temp	x				x				x		x
Return Air Carbon Dioxide PPM	x								x		x
Return Air Humidity	x				x				x		x
Space Humidity	X								X		x
Return Air Temp	x				x				x		x
Supply Air Static Pressure	x				x				x	x	x
Supply Air Temp	x				x				x		x
Mixed Air Dampers		x			x				x		x
Fan Status (depended on number / type of fans)			x			x			x		x
Cooling Stage 1				x		x			x		x
Cooling Stage 2				x		x			x		x

Cooling Stage 3				x		x			x		x
Cooling Stage 4				x		x			x		x
Commanded Points											
Building Static Pressure Set-point					x						x
Dehumidification Setpoint					x				x		x
Return CO2 Setpoint					x				x		x
Supply Air Static Pressure Setpoint					x				x		x
Supply Air Temp Setpoint					x				x		x
Emergency Shutdown						x				x	x

*Controls are by the unit manufacturer. EMS will monitor / control via the BACnet interface only. Red indicate monitoring points, Green are commanded points.

3.

4.

1.5 AIR TERMINAL UNIT OPERATION – Building 6600 Single Duct VAV & Parallel Fan Powered Boxes

A. Direct Digital Controls: DDC controls, actuators and costs to mount, calibrate and test the system shall be the responsibility of Controls Contractor.

B. Terminal Unit Control:

1. The terminal box units shall be individually controlled by a DDC terminal controller per terminal unit.

2. The BAS shall perform the following terminal unit control strategies and provide the points as listed on the DDC terminal point list and the specified monitoring and diagnostics.

a. Set point Control: The BAS shall edit the zone space temperature set-point of each terminal box. The zone temperature set-point shall be operator adjustable. Individual zone set-point and control logic shall reside at the zone level and shall not be dependent upon the BAS for control. In the event of communication loss, the box shall continue to control to current set-points.

b. Cooling Valve Control: The BAS shall control the cooling air valve to a fully open, fully closed, maximum CFM or minimum CFM position based on operator

commands. The operator shall also have the capability to adjust the maximum and minimum airflow limits of the air valve through the BAS.

c. Operating Mode: The BAS shall place the box in either the occupied or unoccupied mode based on an operator adjustable time schedule. Separate heating and cooling set-points shall be provided for each mode through the BAS. Other modes available for special applications shall include full open, full closed, maximum flow and minimum flow.

d. Occupied Mode:

1) VAV Boxes: As the space temperature rises above the cooling set-point, the terminal unit shall modulate to its maximum CFM set-point. As the space temperature falls below cooling set-point, the terminal unit shall modulate to its minimum CFM set-point. Upon a further decrease in space temperature, the terminal unit shall remain at minimum CFM and electric heat shall energize.

2) Parallel Fan Boxes: As the space temperature rises above the cooling set-point, the terminal unit shall modulate to its maximum CFM set-point. As the space temperature falls below cooling set-point, the terminal unit shall modulate to its minimum CFM set-point. Upon a further decrease in space temperature, the terminal unit shall remain at minimum CFM and parallel fan shall be energized. As the space temperature continues to drop, electric heat shall energize.

e. Unoccupied Mode:

1) VAV Boxes: During this mode, the air valve on the terminal unit shall be closed. When required by the unoccupied set-point, the air valve shall open to minimum position and heat shall energize to maintain a reduced space temperature.

2) Parallel Fan Boxes: During this mode, the air valve on the terminal unit shall be closed. When required by the unoccupied set-point, the parallel fan shall energize and heat shall energize to maintain a reduced space temperature.

f. Morning warm-up Mode:

1) VAV Boxes: The air valve on the terminal unit shall modulate to the minimum CFM and the heat shall energize to maintain the occupied heating set-point.

2) Parallel Fan Boxes: The air valve on the terminal unit shall remain closed, parallel fan shall energize and electric heat shall energize to maintain the occupied heating set-point.

g. The building automation system shall provide the ability to automatically commission and calibrate the terminal Air System. The following tests shall be performed, at a minimum: Calibration of the air valve/damper, Verification of air flow through the terminal box, Verification of local reheat performance.

h. The building automation system (BAS) shall provide the ability to initiate the auto-commissioning/auto-calibration command directly from the user interface. Special service tools shall not be required. The terminal boxes shall allow the operator to perform on an individual or group basis auto-commissioning report for the terminal Air System which contains the results of the auto-commissioning/auto-calibration tests which is printable and remain in memory until the next auto-commissioning test is initiated. This report shall contain, at a minimum, the following information for each terminal box in the system. Name of terminal box. Date and time the terminal box was tested. Presence of any alarms. Space temperature and set-point. Active airflow (in CFM). Air valve/damper position at every 5% increment. Discharge air temperature of the terminal box when the hot heat is active.

C. Zone Thermostats:

1. The zone thermostats shall be accurate to within 1.0 degrees F. The thermostats shall be provided by the controls contractor and shall be as noted in section 230900 space thermostats (2.12G).

2. The zone thermostat shall be installed to avoid relaying false temperatures (i.e. not close to heating/cooling sources).

3.

Air Terminal Unit	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Airflow	x								x		x
Discharge Air Temp	x								x		x
Zone Temp	x								x		x
Zone Setpoint Adjustment (where required)	x								x		x
Zone Override (where re-quired)			x						x		x
Parallel Fan			x						X		x
Electric reheat coil		x							x		x
Zone Damper		x							x		x
Airflow Setpoint					x				x		x
Cooling Setpoint					x				x		x

DAT Heating Limit					x						
Heating Setpoint					x				x		x
Percent of Time Satisfied					x				x		
Heating Mode						x			x		
Schedule								x			

4.

1.6 DEDICATED OUTSIDE AIR UNIT OPERATON – Building 6623 & 6635

A. The Building Automation System (BAS) shall perform the following control strategies, appropriate to the given occupancy mode of the system, as determined by the user-adjustable time-of-day schedule for the system. Verify time schedule during Owner's training.

B. Dedicated Outside Air Unit shall run on a time of day schedule, with timing to be verified by owner when the building is in the occupied mode.

C. Occupied Mode Cooling Control: The compressors shall modulate to maintain the discharge temperature between 65°F. and 75°F.

D. Occupied Mode Heating Control: Heating during Occupied Mode shall be controlled via the gas heating section to maintain the discharge temperature between 65°F. and 75°F.

E. Dehumidification:

1. Provide all necessary sensors for dehumidification control at each air handler.

2. The controller shall measure the space humidity and override the cooling sequence to maintain a space humidity setpoint of 60% rh (adj.). The dehumidification shall turn off whenever the space humidity drops below 55% rh (adj.).

a. When dehumidification mode is engaged per the requirements above, the unit shall go to cooling mode with hot gas reheat providing space temperature control.

3. Dehumidification shall be enabled whenever:

a. Fan status is on

b. Zone humidity exceeds 60% (adj.) relative humidity in either occupied or unoccupied mode.

4. Alarms shall be provided as follows:

a. High Space Humidity: If the space humidity is 10% rh (adj.) greater than setpoint.

F. Safety Interlock: The following shall de-energize the supply fan: Duct detector.

1.7

1.8

A.

Dedicated Outside Air Unit - DX

	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Outside Air Humidity	x								x		x
Outside Air Temp	x								x		x
Space Humidity	x								x		x
Return Air Temp	x								x		x
Supply Air Temp	x								x		x
Smoke Detector			x						x	x	x
Zone Override			x						x		x
Cooling Stage 1				x					x		x
Heating Stage 1				x					x		x
Supply Fan Start/Stop				x					x		x
Supply Fan Status			x						x		x
Supply Fan Failure										x	
Supply Fan in Hand										x	
Exhaust Fan Start/Stop				x					x		x
Exhaust Fan Status			x						x		x
Exhaust Fan Failure										x	
Exhaust Fan in Hand										x	
Heat Wheel Status			x						x		x

Cooling Setpoint					x				x		x
Heating Setpoint					x				x		x
High Space Humidity										x	
High Supply Air Temp										x	
Low Supply Air Temp										x	

*Controls are by the unit manufacturer. EMS will monitor / control via the BACnet interface only. Red indicate monitoring points, Green are commanded points.

1.9 WATER SOURCE HEAT PUMPS – Buildings 6623 & 6635

A. Water Source Heat Pumps (WSHPs) shall be provided with a two-way condenser water control valve interlocked with the heat pump compressor (unless noted otherwise). On a call for heating or cooling, valve shall open to the unit and heat pump heating/cooling system shall start on a two minute delay. Selected units at the end of each piping run are not provided with two way control valves to maintain minimum flow in the system, see plans for units not requiring control valve.

B. When placed in the occupied mode by the BAS, the units shall be indexed "on". Units shall be allowed to start following a five minute delay relative to the start of the WSHP loop pumps.

C. WSHP's shall be provided with a wall mounted DDC sensor for space temperature control. While in the occupied mode the supply fan, condenser water control valve, and heat pump heating/cooling system shall cycle on upon a call for heating or cooling as required to maintain space temperature.

D. While in the unoccupied mode, the unit shall cycle as noted above to maintain setback temperatures. If activated during the unoccupied mode, the unit shall run for a minimum of 20 minutes and shall not be allowed to restart for a minimum of five minutes following shut-down.

E. A central timed override panel shall be located in the central area, to temporarily place any zone into the occupied mode. When placed in override, unit and central plant shall operate as if in the occupied mode.

F. Units provided with duct smoke detectors (see plans) shall have duct detector installed in the return duct prior to the outside air duct connection. Duct detector shall shut-down unit and activate fire alarm upon detection of smoke.

WSHP

	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic

Supply Air Temp	x								x		x
Zone Setpoint Adjust	x										x
Zone Temp	x								x		x
Smoke Detector			x						x	x	x
Fan Status (depended on number / type of fans)						x			x		x
Zone Override			x						x		x
Cooling Stage 1				x					x		x
Supply Fan Start/Stop				x					x		x
Cooling Setpoint					x				x		x
Heating Setpoint					x				x		x
Supply Fan Failure										x	

*Controls are by the unit manufacturer. EMS will monitor / control via the BACnet interface only. Red indicate monitoring points, Green are commanded points.

G.

1.10 COOLIING TOWER & BOILER SYSTEM – Buildings 6623 & 6635

A. The system shall be started by the BAS. When placed in the occupied mode, existing system pumps shall be indexed on and existing pump p-1 shall be started as the lead pump with existing pump p-2 serving as the lag pump. BAS shall alternate lead pump to maintain equal run time for existing system pumps p-1 and p-2. Lead pump shall start at low speed and then increase in speed via pump VFD as required to maintain system pressure as measured by differential pressure in loop piping. When lead pump speed reaches 90%, lag pump shall be started and both pumps shall operate at equal speed to maintain system operating pressure. As pump speeds fall below 40%, the lead pump shall be stopped and the lag pump shall continue to operate to maintain system pressure.

B. Water source heat pump (WSHP) loop temperature shall be maintained between 60° F. And 90° F. An alarm shall be activated if the loop temperature falls below 55° F. Or rises above 100° F.

C. Loop heat removal (existing cooling tower) - When the loop temperature rises above 85° F. while in the occupied mode, existing cooling tower fan shall be started at low speed (50%). When the loop temperature rises to 88° f., the existing cooling tower fan shall be increased to high speed (100%). As the loop temperature falls below 84° f., existing cooling tower fan shall be reset to low speed and shall be stopped when the loop temperature falls below 80°. F.

D. Loop heat addition (existing boiler and associated pump) - When loop temperature falls to 65° F., existing boiler and associated pump shall be started. As the loop temperature begins to rise, existing boiler and pump shall be stopped when the loop temperature rises to 76° F. Existing boiler controls shall stage boiler firing rate. BAS shall stop/start boiler operation based on loop temperature as outlined above and shall monitor boiler status, pump status, HWS and HWR temperature.

E. Unoccupied mode -_WSHP loop pumps shall remain off while in the unoccupied mode unless required to operate for a low limit or high limit setback signal from any WSHP or a timed override of the system. WSHP loop pumps shall be sequenced as outlined above when started during unoccupied periods. Cooling and heating systems shall also operate as outlined above to maintain loop water temperature anytime the loop system pumps are started during unoccupied periods. When the system is activated based on a setback condition, the start of the WSHP shall be delayed five minutes after the start of the WSHP loop pumps and loop flow has been verified.

F. Lead system pump shall operate continuously anytime the outdoor air temperature is below 28° F. Regardless of operating mode (occupied or unoccupied).

G.

Cooling Tower & Boiler System	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Loop Water Differential Pressure	x								x		x
Main Loop Water Return Temp	x								x		x
Main Loop Water Supply Temp	x								x		x
Cooling Tower Return Temp	x								x		x
Cooling Tower Supply Temp	x								x		x
Loop Water Pump 1 VFD Speed		x							x		x
Loop Water Pump 2 VFD Speed		x							x		x
Cooling Tower Status			x						x		x

Cooling Tower Fault			x						x	x	x
Loop Water Pump 1 Status			x						x		x
Loop Water Pump 1 VFD Fault			x						x	x	x
Loop Water Pump 2 Status			x						x		x
Loop Water Pump 2 VFD Fault			x						x	x	x
Cooling Tower Enable/Disable				x					x		x
Loop Water Pump 1 Start/Stop				x					x		x
Loop Water Pump 2 Start/Stop				x					x		x
Loop Water Differential Pressure Setpoint					x				x		x
Outside Air Temp					x				x		x
Cooling Tower Failure										x	x
Low Loop Water Supply Temp										x	
High Loop Water Supply Temp										x	
Loop Water Pump 1 Failure										x	
Loop Water Pump 1 Running in Hand										x	
Loop Water Pump 2 Failure										x	
Loop Water Pump 2 Running in Hand										x	
High Loop Water Differential Pressure										x	
Boiler Hot Water Return Temp	x								x		x

Boiler Hot Water Supply Temp	x								x		x
Boiler Hot Water Supply Temp Setpoint Reset		x							x		x
Boiler Alarm Status			x						x	x	x
Boiler Status			x						x		x
Circulation Pump Status			x						x		x
Boiler Enable				x					x		x
Circulation Pump Start/Stop				x					x		x
Boiler Failure										x	
Boiler High Hot Water Supply Temp										x	
Boiler Low Hot Water Sup-ply Temp										x	
Boiler Running in Hand										x	
Boiler Failure										x	
Circulation Pump Failure										x	

H.

1.11 TOILET EXHAUST RISERS

A. EF shall energize on time of day schedule from BAS. Monitor status of fans on BAS.

B.

Toilet Exhaust Riser	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Fan Status			x						x		x
Exhaust Air Damper				x					x		x
Fan Start/Stop				x					x		x

Schedule								x			
Fan Failure										x	x

C.

1.12 DUCTLESS SPLIT SYSTEMS

A. Where IDF, MDF, and data rooms are provided with both ductless split systems and VAV boxes, this sequence shall be utilized.

1. During occupied times, VAV box shall serve as the first stage of cooling, with an occupied setpoint of 70°. During unoccupied times, the VAV box shall serve as the second stage of cooling with a setpoint of 75°.

2. Ductless split systems shall perform the opposite function, as the second stage of cooling during occupied times with a setpoint of 75°. During unoccupied times, the ductless split system shall serve as the first stage of cooling with a setpoint of 70°. If space temperature rises above 78° in either the occupied or unoccupied mode, an alarm shall be sent to the central bas.

3. Ductless split system indoor unit fans shall be started and stopped with thermostat call for cooling. Upon a rise in space temperature above thermostat setpoint, unit compressor shall activate to satisfy space conditions

4.

Ductless Split Systems (Rooms with IDF, MDF and VAV boxes)

	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Space Temperature	x									x	
Start/Stop				x		x			x		x
Schedule								x			

5.

B. Elevator machine rooms and data rooms provided with only a ductless split system shall utilize this sequence.

1. Ductless split systems indoor unit fan shall be started and stopped with thermostat call for cooling. Upon a rise in space temperature above thermostat setpoint, unit compressor shall activate to satisfy space conditions. If space temperature rises above 78°, an alarm shall be sent to the central BAS. No occupied or unoccupied settings shall be used.

2.

Ductless Split Systems (Elevator machine rooms with only ductless split systems)

	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Space Temperature	x									x	

3.

1.13 UNIT HEATERS

A. Unit heaters shall be controlled by local thermostats only.

B. Upon the space temperature falling below the setpoint (60 deg (adj.)), the unit heater shall be energized and remain so until the space temperature has risen above the setpoint.

1.14 SMOKE DETECTOR OPERATION

A. When particles of combustion are detected by the duct mounted smoke detector, stop the HVACU supply fan, close the outside damper and stop the fans in all air terminal units associated with the HVACU.

B. Refer to Division 26 Fire Alarm Section for duct mounted smoke detectors.

C. Smoke detectors and sampling tubes shall be furnished by the electrical contractor for installation by the mechanical contractor. Sampling tubes shall be connected under electrical and installed under the mechanical section of this specification.

D.

Smoke Detector Operation	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Smoke Detector Status*			x						x	x	x
Smoke shutdown command						x			x	x	x

*Monitor Smoke detector status on detectors on each HVACU.

E.

1.15 FIRE ALARM INTERFACE

A. The BAS shall shut-down all air handling equipment as required by code upon contact closure by a remote fire alarm relay located adjacent to the BAS control panel. The HVAC equipment shall de-energize based on whether the dedicated smoke detector or the general alarm contact for that floor is in alarm. The equipment shall include, but not be limited to the following:

1. Central Air Handling Units.

2. Dedicated Outside Air Systems.

3. Water Source Heat Pumps.

4. Air terminal units & Fan powered boxes.

5. Toilets riser exhaust fans.

6. Janitor riser exhaust fan.

7.

Fire Alarm Interface	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
FA Remote Relay Status*			x						x	x	x
FA Remote Relay shutdown command**						x			x	x	x

*Monitor FA Remote Relay status on relays next to each HVACU control panel.

**Remote shutdown command shall shutdown equipment by floor or area based on local relay status. HVACU, terminal units and fans included.

8.

1.16 MISCELLANEOUS

A. Gas Meter

1. The controller shall monitor the gas meter for current gas consumption on a continual basis. These values shall be made available to the system at all time.

2. Alarm shall be generated as follows:

a. Meter Failure: Sensor reading indicates a loss of pulse output from the Gas Meter.

3. Peak Demand History:

a. The controller shall monitor and record the peak (high and low) demand readings from the gas meter. These readings shall be recorded on a daily, month-to-date, and year-to-date basis.

4. Usage History:

a. The controller shall monitor and record gas meter readings so as to provide a gas consumption history. KCF usage readings shall be recorded on a daily, month-to-date, and year-to-date basis.

b.

Gas Meter	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Gas Flow Rate	x										
Demand									x		x
Peak Month-to-Date									x		x
Peak Today									x		x
Peak Year-to-Date									x		x
Usage Month-to-Date									x		x
Usage Today									x		x
Usage Year-to-Date									x		x
Meter Failure										x	

c.

1.17 ELECTRICAL POWER AND LIGHTING

A. Electric Meter:

1. The controller shall monitor the electric meter for current power consumption on a continual basis as described in section 26 27 13 Electricity Metering. These values shall be made available to the system at all time.

2. Alarm shall be generated as follows:

a. Meter Failure: Sensor reading indicates a loss of pulse output from the Electric Meter.

b. Peak Demand History:

3. The controller shall monitor and record the peak (high and low) demand readings from the electric meter. These readings shall be recorded on a daily, month-to-date, and year-to-date basis.

4. Usage History:

a. The controller shall monitor and record electric meter readings so as to provide a power consumption history. KWH usage readings shall be recorded on a daily, month-to-date, and year-to-date basis.

1)

Electric Meter	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
kW Pulse	x										x
Current Demand Level					x				x		x
kW Demand									x		x
kW Peak Month-to-Date									x		x
kW Peak Today									x		x
kW Peak Year-to-Date									x		x
kWh Today									x		x
MWh Month-to-Date									x		x
MWh Year-to-Date									x		x
Meter Failure										x	

2)

Power Monitoring Interface

(BACnet interface)	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic

Apparent Power - kVA					x				x		x
Current Neutral					x				x		x
Current Phase A					x				x		x
Current Phase B					x				x		x
Current Phase C					x				x		x
Frequency					x				x		x
Power Factor					x				x		x
Real Energy - kWh					x				x		x
Real Power - kW					x				x		x
Voltage A-B					x				x		x
Voltage A-N					x				x		x
Voltage B-C					x				x		x
Voltage B-N					x				x		x
Voltage C-A					x				x		x
Voltage C-N					x				x		x

B. The BAS shall monitor and control lighting via via normally closed relays that interface in the lighting control contactors provided by the electrical contractor.

1. When the security alarm is turned on, building lighting shall give a single "flash" to alert occupants that the security alarm will engage in one minute and lighting to sweep off after alarm is enabled.

2.

Indoor Lighting	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
TLO Input			x						x		x
Lighting Output				x					x		x
Schedule								x			

Outdoor Lighting	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Lighting Output (typical for each circuit)				x					x		x

3.

C. The BAS shall monitor "normal" and "emergency" contacts on all automatic transfer switches (ATS). The ATS's will be furnished with two normally open contacts.

D.

Automatic Transfer Switch	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
ATS Normal			x						x		x

E. The BAS shall monitor and control all variable frequency drives (VFD) via BACnet interface in the drives.

F.

Variable Frequency Drive Interface

	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Start / Stop*				x					x		x
Speed*		x							x		x
Motor Current Amps					x				x		x
Motor Frequency Hertz					x				x		x

Motor Runtime					x						x
Motor Speed RPM					x				x		x
In Fault Condition						x			x	x	x
VFD Status						x			x		x

*Note: All VFDs shall have Start/Stop, Status and Speed as **hardwired** direct contact points. Other listed points shall be provided via a BACnet interface.

G. The BAS shall monitor the generator

1. NFPA 110 alarm active via generator controller.

Generator	Hardware Points				Software Points						
Point Name	AI	AO	BI	BO	AV	BV	Loop	Sched	Trend	Alarm	Show On Graphic
Generator Status			x						x		x
Generator Alarm			x						x	x	x

2.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:
   1. Condenser-water piping.
   2. Condensate-drain piping.
   3. Air-vent piping.
   4. Safety-valve-inlet and -outlet piping.

1.3 Section includes the following hydronic system specialties:Hydronic Balance ValvesACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Pressure-seal fittings.
   2. Chemical treatment.
   3. Hydronic Balance Valves

B. Qualification Data: For Installer.

C. Welding certificates.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. The producer of automatic or manual balancing fittings shall have current ISO 9001 certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Condenser Water Piping: 150 psig at 200 deg F.
   2. Condensate-Drain Piping: 150 deg F.
   3. Blowdown-Drain Piping: 200 deg F.
   4. Air-Vent Piping: 200 deg F.
   5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Copper or Bronze Pressure-Seal Fittings:
   1. Housing: Copper.
   2. O-Rings and Pipe Stops: EPDM.
   3. Tools: Manufacturer's special tools.
   4. Minimum 200-psig working-pressure rating at 250 deg F.

E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.

F. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53, 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, 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. Steel Pressure-Seal Fittings:
1. Housing: Steel.
2. O-Rings and Pipe Stop: EPDM.
3. Tools: Manufacturer's special tool.
4. Minimum 300-psig working-pressure rating at 230 deg F.

I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 CASED PIPING SYSTEM

A. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.

B. Carrier Pipe: Schedule 40, steel pipe and fittings

C. Carrier Pipe Insulation:
1. Polyurethane Foam Pipe Insulation: Rigid, cellular, high-pressure injected between carrier pipe and jacket.
a. Comply with ASTM C 591; thermal conductivity (k-value) shall not exceed 0.14 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.

D. Casing: Filament-wound, fiberglass-reinforced polyester resin
1. Joint Kit: Half-shell, pourable or split insulation, casing sleeve, and shrink-wrap sleeve.
2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe.

E. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

2.5 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. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Description:
a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg F.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
1. Description:
a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 125 psig minimum at 180 deg F.
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
1. 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.

E. Dielectric Nipples:
1. Description:
a. Standard: IAPMO PS 66.
b. Electroplated steel nipple, complying with ASTM F 1545.
c. Pressure Rating: 300 psig at 225 deg F.
d. End Connections: Male threaded or grooved.
e. Lining: Inert and noncorrosive, propylene.

2.7 BYPASS CHEMICAL FEEDER

A. Description: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.
1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

2.8 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.
5. See Automatic Flow Control Valves for wye-strainers provided as part of coil connection kits.

B. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 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. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

D. Stainless-Steel Bellow, Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

2.9 HYDRONIC BALANCE VALVES

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. IMI Flow Design, Inc
2. Bell & Gossett
3. Griswold Controls
4. Pro Hydronic Specialties

B. Automatic Flow Control Valves
1. Body: Brass or bronze Y-body, integral chrome plated brass-body ball valve, and "O" ring type union fitting.
2. Internal wear surfaces of the valve cartridge shall be 303 stainless steel.

3. The internal flow cartridge body shall have machined threads so the spring free height may be compensated for without the use of fixed shims.
4. The internal flow cartridge shall be permanently marked with a code to identify the gpm and spring range.
5. All valves 1/2" to 2" shall be factory leak tested at 100 psi air under water.
   a. Minimum Ratings:
      1) 1/2" through 2" pipe size: 400 PSIG at 250°F
      2) 2 1/2" through 14" pipe size: 600 PSIG at 250°F.
6. Flow Verification: The differential pressure across the Automatic Flow Control Valve shall be measured for verification and to deter mine the amount of system over heading (excess pressure) or under pumping.
7. Test Kit: The kit consists of a 4 1/2" gauge with three ball valves calibrated at 150 psi & 1000 kpa, two 10' hoses with shut-off valves and a pair of GA 18 std. P/T adapters.

C. Calibrated Balance (Ball Style) Valve (2 ½" – 4")
1. Body: Valve body shall be constructed out of cast iron and rated for 175 PSIG working pressure.
2. Valve shall include a ball valve constructed in brass.
3. Valve body shall include two extended pressure/temperature ports.
4. Valve body shall include a drain valve port with drain valve and hose end connection with cap.
5. Valve shall utilize a calibrated nameplate with a memory stop.
6. Valve shall utilize a reduced port design that provides velocity head recovery.
7. Valve temperature range shall be from -4°F (-20°C) to 250°F (121°C).

D. Calibrated Balance (Globe Style) Valve (4" – 12")
1. Body:
   a. Valve body shall be constructed of cast iron, rated for 175 PSIG working pressure (flanged), with ANSI Class 125# flanged connections.
   b. Valve body shall be constructed of ductile iron and rated for 300 PSIG working pressure (grooved) with grooved end connections.
2. Valve shall be a multi-turn globe style valve.
3. Valve shall include a brass disc.
4. Valve disc shall have a soft seat design made of EPDM.
5. Valve body shall include two pressure/temperature ports.
6. Valve shall utilize a calibrated nameplate with position indicator from 0 to 100% open.
7. Valve shall include a memory button to allow for positioning the valve to the appropriate set position after closing.
8. Valve temperature range shall be from -4°F (-20°C) to 250°F (121°C).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Condenser-water piping, aboveground, shall be the following:
1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

B. Condensate-Drain Piping:
1. Roof - Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

2. Inside building - Schedule 40 PVC plastic pipe and fittings and solvent-welded joints. Do not install PVC piping in return air plenums.

C. Air-Vent Piping:
1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

D. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 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 on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. 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 short 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. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "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 Section 230518 "Escutcheons for HVAC Piping."

Y. Paint (oil based) steel piping before installing.

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2and Smaller: Use dielectric nipples [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.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment" for seismic restraints.

C. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/2: Maximum span, 9 feet.
4. NPS 2: Maximum span, 10 feet.
5. NPS 2-1/2: Maximum span, 11 feet.
6. NPS 3 and Larger: Maximum span, 12 feet.

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE 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 pipe and fittings before assembly.

C. 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.

D. 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.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to "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.

H. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

I. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with ball valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 HYDRONIC BALANCE VALVE INSTALLATION

A. Installation
1. Install flow control valves on the return lines of coils as indicated on the plans. A balancing valve on supply side is not acceptable.
2. The standard ports and handles shall clear 1” thick insulation. Handle and port extensions are required for over 1” thick insulation. Do not insulate flow control valves used on heating coils.
3. Install, on the supply side of coils, a Y or a T-strainer (20 mesh) with brass blow down valve with 3/4” hose-end connection with cap. Inline (basket) strainer is not acceptable.
4. All valves shall be installed in accordance with manuafacturer’s instructions.

B. Packaging
1. All fittings needed for each individual coil shall be shipped from the factory and labeled to indicate the appropriate terminal.
2. The packages for individual terminals shall further be grouped according to individual floors or regions of the building for easy routing to the appropriate location.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 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.

C. Perform the following before operating the system:
1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:
   1. Suction Lines for Air-Conditioning Applications: 300 psig.
   2. Suction Lines for Heat-Pump Applications: 535 psig.
   3. Hot-Gas and Liquid Lines: 535 psig.

1.3 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
   1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 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.

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. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. 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. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 115-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

C. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

D. 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. Reverse-flow option (for heat-pump applications).
7. End Connections: Socket, flare, or threaded union.
8. Working Pressure Rating: 450 psig.

E. 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.

F. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
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 (for heat-pump applications).
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.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

G. 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 (for heat-pump applications).
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.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

H. Liquid Accumulators: Comply with ARI 495.
1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Liquid Lines and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install service valves for gage taps if they are not an integral part of condensing unit.

B. Install solenoid valves upstream from each expansion valve when recommended by the equipment manufacturer. Install solenoid valves in horizontal lines with coil at top.

C. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

D. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

E. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

F. Install filter dryers in liquid line between compressor and thermostatic expansion valve when recommended by the equipment manufacturer.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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 above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping adjacent to machines to allow service and maintenance.

F. Install piping free of sags and bends.

G. Select system components with pressure rating equal to or greater than system operating pressure.

H. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

I. 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 when valves or equipment requiring maintenance is concealed behind finished surfaces.

J. Install refrigerant piping in protective conduit where installed belowground.

K. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

L. Slope refrigerant piping as follows:
   1. Install horizontal suction lines with a uniform slope downward to compressor.
   2. Liquid lines may be installed level.

M. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

N. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

O. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Q. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

R. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

3.4 PIPE JOINT CONSTRUCTION

A. 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.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs.
   2. 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. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
   4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
   9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

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 and specialties. 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.
4. Commissioning agent to verify pressure testing of refrigerant piping.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:
1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

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.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Verify that compressor oil level is correct.
2. Open compressor suction and discharge valves.
3. Open refrigerant valves except bypass valves that are used for other purposes.
4. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following HVAC water-treatment systems:
   1. HVAC water-treatment chemicals.

1.3 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. 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.

C. RO: Reverse osmosis.

D. TDS: Total dissolved solids.

E. UV: Ultraviolet.

1.4 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

1.5 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
   1. Bypass feeders.
   2. Water meters.
   3. pH controllers.
   4. TDS controllers.
   5. Chemical solution tanks.
   6. Injection pumps.
   7. Chemical test equipment.
   8. Centrifugal separators.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: Power and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

B. Other Informational Submittals:
   1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
   2. Water Analysis: Illustrate water quality available at Project site.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

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.

1.9 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping, heating, hot-water piping, and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:
   1. Initial water analysis and HVAC water-treatment recommendations.
   2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
   3. Periodic field service and consultation.
   4. Customer report charts and log sheets.
   5. Laboratory technical analysis.
   6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Der-Kel Inc.
2. Aqua-Chem, Inc.; Cleaver-Brooks Div.
3. Greenway Chemical Systems & Services Company

2.2 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Water Meter:
1. AWWA C700, oscillating-piston, magnetic-drive, totalization meter.
2. Body: Bronze.
3. Minimum Working-Pressure Rating: 150 psig.
4. Maximum Pressure Loss at Design Flow: 3 psig.
5. Registration: Gallons or cubic feet.
6. End Connections: Threaded.
7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.

B. Inhibitor Injection Timers:
1. Microprocessor-based controller with LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door.
2. Programmable timers with infinite adjustment over full range, and mounted in cabinet with hand-off-auto switches and status lights.
3. Test switch.
4. Hand-off-auto switch for chemical pump.
5. Illuminated legend to indicate feed when pump is activated.
6. Programmable lockout timer with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.
7. LCD makeup totalizer to measure amount of makeup and bleed-off water from two water meter inputs.

C. Biocide Feeder Timer:
1. Microprocessor-based controller with digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door.
2. 24-hour timer with 14-day skip feature to permit activation any hour of day.
3. Precision, solid-state, bleed-off lockout timer and clock-controlled biocide pump timer. Prebleed and bleed lockout timers.
4. Solid-state alternator to enable use of two different formulations.
5. 24-hour display of time of day.
6. 14-day display of day of week.
7. Battery backup so clock is not disturbed by power outages.
8. Hand-off-auto switches for biocide pumps.
9. Biocide A and Biocide B pump running indication.

D. Chemical Solution Tanks:
1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: [30 gal.] [50 gal.] [120 gal.].

E. Chemical Solution Injection Pumps:
1. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
2. Adjustable flow rate.

3. Metal and thermoplastic construction.
4. Built-in relief valve.
5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

F. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints except ASTM A 269, Type 304, stainless steel for steam boiler injection assemblies.

G. Injection Assembly:
1. Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
2. Ball Valve: [Three] [Two]-piece, stainless steel as described in "Stainless-Steel Pipes and Fittings" Article below; and selected to fit quill.
3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
4. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

2.3 STAINLESS-STEEL PIPES AND FITTINGS

A. Stainless-Steel Tubing: Comply with ASTM A 269, Type 316.

B. Stainless-Steel Fittings: Complying with ASTM A 815/A 815M, Type 316, Grade WP-S.

C. Two-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, carbon-filled TFE seats, threaded body design with adjustable stem packing, threaded ends, and 250-psig SWP and 600-psig CWP ratings.

D. Three-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, threaded body design with adjustable stem packing, threaded ends, and 150-psig SWP and 600-psig CWP rating.

2.4 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.

2.5 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install water testing equipment on wall near water chemical application equipment.

C. Install interconnecting control wiring for chemical treatment controls and sensors.

D. Mount sensors and injectors in piping circuits.

E. Bypass Feeders: Install in closed hydronic systems and equipped with the following:
1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
2. Install water meter in makeup water supply.
3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
4. Install a full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
5. Install a swing check on inlet after the isolation valve.

F. Install automatic chemical-feed equipment for condenser water and include the following:
1. Install makeup water softener.
2. Install water meter in makeup water supply.
3. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.
    a. Pumps shall operate for timed interval on contact closure at water meter in makeup water supply connection. Injection pump shall discharge into boiler feed water tank or feed water supply connection at boiler.
4. Install test equipment and provide test-kit to Owner. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
5. Install TDS controller with sensor and bleed valves.
    a. Bleed valves shall cycle to maintain maximum TDS concentration.
6. Install pH sensor and controller with injection pumps and solution tanks.
    a. Injector pumps shall operate to maintain required pH.
7. Install biocide feeder alternating timer with two sets of injection pumps and solution tanks.
    a. Injection pumps shall operate to feed biocide on an alternating basis.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Section 232113 "Hydronic Piping."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 230523 "General-Duty Valves for HVAC Piping."

E. Refer to Section 221119 "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.

F. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.

G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.
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. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. 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 test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.
9. Submit all field tests for lab testing of Legionella Disease. Provide final report to CMS.

D. Remove and replace malfunctioning units and retest as specified above.

E. Comply with ASTM D 3370 and with the following standards:
1. Silica: ASTM D 859.
2. Steam System: ASTM D 1066.
3. Acidity and Alkalinity: ASTM D 1067.
4. Iron: ASTM D 1068.

5. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Section 017900 "Demonstration and Training."

B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

END OF SECTION

SECTION 232923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFC: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.
   1. Include dimensions and finishes for VFCs.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.
   1. Include mounting and attachment details.
   2. Include details of equipment 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.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which, the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Required working clearances and required area above and around VFCs.
   2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
   3. Show support locations, type of support, and weight on each support.
   4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Seismic Qualification Certificates: For each VFC, accessories, and components, from manufacturer.
   1. Certificate of compliance.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each VFC from manufacturer.

E. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 01 78 24 "Operation and Maintenance Data," include the following:
      a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
      b. Manufacturer's written instructions for setting field-adjustable overload relays.
      c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
      d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
      e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
      f. 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.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Power Fuses: Equal to [10] percent of quantity installed for each size and type, but no fewer than [three] of each size and type.
   2. Control Power Fuses: Equal to [10] percent of quantity installed for each size and type, but no fewer than [two] of each size and type.
   3. Indicating Lights: [Two] of each type and color installed.
   4. Auxiliary Contacts: Furnish [one] spare(s) for each size and type of magnetic controller installed.
   5. Power Contacts: Furnish [three] spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
   2. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems."
   3. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.
   4. Comply with NFPA 70, "National Electrical Code."
   5. Comply with NECA 230, "Standard for Selecting, Installing, and Maintaining Electric Motors and Motor Controllers."
   6. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Mitsubishi Electric.
   2. Allen Bradley
   3. Yaskawa Electric America, Inc.

B. All VFD's in a project shall be by the same manufacturer. This shall include all pumps and air handler fans, where indicated on the plans.

2.2 SYSTEM DESCRIPTION

A. General Requirements for VFCs:
1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.

B. Application: Constant torque and/or variable torque.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
4. Short-circuit current (withstand) rating (SCCR) shall exceed available fault-current rating at the point of connection.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to [60 Hz, with voltage proportional to frequency throughout voltage range]; maximum voltage equals input voltage.

F. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Short-Circuit Current (Withstand) Rating shall exceed available fault-current rating at the point of connection..
7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
8. Humidity Rating: Less than 95 percent (noncondensing).
9. Altitude Rating: Not exceeding 3300 feet.
10. Vibration Withstand: Comply with NEMA ICS 61800-2.
11. Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.

12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus/minus 5 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, 16 bit, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
1. Signal: Electrical.

I. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:
1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 fourth edition SPD, Type 2.
2. Surge Suppression: Field-mounted surge suppressors complying with Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
4. Under- and overvoltage trips.
5. Inverter overcurrent trips.
6. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
7. Critical frequency rejection, with three selectable, adjustable deadbands.
8. Instantaneous line-to-line and line-to-ground overcurrent trips.
9. Loss-of-phase protection.
10. Reverse-phase protection.
11. Short-circuit protection.
12. Motor-overtemperature fault.
13. Each AC drive shall have single phase and over and under voltage protection of the drive and bypass system to ensure continued operation after utility power failures. Drive protection module shall be Allen Bradley 813S-V3-480V Ser B or pre-approved equal by CMS. Protection modules shall monitor incoming 480V-3 phase and shall interrupt the 120V control circuit. Modules shall be installed inside drive cabinets.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Integral Input Disconnecting Means and OCPD: [UL 489, instantaneous-trip circuit breaker] [UL 489, molded-case switch, with power fuse block and current-limiting fuses] [UL 489, thermal-magnetic circuit breaker] [NEMA KS 1, nonfusible switch, with power fuse block and current-limiting fuses] [NEMA KS 1, fusible switch] with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
5. NC alarm contact that operates only when circuit breaker has tripped.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.

2.4 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:
1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last [four] faults with time and date stamp for each.

D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
   1. Output frequency (Hz).
   2. Motor speed (rpm).
   3. Motor status (running, stop, fault).
   4. Motor current (amperes).
   5. Motor torque (percent).
   6. Fault or alarming status (code).
   7. PID feedback signal (percent).
   8. DC-link voltage (V dc).
   9. Set point frequency (Hz).
   10. Motor output voltage (V ac).

E. Control Signal Interfaces:
   1. Electric Input Signal Interface:
      a. A minimum of two programmable analog inputs: [0- to 10-V dc] [4- to 20-mA dc] [Operator-selectable "x"- to "y"-mA dc].
      b. A minimum of six multifunction programmable digital inputs.
   2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:
      a. 0- to 10-V dc.
      b. 4- to 20-mA dc.
      c. Potentiometer using up/down digital inputs.
      d. Fixed frequencies using digital inputs.
   3. Output Signal Interface: A minimum of [one] programmable analog output signal(s) ([0- to 10-V dc] [4- to 20-mA dc] [operator-selectable "x"- to "y"-mA dc]), which can be configured for any of the following:
      a. Output frequency (Hz).
      b. Output current (load).
      c. DC-link voltage (V dc).
      d. Motor torque (percent).
      e. Motor speed (rpm).
      f. Set point frequency (Hz).
   4. Remote Indication Interface: A minimum of [two] programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
      a. Motor running.
      b. Set point speed reached.
      c. Fault and warning indication (overtemperature or overcurrent).
      d. PID high- or low-speed limits reached.

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
   1. Number of Loops: Two.

G. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.
   1. Hardwired Points:
      a. Monitoring: On-off status, <Insert monitoring point>.
      b. Control: On-off operation, <Insert control point>.
   2. Communication Interface: Comply with [ASHRAE 135]. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.5 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.

B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for [Category C2].

2.6 BYPASS SYSTEMS

A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

B. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic-control system feedback.

C. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
   1. Bypass Contactor: Load-break, NEMA-rated contactor.
   2. Output Isolating Contactor: Non-load-break, NEMA-rated contactor.
   3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

D. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller[; with input isolating switch and barrier] arranged to isolate the power converter input and output and permit safe testing[and troubleshooting] of the power converter, both energized and de-energized, while motor is operating in bypass mode.
   1. Bypass Contactor: Load-break, NEMA-rated contactor.
   2. Input and Output Isolating Contactors: Non-load-break, NEMA-rated contactors.
   3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and

de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

E. Bypass Contactor Configuration: [Full-voltage (across-the-line)] [Reduced-voltage (autotransformer)] type.
   1. NORMAL/BYPASS selector switch.
   2. HAND/OFF/AUTO selector switch.
   3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
   4. Contactor Coils: Pressure-encapsulated typewith coil transient suppressors.
      a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
      b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
   5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with control power source of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
      a. CPT Spare Capacity: 100 VA.
   6. Overload Relays: NEMA ICS 2.
      a. Melting-Alloy Overload Relays:
         1) Inverse-time-current characteristic.
         2) Class 10 tripping characteristic.
         3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
      b. Bimetallic Overload Relays:
         1) Inverse-time-current characteristic.
         2) Class 10tripping characteristic.
         3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
         4) Ambient compensated.
         5) Automatic resetting.
      c. Solid-State Overload Relays:
         1) Switch or dial selectable for motor-running overload protection.
         2) Sensors in each phase.
         3) Class 10tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
         4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
         5) Analog communication module.
      d. NC isolated overload alarm contact.
      e. External overload, reset push button.

2.7 OPTIONAL FEATURES

A. Damper control circuit with end-of-travel feedback capability.

B. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.

C. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.

D. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from [the firefighter's control station] [smoke-control fan controller] <Insert location>, this password-protected input:
   1. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).
   2. Forces VFC to transfer to bypass mode and operate motor at full speed.
   3. Causes display of override mode on the VFC display.
   4. Reset VFC to normal operation on removal of override signal [automatically] [manually].

E. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

F. Remote digital operator kit.

G. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer[and a notebook computer].

2.8 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
   1. Dry and Clean Indoor Locations: Type 1.
   2. Outdoor Locations: Type 4X.
   3. Kitchen and Wash-Down Areas: Type 4X, stainless steel.
   4. Other Wet or Damp Indoor Locations: Type 4.
   5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.9 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
   1. Push Buttons: Covered.
   2. Pilot Lights: Push to test.
   3. Selector Switches: Rotary type.
   4. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

B. NC bypass contactor 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.
   1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

E. Supplemental Digital Meters:
   1. Elapsed-time meter.
   2. Kilowatt meter.
   3. Kilowatt-hour meter.

F. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

H. Cooling Fan and Exhaust System: For NEMA 250, Type 12; UL 508 component recognized: Supply fan, with stainless-steel intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

I. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

J. Spare control-wiring terminal blocks; wired.

2.10 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in [NEMA ICS 61800-2] <Insert standard>.
   1. Test each VFC while connected to [its specified motor] [a motor that is comparable to that for which the VFC is rated].
   2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems."

B. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
   1. 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.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
   1. Curbs and roof penetrations are specified in Section 07 72 00 "Roof Accessories."
   2. Structural-steel channels are specified in Section 26 05 29 "Hangers and Supports for Electrical Systems."

D. Seismic Bracing: Comply with requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

F. Install fuses in each fusible-switch VFC.

G. Install fuses in control circuits if not factory installed. Comply with requirements in Section 26 28 13 "Fuses."

H. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

I. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

J. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 26 05 23 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control devices where applicable.
   1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
   2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each VFC with engraved nameplate.
   3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Acceptance Testing Preparation:
   1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

E. Tests and Inspections:
   1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
   2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
   3. Test continuity of each circuit.
   4. Verify that voltages at VFC locations are within 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 tests according to the Inspection and Test Procedures for Adjustable Speed Drives 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. Perform the following infrared (thermographic) 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 VFC. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
    c. 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.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify [Architect] [Construction Manager] [Owner] before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

F. Set field-adjustable pressure switches.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

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

END OF SECTION

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:
1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

B. All ductwork installation including hangers, supports, access doors, etc. shall be in accordance with the latest recommendations of the ASHRAE Guide, the SMACNA Medium Pressure Duct Construction Standards, SMACNA Low Pressure Duct Construction Standards, and with details on the Drawings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:
1. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
2. Fittings.

3. Seam and joint construction.
4. Penetrations through fire-rated and other partitions.
5. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
6. Hangers and supports, including methods for duct and building attachment [seismic restraints,] and vibration isolation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Round medium pressure ductwork and fittings shall be fabricated by a company who has had as its principal business the manufacture of medium pressure duct and fittings for at least three years.

B. All sheet metal work shall be performed by trained mechanics, experienced in this type of work and shall be installed in a neat workmanlike and substantial manner.

C. All duct joints sealing compounds, glues, mastics, and adhesives used on duct construction shall be "Fire Safe" and be "U.L." approved and labeled.

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" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 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."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 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."

2.2 SINGLE-WALL ROUND[AND FLAT-OVAL] DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Lindab Inc.
      b. McGill AirFlow LLC.
      c. SEMCO Incorporated.
      d. Sheet Metal Connectors, Inc.
      e. Spiral Manufacturing Co., Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse 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."

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round 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."
   1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
   2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree 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."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G90.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

D. 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.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. 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.

2.4 DUCT LINER

A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
   1. Manufacturers:
      a. CertainTeed Corp.; Insulation Group.
      b. Johns Manville International, Inc.
      c. Knauf Fiber Glass GmbH.
      d. Owens Corning.
   2. Materials: ASTM C 1071; surfaces exposed to air stream shall be coated to prevent erosion of glass fibers.
      a. Thickness: 1.5 inch or as indicated on the drawings.
      b. Density: Minimum 1.5 PCF.
      c. Thermal Conductivity (R-Value): Min R-5.0 at 1.5” thick.
      d. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
      e. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
      f. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
         1) Tensile Strength: Indefinitely sustain a 50-lb tensile, dead-load test perpendicular to duct wall.
         2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
         3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
      g. Acoustical performance: Min 0.49 sound absorption coefficient at 500 Hz as tested in accordance with ASTM C423 Mounting A.

B. 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. 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.
7. 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.
8. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
9. 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.

2.5 FLEXIBLE DUCTWORK

A. Insulated Flexible Duct:
    1. Product and Manufacturer – Basis of Design: Genflex, Type IGE-3.
        a. Working Pressure: Rated to 15 inch.
        b. Liner: UL-181 Class 1 Air Duct Material; liner shall be as described for type GE-3 encapsulating a spring steel helix. The liner shall completely shield the nominal 1 inch by 1 lb. per cu. ft. fiberglass insulation from the air stream. A tough seamless non-vinyl exterior vapor barrier jacket shall complete the assembly.

B. Ductwork shall be a maximum of 5 foot long and shall be provided with a flame-resistant PVC vapor barrier and 1 inch thick, 3/4 inch density fiberglass insulation.

C. Ductwork shall comply with NFPA Bulletin 90A and be listed as a Class I connector per UL Standard 181.

2.6 Retain or remove paragraphs below based on which methods of duct sealant are to be included. Some or all paragraphs may remain.

2.7 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
    1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
    2. Tape Width: [3 inches] [4 inches] [6 inches].
    3. Sealant: Modified styrene acrylic.

4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant 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."

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.

D. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Sealant 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."
11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. 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. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealant 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."

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. 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.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. 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.

2.9 Coordinate the section below with the structural engineer to determine if this section is necessary and what should be included.

2.10 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.
6. Mason Industries.

7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by [an evaluation service member of the ICC Evaluation Service] [the Office of Statewide Health Planning and Development for the State of California] [an agency acceptable to authorities having jurisdiction].
   1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: [ASTM A 603, galvanized] [ASTM A 492, stainless]-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: [Steel tube or steel slotted-support-system sleeve with internally bolted connections] [Reinforcing steel angle clamped] to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Refer to SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems".

3.2 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.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
   1. Outdoor, Supply-Air Ducts: Seal Class A.
   2. Outdoor, Exhaust Ducts: Seal Class C.
   3. Outdoor, Return-Air Ducts: Seal Class C.
   4. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.

5. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
6. Unconditioned Space, Exhaust Ducts: Seal Class C.
7. Unconditioned Space, Return-Air Ducts: Seal Class B.
8. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
10. Conditioned Space, Exhaust Ducts: Seal Class B.
11. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 If duct hangar supports are scheduled or detailed on plans, omit this next section.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," 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.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

E. 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 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

B. Exposed duct shall be prepared for painting.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:
a. All medium pressure supply mains from built-up Air Handling Units to the terminal box connections.
b. All concealed low pressure supply mains from built up Air Handing Units.
c. Low pressure supply ducts (single zone units and supply ductwork downstream of terminal boxes): Test representative duct sections**,** totaling no less than 10 percent of total installed duct area for each designated pressure class.
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. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
1. Duct systems shall only be cleaned if observed to be dirty.

B. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

C. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.11 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.12 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
   1. Dishwasher and Kitchen Hood Exhaust.

B. Supply Ducts:
   1. Ducts Connected downstream of Terminal Units and other low-pressure conditions:
      a. Pressure Class: Positive 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
      d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.
   2. Ducts Connected to Constant-Volume Air-Handling Units:
      a. Pressure Class: Positive 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
      d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.
   3. Ducts Connected to Variable-Air-Volume Air-Handling Units :
      a. Pressure Class: Positive 3-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
      d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.
   4. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
      d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.

C. Return Ducts:
   1. Ducts Connected to all equipment:
      a. Pressure Class: Positive or negative 2-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
      d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.

D. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 2-inch wg.

b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.

2. Ducts Connected to VAV Air-Handling Units:
   a. Pressure Class: Negative 3-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
   d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.
3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
   a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
   b. Concealed: Carbon-steel sheet.
   c. Welded seams and joints.
   d. Pressure Class: Positive or negative 3-inch wg.
   e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
   f. SMACNA Leakage Class: Per current SMACNA standards based on specified pressure class.
4. Ducts Connected to Dishwasher Hoods:
   a. Type 304, stainless-steel sheet.
   b. Exposed to View: No. 4 finish.
   c. Concealed: No. 2D finish.
   d. Welded seams and flanged joints with watertight EPDM gaskets.
   e. Pressure Class: Positive or negative 2-inch wg.
   f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
   g. SMACNA Leakage Class: Per current SMACNA standards based on specified pressure class.
5. Ducts Connected to Equipment Not Listed Above:
   a. Pressure Class: Positive or negative 3-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
   d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to all equipment:
   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: Per current SMACNA standards based on specified pressure class.
   d. SMACNA Leakage Class for Round and Flat Oval: Per current SMACNA standards based on specified pressure class.

F. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts:
   a. Exposed to Airstream: Match duct material.
   b. Not Exposed to Airstream: Match duct material.
3. Aluminum Ducts: Aluminum.

G. Liner:
1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
2. Return Air Ducts: Fibrous glass, Type I,1 inch thick.
3. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

H. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Velocity 1000 fpm or Lower:
      1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      2) Mitered Type RE 4 with vanes.
   b. Velocity 1000 to 1500 fpm:
      1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
   c. Velocity 1500 fpm or Higher:
      1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to Diameter Ratio: 1.5.
   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

I. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.

b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Barometric relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Combination fire and smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Flexible connectors.
9. Flexible ducts.
10. Duct accessory hardware.

B. Related Requirements:
1. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.
3. Section 283112 "Zoned (DC-Loop) Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.
1. -

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

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 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.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

C. 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.

2.3 BAROMETRIC RELIEF DAMPERS

A. Suitable for horizontal or vertical mounting.

B. Maximum Air Velocity: 2500 fpm

C. Maximum System Pressure: 3-inch wg

D. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel

E. Blades:
1. Multiple, 0.025-inch-thick, roll-formed aluminum
2. Maximum Width: 6 inches.
3. Action: Parallel.

4. Balance: Gravity.

F. Blade Seals: Neoprene

G. Tie Bars and Brackets:
1. Material: Galvanized steel.
2. Rattle free with 90-degree stop.

H. Return Spring: Adjustable tension.

I. Bearings: Stainless steel.

J. Accessories:
1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

2.4 MANUAL VOLUME DAMPERS

A. Low-Leakage, Steel, Manual Volume Dampers:
1. Comply with AMCA 500-D testing for damper rating.
2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.
4. Frames:
   a. Hat shaped.
   b. 0.094-inch-thick, galvanized sheet steel
   c. Mitered and welded corners.
   d. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Tiffen damper blades for stability.
   d. Galvanized, roll-formed steel, 0.064 inch thick.
6. Blade Axles: Galvanized steel
7. Bearings:
   a. Molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Blade Seals: Vinyl.
9. Jamb Seals: Cambered stainless steel.
10. Tie Bars and Brackets: Galvanized steel.
11. Provide locking quadrants with insulation standoffs
12. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

2.5 CONTROL DAMPERS

A. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

B. Frames:

1. Hat shaped.
2. Galvanized-steel channels, 0.064 inch thick.
3. Mitered and welded corners.

C. Blades:
1. Multiple blade with maximum blade width of 8 inches, airfoil design.
2. Opposed-blade design.
3. Galvanized steel.
4. 14-gauge thickness.
5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.

E. Bearings:
1. Stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.6 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Ruskin Company.

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 20-gauge galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links (unless noted otherwise).

2.7 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

F. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links (unless noted otherwise).

G. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

H. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Leakage: Class I.

J. Rated pressure and velocity to exceed design airflow conditions.

K. Mounting Sleeve: Factory-installed, 20-gauge thickness, galvanized sheet steel; length to suit wall or floor application.

L. Master control panel for use in dynamic smoke-management systems.

M. Damper Motors: Modulating or two-position action.

N. 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 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 23 Section "Instrumentation and Control for HVAC." and Division 26 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 where indicated. 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 minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 120V or 24V as noted on the drawings.

O. Accessories: (as indicated on the drawings)
1. Auxiliary switches for position indication.
2. Momentary test switch, damper mounted.

2.8 FLANGE CONNECTORS

A. Description: Add-on, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

B. Material: Galvanized steel.

C. Gage and Shape: Match connecting ductwork.

2.9 TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and closed fill.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

C. Vane Construction: Single wall for ducts up to 30 inches wide and double wall for larger dimensions.

2.10 REMOTE DAMPER OPERATORS

A. Description: Cable system designed for remote manual damper adjustment.

B. Tubing: Brass.

C. Cable: Stainless steel.

D. Wall-Box Mounting: Recessed.

E. Wall-Box Cover-Plate Material: Stainless steel.

2.11 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
a. Double wall, rectangular.

b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches 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.
   d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

B. Pressure Relief Access Door:
1. Door and Frame Material: Galvanized sheet steel.
2. Door: Single wall, 12-gauge.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.

Retain first subparagraph below if pressure is not indicated on Drawings.

4. Factory set at 2” to 10” for positive pressure and -4” to -10” for negative pressure.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.12 DUCT ACCESS PANEL ASSEMBLIES

A. Labeled according to UL 1978 by an NRTL.

B. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.

C. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

D. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

E. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.13 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

D. 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.

E. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor 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.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.14 FLEXIBLE DUCTS

A. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or nylon strap in sizes 3 through 18 inches, to suit duct size.

2.15 DUCT ACCESSORY HARDWARE

A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 Designer Note: Remove paragraphs for accessories not included in sections above.

3.2 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install [backdraft] [control] dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install fire and smoke dampers according to UL listing.

G. Install duct security bars. Construct duct security bars from 0.164-inchsteel sleeve, continuously welded at all joints and 1/2-inch-diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.

H. Connect ducts to duct silencers rigidly.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. On both sides of duct coils.
   2. Upstream [and downstream] from duct filters.
   3. At outdoor-air intakes and mixed-air plenums.
   4. At drain pans and seals.
   5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
   6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
   7. Control devices requiring inspection.
   8. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.
   3. Head and Hand Access: 18 by 10 inches.
   4. Head and Shoulders Access: 21 by 14 inches.
   5. Body Access: 25 by 14 inches.
   6. Body plus Ladder Access: 25 by 17 inches.

L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Connect terminal units to supply ducts with maximum [12-inch] lengths of flexible duct. Do not use flexible ducts to change directions.

P. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

Q. Connect flexible ducts to metal ducts with [adhesive] [liquid adhesive plus tape] [draw bands] [adhesive plus sheet metal screws].

R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Centrifugal roof ventilators.
2. Ceiling-mounted ventilators.
3. In-line centrifugal fans.
4. Propeller fans

1.3 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Twin City.
2. Loren Cook Company.
3. Greenheck.

1.4 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. 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.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 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 restaurant kitchen exhaust shall also comply with UL 762.

1.8 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Housing: Removable, spun-aluminum, dome top and outlet baffle; 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 and grease collector.
   2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

B. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

C. Belt Drives:
   1. Resiliently mounted to housing.
   2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
   4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
   5. Fan and motor isolated from exhaust airstream.

D. Accessories:
   1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
   2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
   3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
   4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
   5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

E. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
   1. Configuration: Self-flashing without a cant strip, with mounting flange
   2. Overall Height: 12 inches
   3. Sound Curb: Curb with sound-absorbing insulation.
   4. Pitch Mounting: Manufacture curb for roof slope.
   5. Metal Liner: Galvanized steel.
   6. Burglar Bars: 1/2-inch-thick steel bars welded in place to form 6-inch squares.
   7. Mounting Pedestal: Galvanized steel with removable access panel.
   8. Vented Curb: Unlined with louvered vents in vertical sides.

2.2 CEILING-MOUNTED VENTILATORS

A. Housing: Steel, lined with acoustical insulation.

B. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

C. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

D. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

E. Accessories:
   1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
   2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
   3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
   4. Motion Sensor: Motion detector with adjustable shutoff timer.
   5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
   6. Filter: Washable aluminum to fit between fan and grille.
   7. Isolation: Rubber-in-shear vibration isolators.
   8. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.3 IN-LINE CENTRIFUGAL FANS

A. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

B. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

C. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

D. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

E. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.4 PROPELLER FANS

A. Description: Direct- or belt-driven propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly, and accessories.

B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.

C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

D. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
1. Service Factor Based on Fan Motor Size: 1.4.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
   a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 100,000 hours.
4. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
5. Motor Pulleys: Adjustable pitch for use with motors through 10 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
6. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
7. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

F. Accessories: (See drawings for required accessories).
1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
3. Wall housing: Galvanized steel to match fan and accessory size.
4. Weathershield Hood: Galvanized steel to match fan and accessory size.
5. Weathershield Front Guard: Galvanized steel with expanded metal screen.
6. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
7. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.5 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC 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.

B. Enclosure Type: Totally enclosed, fan cooled.

2.6 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

D. Support suspended units from structure using threaded steel rods and spring hangers > having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 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 on mountings and supporting devices and that 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. 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 and adjust belts, and install belt guards.
   5. Adjust belt tension.
   6. Adjust damper linkages for proper damper operation.
   7. Verify lubrication for bearings and other moving parts.
   8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
   9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and 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.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Variable Air Volume units.
2. Fan-Powered Air Terminal Units

1.3 ACTION 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.
4. Seismic-restraint devices.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.5 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.6 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Krueger.
2. Nailor Industries Inc.
3. Price Industries.
4. Titus.
5. Trane; a business of American Standard Companies.
~~6. Carrier.~~
7. York.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 Structural Performance: Hangers and 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" and ASCE/SEI 7. 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.

2.3 VARIABLE AIR VOLUME UNITS

A. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

B. Casing: 0.034-inch steel, single wall.
1. Casing Lining: Adhesive attached, 1-inch-thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
a. Cover liner with nonporous foil.
2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from 0 to 140 deg F, shall be impervious to moisture and fungus, shall be suitable for 10-inch wg static pressure, and shall be factory tested for leaks.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at [3-inch wg] inlet static pressure.
2. Damper Position: Normally open.

E. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

F. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor. Control devices shall be compatible with temperature controls specified in Section 230900 "Instrumentation and Control for HVAC" and shall have the following features:
1. Provide control voltage transformers as required for box operation.
2. Damper Actuator: Belimo, 24 V, powered closed, powered open.
3. Terminal Unit Controller: Provided by the controls contractor and shall be the same brand as the controls contractor, pressure-independent, variable-air-volume controller with

electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
a. Occupied and unoccupied operating mode.
b. Remote reset of airflow or temperature set points.
c. Adjusting and monitoring with portable terminal.
d. Communication with temperature-control system specified in Section 230900 "Instrumentation and Control for HVAC."

4. Room Sensor: Wall mounted; see controls specifications for room sensor.

2.4 FAN-POWERED AIR TERMINAL UNITS

A. Configuration: Volume-damper assembly and fan in series or in parallel arrangement, as indicated on Drawings, inside unit casing with control components inside a protective metal shroud.

B. Casing: 22-gauge steel.
1. Casing Lining: 1-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive. Cover liner with nonporous foil.
2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.

D. Fan Section: Galvanized-steel plenum, with direct-drive, forward-curved fan with air filter and backdraft damper.
1. Motor: PSC as specified on the terminal unit schedule. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
a. Speed Control: Infinitely adjustable with pneumatic-electric and electronic controls.
b. Fan-Motor Assembly Isolation: Rubber isolators.
2. Air Filter: 1-inch- thick, fiberglass throwaway, MERV 6 according to ASHRAE 52.2.

E. Electric Heating Coil: Slip-in-type, open-coil design with integral control box factory wired and installed. Include the following features:
1. Primary and secondary overtemperature protection.
2. Nickel chrome 80/20 heating elements.
3. Fan interlock contacts.
4. Noninterlocking disconnect switch.
5. Fuses (for coils more than 48 A).
6. Magnetic contactor for each step of control (for three-phase coils).

F. Factory-Mounted and -Wired Controls: Electrical components shall be mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.

2. Wiring Terminations: Fan and controls to terminal strip, and terminal lugs shall match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
3. Disconnect Switch: Factory-mounted, fused type.

G. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

H. DDC Controls: Single-package unitary controller and actuator specified in Division 23 Section " Instrumentation and Control for HVAC."
1. DDC controls shall be furnished by the controls vendor and shipped to the terminal unit manufacturer for factory mounting.
2. DDC controller shall be supplied by the BAS contractor to be factory mounted by the terminal box manufacturer.

I. Control Sequence: See Sequence of Operation.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. 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.

2.6 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to ARI 880.
1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

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.

C. Install wall-mounted thermostats.

D. Control valves for the hot water coils shall be located on the same side of the box as the VAV controller.

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 more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches 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 Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," 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 Section 233113 "Metal Ducts."

D. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. 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.

E. Air terminal unit will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
   3. Verify that controls and control enclosure are accessible.
   4. Verify that control connections are complete.
   5. Verify that nameplate and identification tag are visible.
   6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

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

END OF SECTION

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ceiling and wall-mounted diffusers, registers, and grilles.

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 and drop, static-pressure drop and noise ratings.
   2. Diffuser, Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size and accessories furnished.
   3. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
      a. Size and location of initial access modules for acoustical tile.
      b. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

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. Products: Subject to compliance with requirements, provide one of the products specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DIFFUSERS, REGISTERS AND GRILLES

A. Provide as scheduled on the drawings.
   1. Manufacturers:
      a. Krueger.
      b. Nailor Industries of Texas Inc.
      c. Price Industries.
      d. Titus.
      e. Metalaire.
   2. All air devices shall be provided by the same manufacturer.

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."

2.4 DIFFUSERS

A. Square Ceiling Diffusers:

1. Construction:
    a. Material: Aluminum.
    b. Finish: Baked enamel.
    c. Face Size: As indicated on the Drawings.
    d. Face Style: As indicated on the Drawings.
    e. Mounting: T-bar lay-in for suspended ceiling systems; provide ceiling frame for gypsum board ceilings.
    f. Pattern: Adjustable.
    g. Damper Type: Adjustable opposed blade operable from face of register.
    h. Accessories:
        1) Equalizing grid.
        2) Square to round transition.

2.5 REGISTERS AND GRILLES

A. Registers:
1. Construction:
    a. Material: Aluminum.
    b. Finish: Baked enamel.
    c. Face Blade Arrangement: Vertical.
    d. Core Construction: Removable.
    e. Mounting: Countersunk screw.
    f. Damper Type: Adjustable opposed blade operable from face of register.
    g. Accessories:
        1) Equalizing grid.

B. Grilles:
1. Construction:
    a. Material: Aluminum.
    b. Finish: Baked enamel.
    c. Core Construction: Removable.
    d. Mounting: Countersunk screw.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers, registers and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 233723 - HVAC GRAVITY VENTILATORS

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 types of roof-mounting intake and relief ventilators:
   1. Louver penthouses.
   2. Roof hoods.
   3. Goosenecks.

B. Related Sections include the following:
   1. Division 08 Section "Louvers and Vents" for ventilator assemblies provided as part of the general construction.
   2. Division 23 Section "HVAC Power Ventilators" for roof-mounting exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Intake and relief ventilators shall be capable of withstanding the effects of gravity loads, wind loads, seismic loads (if required), and thermal movements without permanent deformation of components, noise or metal fatigue, or permanent damage to fasteners and anchors.

B. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1-2007.

1.4 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acme Corp.
   2. Greenheck
   3. Loren Cook Co.
   4. Penn Ventilation
   5. Ruskin
   6.

B. Listing of manufacturers name does not guarantee approval. All equipment must meet or exceed quality and capacities of specified equipment. Final approval will be based on equipment submittals. Any manufacturer not listed but wishing to bid this project shall submit a written request 14 days prior to bid date, prior approval is required for all manufacturers not listed.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For intake and relief ventilators. Include details and ventilator attachments to curbs and curb attachments to roof structure.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain ventilators through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of intake and relief ventilators and are based on the specific equipment indicated. Refer to Division 01 Section "Product Requirements."
1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

C. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.2, "Structural Welding Code--Aluminum."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.7 COORDINATION

A. Coordinate installation of roof curbs and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
1. Use types and sizes to suit unit installation conditions.
2. Use hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.

E. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry,

as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187, when noted on the drawings.

2.2 FABRICATION, GENERAL

A. Factory or shop fabricate intake and relief ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.3 LOUVER PENTHOUSES

A. Construction: All-welded assembly with 4-inch-deep louvers, mitered corners, and aluminum sheet roof.

B. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, of thickness required to comply with structural performance requirements, but not less than 0.052 inch for frames and 0.052 inch for blades.
1. Blade Spacing: 4”.
2. Blade Angle: 45 degrees.
3. Air Performance: Not more than 0.10-inch wg static pressure drop at 750-fpm free-area velocity.
4. AMCA Seal: Mark units with the AMCA Certified Ratings Seal.
5. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.

C. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 12 inches unless noted otherwise.

D. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

E. Galvanized-Steel Sheet Finish:
1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.

2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
    a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.4 ROOF HOODS

A. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.

B. Materials: Galvanized-steel sheet, minimum 0.064-inch- thick base and 0.040-inch- thick hood; suitably reinforced.

C. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 12 inches unless noted otherwise.

D. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

E. Galvanized-Steel Sheet Finish:
1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
    a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.5 GOOSENECKS

A. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 5-5; with a minimum of 0.052-inch- thick, galvanized-steel sheet.

B. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 12 inches.

C. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

D. Galvanized-Steel Sheet Finish:

1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
   a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install intake and relief ventilators level, plumb, and at indicated alignment with adjacent work.

B. Secure intake and relief ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

C. Install goosenecks on curb base where throat size exceeds 9 by 9 inches.

D. Install intake and relief ventilators with clearances for service and maintenance.

E. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

F. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section "Joint Sealants" for sealants applied during installation.

G. Label intake and relief ventilators according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

H. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

I. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION

SECTION 237200 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Packaged energy recovery units.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Air-to-air energy recovery equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For air-to-air energy recovery equipment. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fan Belts: One set(s) of belts for each belt-driven fan in energy recovery units.

2. Wheel Belts: One set(s) of belts for each heat wheel.

1.8 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. ARI Compliance:
1. Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."
2. Capacity ratings for air coils shall comply with ARI 410, "Forced-Circulation Air- Cooling and Air-Heating Coils."

C. ASHRAE Compliance:
1. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

D. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

E. UL Compliance:
1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."
2. Electric coils shall comply with requirements in UL 1995, "Heating and Cooling Equipment."

1.9 COORDINATION

A. Coordinate layout and installation of air-to-air energy recovery equipment 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 concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Packaged Energy Recovery Units: Five years.

PART 2 - PRODUCTS

2.1 PACKAGED ENERGY RECOVERY UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Munters.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. SEMCO Incorporated.
5. Trane; American Standard Companies, Inc.
6. Venmar CES Inc.
7. Aaon.

B. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, gasketed and calked weathertight, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 1-inch-thick thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.
1. Inlet: Weatherproof hood, with damper for exhaust and supply.
a. Exhaust: Spring-return, two-position, motor-operated damper.
b. Supply: Spring-return, two-position, motor-operated damper.
2. Roof Curb: Refer to Section 077200 "Roof Accessories" for roof curbs and equipment supports.

D. Heat Recovery Device: Heat wheel.

E. Supply and Exhaust Fans: Forward-curved, centrifugal fan with spring isolators and insulated flexible duct connections.
1. Motor and Drive: Drive type indicated on Drawings.
2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
3. 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.
4. Spring isolators on each fan having 1-inch static deflection.

F. Disposable Panel Filters:
1. Comply with NFPA 90A.
2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
3. Factory-fabricated, viscous-coated, flat-panel type.
4. Thickness: 1 inch.
5. Minimum Merv: 8, according to ASHRAE 52.2.
6. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
7. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

G. Accessories:
1. Roof Curb: Galvanized steel with gasketing, and factory-installed wood nailer; complying with NRCA standards; minimum height of 14 inches

2. Intake weather hood with 2-inch-thick filters.
3. Exhaust weather hood with bird screen.
4. Low-Leakage, Isolation Dampers: Double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals, in opposed-blade arrangement with steel operating rods rotating in stainless-steel sleeve bearings mounted in a single galvanized-steel frame, with operating rods connected with a common linkage, and electric damper operator factory wired. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.
5. Duct flanges.
6. Rubber-in-shear isolators for ceiling-mounted units.
7. Hinged access doors with quarter-turn latches.
8. Automatic, in-place, spray-wash system.
9. Weatherproofing for tilt-control system.

2.2 CONTROLS

A. Unit shall be furnished from factory with BACnet communication device to be controlled via owner's BACnet based building control system. All sensors and control devices including coil control valves shall be able to communicate with BACnet based building control system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install heat wheels so supply and exhaust airstreams flow in opposite directions and rotation is away from exhaust side to purge section to supply side.
1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
3. Access doors and panels are specified in Section 233300 "Air Duct Accessories."

B. Install floor-mounted units on 4-inch-high concrete base.

C. Equipment Mounting: Install air-to-air energy recovery equipment on concrete bases.
1. 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.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

D. Roof Curb: Install on roof structure or concrete base, level and secure. Install air-to-air energy recovery equipment on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure air-to-air energy recovery equipment to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

E. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure air-to-air energy recovery equipment to structural support with anchor bolts.

F. Install wind and seismic restraints according to manufacturers' written instructions.

G. Install units with clearances for service and maintenance.

H. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 CONNECTIONS

A. Comply with requirements for ductwork specified in Section 233113 "Metal Ducts."

B. Install electrical devices furnished with units but not factory mounted.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Set initial temperature and humidity set points.
5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

D. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units. Provide four hours of training time.

END OF SECTION

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: 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.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 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."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:
      a. For Complete Unit: One year from date of Substantial Completion.
      b. For Compressor: Five year(s) from date of Substantial Completion.
      c. For Parts: One year from date of Substantial Completion.
      d. For Labor: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Trane; a business of American Standard companies.
   2. Daikin AC
   3. Mitsubishi
   ~~4. Carrier~~
   5. York/JCI

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Concealed Evaporator-Fan Components:
   1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
   2. Insulation: Faced, glass-fiber duct liner.
   3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
   4. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch; leak tested to 300 psig underwater; with a two-position control valve.
   5. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
   6. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
   7. Fan Motors:
      a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
9. Filters: Permanent.
10. Condensate Drain Pans:
    a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
        1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1
        2) Depth: A minimum of 2 inches deep.
    b. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
    c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
        1) Minimum Connection Size: 3/4".
    d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
    e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

B. Floor-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
    a. Discharge Grille: Aluminum with surface-mounted frame
    b. Insulation: Faced, glass-fiber duct liner.
    c. Drain Pans: Galvanized steel, with connection for drain; insulated.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Belt drive, centrifugal
5. Fan Motors:
    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
6. Air Filtration Section:
    a. General Requirements for Air Filtration Section:
        1) Comply with NFPA 90A.
        2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
        3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
    b. Extended-Surface, Panel Filters:
        1) Factory-fabricated, dry, extended-surface type.
        2) Thickness: 1 inch.
        3) Arrestance according to ASHRAE 52.1: 20.
        4) Media-Grid Frame: Galvanized steel

5) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

C. Wall-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
   c. Enclosure Type: Totally enclosed, fan cooled.
   d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
   e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
   f. Mount unit-mounted disconnect switches on interior of unit.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:
   a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1
      2) Depth: A minimum of 1 inch deep.
   b. Single-wall, [stainless-steel sheet.
   c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
      1) Minimum Connection Size: 3/4”.
   d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
8. Air Filtration Section:
   a. General Requirements for Air Filtration Section:
      1) Comply with NFPA 90A.
      2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
      3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
   b. Washable Panel Filters:
      1) Factory-fabricated, viscous-coated, flat-panel type.
      2) Thickness: 1 inch.
      3) Arrestance according to ASHRAE 52.1: 20.
      4) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:
1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
a. Compressor Type: Scroll.
b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
c. Refrigerant Charge: R-407CR-410A
d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 0 deg F.
7. Mounting Base: Concrete.

2.4 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
1. Thermostat shall be hard wired, installed on the wall. Wireless controllers are not acceptable.

C. Automatic-reset timer to prevent rapid cycling of compressor.

D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install ground-mounted, compressor-condenser components on 4-inch-thick, reinforced concrete base that is 4 inches larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

D. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

E. Install seismic restraints.

F. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

G. No condensing units shall be installed indoors.

H. Condensing units shall be connected to concrete pads with the perimeter of the base fenced. Maintain the manufacturer's minimum clearance requirements as well as the NEC requirements (whichever is more stringent).

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   4. Pressure test shall be verified by the Commissioning Agent.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

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

END OF SECTION

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SECTION 238146 - WATER-SOURCE UNITARY HEAT PUMPS

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 types of water-source heat pumps:

1. Concealed horizontal or vertical units, 6 tons and smaller.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each model.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Product Certificates: For each type of water-source heat pump, signed by product manufacturer. All equipment listed in this section must be rated and certified in accordance with American Refrigeration Institute / International Standards Organization (ARI / ISO) and Canadian Standards Association (CSA-US). The units shall have ARI / ISO and CSA-US labels

D. Operation and Maintenance Data: For water-source heat pumps to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.4 ACCEPTABLE MANUFACTURERS

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

1. Climate Master
2. ~~Carrier~~

3. Trane
4. McQuay

B. Listing of manufacturers name does not guarantee approval. All equipment must meet or exceed quality and capacities of specified equipment. Final approval will be based on equipment submittals. Any manufacturer not listed but wishing to bid this project shall submit a written request 10 days prior to bid date, prior approval is required for all manufacturers not listed.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water-source heat pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

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. ASHRAE Compliance:

1. ASHRAE 15.
2. Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. Comply with NFPA 70.

F. Comply with safety requirements in UL 484 for assembly of free-delivery water-source heat pumps.

G. Comply with safety requirements in UL 1995 for duct-system connections.

1.6 COORDINATION

A. Coordinate layout and installation of water-source heat pumps and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, and partition assemblies.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water-source heat pumps that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, refrigeration components.
2. Warranty Period: Manufacturer shall warranty all parts one year from start-up or 18 months from shipment. The compressor shall have a 5-year warranty. Installing contractor shall provide warranty labor for a period on one year.

PART 2 - PRODUCTS

2.1 WATER-SOURCE HEAT PUMPS

A. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ARI-ISO-13256-1.

B. Cabinet and Chassis: Galvanized-steel casing, powder coated on both sides, with the following features:

1. Minimum of three (3) Access panels for serviceability of internal components.
2. Knockouts for electrical and piping connections.
3. Flanged duct connections.
4. Compressor Section Cabinet Insulation: Glass-fiber liner, minimum 1/2-inch thick, dual density, 1 ¾lb.
5. Air Handling Section Cabinet Insulation: Glass-fiber liner, minimum 1/2-inch thick, single density, foil backed 1 ¾lb.
6. Standard cabinet panel insulation must meet NFPA 90A requirements, air erosion and mold growth limits of UL-181, stringent fungal resistance test per ASTM-C1071 and ASTM G21, and shall meet zero level bacteria growth per ASTM G22.
7. Condensate Drainage: HDPE or stainless-steel drain pan with condensate drain piping projecting through unit cabinet and complying with ASHRAE 62.1-2004.
8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
9. All units must have an insulated panel separating the fan compartment from the compressor compartment. The compressor shall be located outside the air stream.

C. Fan and Motor:

1. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Blower shall have inlet rings to allow removal of wheel and motor from one side without removing housing. Units shall have a direct-drive centrifugal fan. The fan motor shall be 3-speed, permanently lubricated, PSC type, with internal thermal overload protection. Units supplied without permanently lubricated motors must provide external oilers for easy service. The fan motor shall be isolated from the fan housing by a torsionally flexible motor mounting system with rubber type grommets to inhibit vibration induced high noise levels associated with “hard wire belly band” motor mounting. The fan and motor assembly must be capable of overcoming the external static pressures as shown

on the schedule. Airflow / Static pressure rating of the unit shall be based on a dry coil and a clean filter in place.

D. Water Circuit:

1. Refrigerant-to-Water Heat Exchangers:

   a. Coaxial heat exchangers with copper water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube leak tested to 500 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.
   b. Stainless-steel, brazed-plate heat exchanger leak tested to 450 psig for refrigerant side and 400 psig for water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

2. Motorized Water Valve: Stop water flow through the unit when compressor is off.

E. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig.

F. Refrigerant Circuit Components:

1. Sealed Refrigerant Circuit: Charge with R-407C or R-410A refrigerant.
2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.
3. Charging Connections: Service fittings on suction and liquid for charging and testing.
4. Reversing Valve: Pilot-operated sliding-type valve designed to be fail-safe in heating position with replaceable magnetic coil.
5. Compressor: Hermetic rotary or scroll compressor installed on vibration isolators and housed in an acoustically treated enclosure with factory-installed safeties. Activation of any safety device shall prevent compressor operation via a microprocessor lockout circuit. The lockout circuit shall be reset at the thermostat or at the contractor supplied disconnect switch. Factory installed safeties required as follows:

   a. Anti- short cycle timer.
   b. High-pressure cutout.
   c. Low-pressure cutout or loss of charge switch.
   d. Water coil low temperature sensor
   e. Air coil low temperature sensor
   f. Condensate overflow sensor

6. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.
7. Pipe Insulation: Refrigerant minimum 3/8-inch- thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes according to ASTM E 84.
8. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 40 to 100 deg F.

G. Filters: Disposable, pleated type, 1 inch thick and with a minimum of 90 percent arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value of 7 according to ASHRAE 52.2.

H. Sound Attenuation (required for units 5 tons and below only):

1. Ultra quiet package shall consist of high technology sound attenuating material that is strategically applied to the compressor and air handling compartment casings and fan scroll in addition to the standard system design, to further dampen and attenuate sound transmissions.

I. Hot gas reheat (where indicated)

1. Dehumidification (where indicated) is provided through a hot gas reheat option. The coil shall consist of 3/8"/1/2" copper tubes mechanically expanded into evenly spaced aluminum fins. All coils shall be proof and leak tested. The proof test must be performed at 1.5 times the maximum operating pressure and the leak test performed at the maximum operating pressure.

J. Drain Pan: the drain pan shall be constructed of 304 Stainless Steel to inhibit corrosion. This corrosion protection system shall meet the stringent 1000 hour salt spray test per ASTM B117. If plastic type material is used, it must be HDPE (High Density Polyethylene) to avoid thermal cycling shock stress failure over the lifetime of the unit. Drain pan shall be fully insulated. Drain outlet shall be located at pan as to allow complete and unobstructed drainage of condensate. Drain outlet for horizontal units shall be connected from pan directly to IPT fitting. The unit as standard will be supplied with solid-state electronic condensate overflow protection.
Vertical units shall be furnished with a PVC slip condensate drain connection and an internal factory installed condensate trap.

K. Control equipment is specified in Division 23 Sections "Instrumentation and Controls for HVAC." See plans for Sequence of Operation.

L. Controls:

Solid state control system shall communicate with thermostat to display (at the thermostat) the unit status, fault status, and specific fault condition, as well as retrieve previously stored fault that caused unit shutdown. The Remote Service Sentinel allows building maintenance personnel or service personnel to diagnose unit from the wall thermostat. The control board shall provide a signal to the thermostat fault light, indicating a lockout. Upon cycling the G (fan) input 3 times within a 60 second time period, the fault light shall display the specific code as indicated by a sequence of flashes. A detailed flashing code shall be provided at the thermostat LED to display unit status and specific fault status such as over/under voltage fault, high pressure fault, low pressure fault, low water temperature fault, condensate overflow fault, etc. The control board will be supplied with a LONWORKS interface board, which is LONMark certified. This will permit all units to be daisy chained via a 2-wire twisted pair shielded cable. The following points must be available at a central or remote computer location:

a. space temperature
b. leaving water temperature
c. discharge air temperature
d. command of space temperature setpoint
e. cooling status
f. heating status
g. low temperature sensor alarm
h. low pressure sensor alarm
i. high pressure switch alarm
j. condensate sensor alarm

k. hi/low voltage alarm
l. fan "ON/AUTO" position of space thermostat as specified above
m. unoccupied / occupied command
n. cooling command
o. heating command
p. fan "ON / AUTO" command
q. fault reset command
r. itemized fault code revealing reason for specific shutdown fault (any one of 7)

M. Electrical Connection: Single electrical connection.

N. Capacities and Characteristics: As indicated on the drawings.

2.2 HOSE KITS

A. General: Hose kits shall be designed for minimum 400 psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.

B. Hose: Length 24 inches. Minimum diameter, equal to water-source heat-pump connection size.

C. Isolation Valves: Two-piece bronze-body ball valves with stainless-steel ball and stem and galvanized-steel lever handle. Provide valve for supply and return. If balancing device is combination shutoff type with memory stop, the isolation valve may be omitted on the return.

D. Strainer: Y-type with blowdown valve in supply connection.

E. Balancing Device: Mount in return connection. Include meter ports to allow flow measurement with differential pressure gage.

1. Automatic balancing valve, factory set to operate within +/-5% of gpm rating. Cartridge must be accessible without removing valve from piping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of water-source heat pumps.

B. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduit before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Concrete Bases: Install floor mounted units on 4-inch- high concrete bases. See Division 23 Section "Common Work Results for HVAC" for concrete base materials and fabrication requirements.

B. Unless otherwise noted, mount horizontal and vertical water-source heat pumps on concrete base with vibration isolators. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Units with Internally Isolated Fans and Compressors: Support on concrete bases using neoprene pads with minimum 0.125-inch static deflection. Secure units to anchor bolts installed in concrete bases.
2. Units without Internally Isolated Fans and Compressors: Support on concrete bases using housed-spring isolators with minimum 1-inch static deflection. Secure units to anchor bolts installed in concrete bases.
3. Install units level.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Connect supply and return hydronic piping to heat pump with hose kits.
2. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts. Specific connection requirements are as follows:

1. Connect supply and return ducts to water-source heat pumps with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."

C. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

D. Install piping adjacent to machine to allow service and maintenance.

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."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.

2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
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.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE (Provided by Installing Contractor)

A. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, coils, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Adjust vibration isolators.
9. Inspect operation of barometric dampers.
10. Verify bearing lubrication on fan.
11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Adjust fan belts to proper alignment and tension.
13. Start unit according to manufacturer's written instructions.
14. Complete startup sheets and attach copy with Contractor's startup report.
15. Inspect and record performance of interlocks and protective devices; verify sequences.
16. Operate unit for an initial period as recommended or required by manufacturer.
17. Verify thermostat and humidistat calibration.
18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
20. Start refrigeration system and measure and record the following:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

21. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

3.6 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. 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 two visits to Project during other than normal occupancy hours for this purpose.

3.7 CLEANING

A. Replace filters used during construction prior to air balance or substantial completion.

B. After completing installation of exposed, factory-finished water-source heat pumps, inspect exposed finishes and repair damaged finishes.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source heat pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

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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 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. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 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, "National Electrical Code."

C. Comply with NECA/NACMA 120, "Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC)."

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. AFC Cable Systems.
   2. Allied Wire & Cable.
   3. Cerro Wire LLC.
   4. Encore Wire Corporation.

5. Southwire Company.
6. Alan Wire.
7. Colonial Wire & Cable
8. Northern Cables
9. Kaf-Tech: a brand of Atkore

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Aluminum conductors to be AA8000 alloy, 75 degree C type XHHW-2

D. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2 and Type XHHW-2Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for armored cable, Type AC, metal-clad cable, Type MC, and Type SO with ground wire.

E. Types AC, NM and NMC are not acceptable.

F. VFC Cable:
1. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable.
2. Type TC-ER with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

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. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
6. 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: Copper stranded.

B. Branch Circuits: Copper. Stranded, except VFC cable, which shall be extra flexible stranded.

C. Branch Circuits: MC cable shall be stranded for any size larger than 12. MC cable with a gauge of 12 is permitted to be solid.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

E. Feeders Installed Below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC; see the below conditions for MC cable.
1. MC cable may be provided for circuits, whether individual or grouped, when carried from the panelboard to each individual circuit's destination building space in conduit and may only transition to MC cable within 20 feet of the first device fed by that individual circuit.
2. After transition to MC cable, MC cable may be provided to service receptacles or lights fed by that circuit, except where otherwise indicated.
3. Transition of grouped circuits from conduit to MC cable just beyond the electrical room is not acceptable.
4. Do not provide individual pieces of MC cable longer than 50 feet.
    a. For distances between devices greater than 50 feet, provide conduit and wire to serve devices.
5. Do not conceal MC cable within masonry walls. MC cable penetrating through masonry walls is acceptable.
    a. For circuits concealed within masonry walls, transition to conduit.
6. Do not provide MC cable in exposed locations visible in occupied spaces, except at certain specialized locations like motor connections where flexibility is required.
7. Branch circuits shall be considered 20A or less, with voltages of 120 and 277.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

I. Branch Circuits Installed Below Raised Flooring: Type THHN/THWN-2, single conductors in raceway Armored cable, or Metal-clad cable, Type MC. See MC cable limitations above.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. VFC Output Circuits: Type XHHW-2 in metal conduit with braided shield.

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 26 05 33 "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. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

G. Allowable uses for aluminum:
1. For new work or major renovations, 480 VAC above ground feeder conductors from service switchgear to 1st distribution panel in secondary electrical rooms for applications of 150 amps and above.
2. Service conductors from the utility transformer to the service switchgear for applications of 800 amps and above.
3.

H. Restrictions when applying aluminum conductors:
1. In no case shall voltage drop for the cable exceed 2% of the design load.
2. If aluminum cable is accepted as an alternate in a project sized for copper, design engineer, not the contractor, shall be responsible for determining the size of equivalent aluminum conductors.
3. Terminations at service equipment and at any other equipment rated 800 A or higher shall be accomplished with barrel type, double crimp, two-hole compression lugs. All other terminations shall be accomplished with compression lugs, but they may be the single crimp, one-hole type.
4. Terminations shall be done according to Aluminum Association and manufacturer’s instructions using oxide inhibiting compound and proper torque values.
5. No splices are allowed in aluminum conductors.

I. Multiwire branch circuits are not permitted. Provide a separate neutral conductor for each respective circuit requiring a neutral.

J. Electrical conduit, cabling, or electrical feeders shall not run above or through the MC, Data, IDF, MDF or any TR room. Only conduit and cabling serving the listed rooms will be permitted.
1.

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.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

D. MC Cable: Install MC cable in manner similar to conduit, run straight and parallel or perpendicular to walls or supporting structures, grouped neatly and well supported.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

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 26 05 44 "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 07 84 13 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Contractor to perform tests and inspections.

B. 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 and conductors feeding the life safety/standby branch circuits for compliance with requirements.
      a. Feeder to each panel.
   2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification.
   3. Insulation Testing: All current carrying phase conductors and neutrals for services feeders and large branch circuits shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500 volt megger. The procedures listed below shall be followed:

a. Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG wire and smaller, 250,000 ohms or more for #4 AWG wire or larger, between conductors and between conductor and the grounding conductor.
b. After all fixtures, devices and equipment are installed and all connections completed to each panel, the contractor shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and the grounded enclosure. If this reading is less than 250,000 ohms, the contractor shall disconnect the branch circuit neutral wires from this neutral bar. He shall then test each one separately to the panel and until the low readings are found. The contractor shall correct troubles, reconnect and retest until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.

C. 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.

D. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. UTP cabling.
2. RS-485 cabling.
3. Low-voltage control cabling.
4. Control-circuit conductors.
5. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

D. RCDD: Registered Communications Distribution Designer.

E. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 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, "National Electrical Code."

C. Comply with NECA/NACMA 120, "Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC)."

PART 2 - PRODUCTS

2.1 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.

2.2 PERFORMANCE REQUIREMENTS

A. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262 by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
1. Flame Travel Distance: 60 inches or less.
2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.

B. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

C. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.3 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Section 06 10 53 "Miscellaneous Rough Carpentry."

B. Painting: Paint plywood on all sides and edges with egg shell gray latex paint. Comply with requirements in Section 09 91 23 "Interior Painting." Do not paint over FRTW labels on backboards.

2.4 UTP 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. 3M.
2. Belden CDT Networking Division/NORDX.
3. General Cable; General Cable Corporation.
4. Mohawk; a division of Belden Networking, Inc.
5. Superior Essex, Inc.
6. Tyco Electronics.
7. Windy City.

B. Description: 100-ohm, four-pair UTP, 25-pair UTP covered with a thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties of Category 5e cables.
2. Comply with ICEA S-102-700 for mechanical properties of Category 6 cables.

3. Comply with TIA-568-C.1 for performance specifications.
4. Comply with TIA-568-C.2, Category 6.
5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with NEMA WC 66, UL 444and NFPA 70 for the following types:
    a. Communications, Plenum Rated: Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway.
    b. Communications, General Purpose: Type CM or Type CMG; or Type CM, Type CMG, Type CMP, or Type CMR in listed communications raceways.

2.5 UTP CABLE HARDWARE

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 Premise Wiring.a
2. Leviton Manufacturing Co., Inc.
3. Molex Premise Networks.
4. Panduit Corp.
5. Tyco Electronics.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Jacks and Jack Assemblies: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-C.1.
1. Snap-in, clear-label covers and machine-printed paper inserts.

2.6 TWIN-AXIAL DATA HIGHWAY CABLE

A. Standard Cable: NFPA 70, Type CM.
1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.7 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CMG.
1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.

3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

2.8 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.
1. One Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
1. One Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.9 CONTROL-CIRCUIT CONDUCTORS

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. Encore Wire Corporation.
2. General Cable; General Cable Corporation.
3. Southwire Company.

B. Class 1 Control Circuits: Stranded copper, Type THHN-2-THWN-2 in raceway, complying with UL 83.

C. Class 2 Control Circuits: Stranded copper, power-limited tray cable, in cable tray, complying with UL 83.

D. Class 3 Remote-Control and Signal Circuits: Stranded copper power-limited tray cable, in cable tray, complying with UL 83.

E. Cable tray allowable systems; Data, Voice, Wireless, CATV. These systems shall occupy the larger portion of the cable tray. Intercom, Video Surveillance, Access control, and Intrusion detection shall occupy the smaller portion of the cable tray. All other systems including but not limited to fire alarm and mechanical control cables shall not be permitted within or attached to the cable tray system.

F. Fire alarm cabling shall be limited to conduit and/or fire alarm rated MC cable. Fire alarm rated MC cable is permitted in accessible concealed ceiling spaces only.

G. Mechanical controls cabling may be free air installed, utilizing j-hook installation in accessible ceilings spaces. Any exposed areas shall refer to specification 260533 for cabling pathway installations. Mechanical control cabling routed inside walls shall use EMT as described in 260533.

H.

2.10 CABLING SUPPORTS

A. Match specification 270528 "Communication hangers and supports for communication systems" for j-hook manufacturer and provisions. Contractor shall provide the same j-hook as supplied under the 270528 contract.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Contractor to engage a qualified testing agency to evaluate cables.

B. Factory test UTP cables according to TIA-568-C.2.

C. Factory test optical-fiber cables according to TIA-568-C.3.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.
1. The loss value of each. Retain test data and include the record in maintenance data.
2. Test each pair of UTP cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
2. Outlet boxes for optical-fiber cables shall be no smaller than 4 inches square by 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
3. Flexible metal conduit shall not be used.

B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering the room from overhead.
4. Extend conduits 3 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1 and NFPA 70.

B. General Requirements for Cabling:
1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems."
3. Terminate all conductors and optical fibers; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced.
5. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
9. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems" and Ch. 6, "Optical Fiber Structured Cabling Systems." Monitor cable pull tensions.
10. Support: Do not allow cables to lay on removable ceiling tiles.
11. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.

C. UTP Cable Installation:
1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 27 15 00 "Communications Horizontal Cabling" unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:
1. Install wiring in raceways. Comply with requirements specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be minimum 12 inches (300 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be minimum 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be minimum 12 inches (300 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: Minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: Minimum 12 inches (300 mm).

3.4 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables to junction box or source panel. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified for future use with a tag.

3.5 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:
1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING

A. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

B. For low-voltage control wiring and cabling, comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

A. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-A; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Contractor to engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:
1. Visually inspect UTP cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment, and labeling of all components.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

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 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 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
   1. Ground rods.
   2. Grounding arrangements and connections for separately derived systems.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1.6 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. Comply with UL 467,"Grounding and Bonding Equipment."

C. Comply with NFPA 70, "National Electrical Code."

D. Comply with NECA 331, "Standard for Building and Service Entrance Grounding and Bonding."

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. 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, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

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. Bare Copper Conductors:
1. Stranded Conductors: ASTM B 8.
2. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
4. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 2 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

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;
1. 3/4 inch by 10 feet for building grounding system.
2. 5/8 by 96 inches for outdoor lighting pole grounding system.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductors unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 30 inches below grade.
   2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.

D. Bus to be 24 inches long unless otherwise noted on the Drawings. 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 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Handholes: Install a driven ground rod through handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor.

C. Pad-Mounted Transformers: Install two ground rods and ground ring around the pad. Bury ground ring not less than 6 inches from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Anti-Frost 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.

D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

E. Metallic Fences: Comply with requirements of IEEE C2.
1. Grounding Conductor: Bare, tinned 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.

3.6 SEPARATE BUILDING SECTIONS

A. Building sections that are part of the same building shall be bonded together to form an effective path to the main service grounding electrode by using 500 KCMIL copper insulated cable. Cable run in return air plenum spaces shall be run in metallic conduit except that bare conductor supported every 6 feet on insulated fittings is also acceptable.

3.7 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. 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.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install it at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

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 (fire and domestic) 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. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

C. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforce steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather.

5. other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

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 Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

B. Related Requirements:
   1. Section 26 05 48.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
      a. Steel slotted support systems.
   2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.
   1. Trapeze hangers. Include product data for components.
   2. Steel slotted-channel systems.
   3. Equipment supports.

C. Delegated-Design Submittal: For hangers and supports for electrical systems.
   1. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Comply with NFPA 70, "National Electrical Code."

C. Comply with NECA 1, "Standard for Good Workmanship in Electrical Construction."

D. Comply with NECA 101, "Standard for Installing Steel Conduits (Rigid, IMC, EMT)."

E. Comply with NECA 102, "Standard for Installing Aluminum Rigid Metal Conduit."

F. Comply with NECA/NEMA 105, "Standard for Installing Metal Cable Tray Systems."

G. Comply with NECA/MACMA 120, Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC)."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to a design hanger and support system.

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor: 1.0.

C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.
1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
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. Allied Tube & Conduit; a brand of Atkore International.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. Thomas & Betts Corporation, A Member of the ABB Group.
d. Unistrut; an Atkore International company.
2. Material: Galvanized steel.
3. Channel Width: 1-5/8 inches, 1-1/4 inches, or 13/16 inches.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
8. Channel Dimensions: Selected for applicable load criteria.

B. Aluminum Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Cooper Industries, Inc.
      b. Flex-Strut Inc.
      c. Haydon Corporation.
      d. MKT Metal Manufacturing.
      e. Thomas & Betts Corporation; A Member of the ABB Group.
      f. Unistrut; Part of Atkore International.
   2. Channel Width: 1-1/4 inches.
   3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
   6. Channel Dimensions: Selected for applicable load criteria.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, 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 nonarmored 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 made of 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 include the following:
   1. Powder-Actuated Fasteners: 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. 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) Hilti, Inc.
         2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
   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 where used.
      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) Empire Tool and Manufacturing Co., Inc.
         3) Hilti, Inc.
         4) ITW Ramset/Red Head; Illinois Tool Works, Inc.

9. MKT Fastening, LLC.
10. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
11. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
12. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
13. Toggle Bolts: All-steel springhead type.
14. Hanger Rods: Threaded steel.

2.3 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 Section 05 50 00 "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 unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other 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 or single-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMTs, IMCs, and RMCs may be supported by openings through structure members, according to NFPA 70.

C. 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.

D. 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
   6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
   7. To Light Steel: Sheet metal screws.
   8. 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 by means that comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05 50 00 "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.

C. Field Welding: Comply with AWS D1.1/D1.1M.

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. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:
   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.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 09 91 23 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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 Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Metallic Floor Boxes.
7. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

B. Source quality-control reports.

1.6 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, "National Electrical Code."

C. Comply with NECA 101, "Standard for Installing Steel Conduits (Rigid, IMC, EMT)."

D. Comply with NECA 111, "Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)."

E. Comply with NECA 605, "Recommended Practice for Installing Underground Nonmetallic Utility Duct.

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. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a brand of Atkore International.
3. Electri-Flex Company.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.
5. Republic Conduit.
6. Southwire Company.
7. Thomas & Betts Corporation, A Member of the ABB Group.
8. Western Tube and Conduit Corporation.
9. Wheatland Tube Company.
10. Shamrock Conduit
11. Madison Elbows
12. ETP – Emerson
13. Appleton – Emerson
14. Arlington
15. Kaf-Tech: a brand of Atkore

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. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

C. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
a. Material: Steel.
b. Type: Compression.
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.

D. Joint Compound for IMC or GRC: 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, 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. CANTEX INC.
2. CertainTeed Corporation.
3. Electri-Flex Company.
4. Kraloy.
5. ABB(Carlon, Thomas & Betts)
6. RACO; Hubbell.
7. National Pipe and Plastics.
8. Queen City Plastics.

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. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

E. Solvent cements and adhesive primers 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."

2.3 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. MonoSystems, Inc.
4. Square D.

H. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. 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.

J. Wireway Covers: Screw-cover type unless otherwise indicated.

K. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, 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 ivory unless otherwise specified.
   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:
   2.
      a. Wiremold / Legrand (Wiremold V4000 basis of design, or V2400BD, unless otherwise specified).
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Panduit Corp.
   3. Provide components covers, large radius turn elbows, device plates (based on WM 4050), etc. for a complete working surface raceway system. System shall utilize entrance/end fittings. Knockout at the entry to the surface raceway shall be sized for the quantity of cabling provided.

C. Tele-Power Poles:
   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. Wiremold / Legrand.
      c. Hubbell.
   2. Material: Galvanized steel with ivory baked-enamel finish.
   3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

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. Adalet.
   2. Cooper Technologies Company.
   3. EGS/Appleton Electric.
   4. Erickson Electrical Equipment Company.
   5. Hoffman; a brand of Pentair Equipment Protection.
   6. Hubbell Incorporated.
   7. Milbank Manufacturing Co.
   8. MonoSystems, Inc.
   9. O-Z/Gedney; a brand of Emerson Industrial Automation.
   10. RACO; Hubbell.
   11. Spring City Electrical Manufacturing Company.
   12. Stahlin Non-Metallic Enclosures.
   13. Thomas & Betts Corporation, A Member of the ABB Group.
   14. Wiremold / Legrand.

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, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb. (23 kg) shall be listed and marked for the maximum allowable weight.

G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb. (32 kg).
   1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep) unless otherwise noted on plans.

L. Gangable boxes are allowed.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R 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: Plastic.
   3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:
   1. NEMA 250, Type 1 unless otherwise noted on the plans, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.
   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.

2.6 METAL FLOOR BOXES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Hubbell Wiring Systems.
   2. Steel City/Thomas & Betts.
   3. Wiremold/Legrand.

B. Material: Cast metal for use in slab on or above grade or sheet metal for use in slab above grade.

C. Type: Fully adjustable.

D. Shape: Rectangular.

E. 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.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:
   1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
   2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, 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. Carson Industries LLC.
      b. Oldcastle Precast, Inc.
      c. Quazite: Hubbell Power Systems, Inc.
   2. Standard: Comply with SCTE 77.
   3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
   4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
   5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   6. Cover Legend: Molded lettering, as indicated for each service.
   7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
   8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

C. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC or IMC.
   2. Concealed Conduit, Aboveground: GRC IMC or RNC, Type EPC-40-PVC.
   3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried unless otherwise indicated herein or on the Drawings.
      a. Service conduits shall be incased in concrete.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT, GRC or IMC.
   2. Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following:
      a. Loading dock.
      b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. Mechanical rooms.
      d. Gymnasiums.
   3. Concealed in Ceilings and Interior Walls and Partitions: EMT, GRC or IMC.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   5. Damp or Wet Locations: GRC or IMC.
   6. 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.

C. Minimum Raceway Size: 1/2-inch (16-mm) trade size, except as follows:
      a. 3/8-inch (12-mm) trade size for drops to recessed lighting fixtures.
      b. 3/4-inch (21-mm) trade size for underground conduit outdoors.

D. 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. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
   3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1, NECA 111, NECA 605, 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. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 26 05 29 "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 three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed (two). Support within 12 inches (300 mm) of changes in direction.

G. Change of direction for conduits or raceways 2" or larger shall be made using formed bends or pull boxes.

H. Conduit bodies shall not be used on any service conduit or raceway.

I. Conduit bodies shall not be used on any conduit or raceway 2" trade size or larger, except by written approval by the architect or engineer.
   1. When allowed by the architect or engineer conduit bodies will be mogul type.

C. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

D. Support conduit within 12 inches (300 mm) of enclosures to which attached.

E. Surface mounted conduit and EMT on exposed finished surfaces shall be installed using one or two conduit straps. Standoff type straps shall not be used for exposed conduit on finished surfaces.

F. Raceways Embedded in Slabs:
   1. Conduit shall not be larger in outside wall dimension than 1/3 the overall thickness of the slab.
   2. Conduit shall be spaced no closer than three (3) diameters or widths on center.
   3. 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 raceways to reinforcement at maximum 10-foot (3-m) intervals.

4. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
5. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
6. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
7. Change from RNC, Type EPC-40-PVC, to EMT, GRC or IMC after rising above floor for exposed conduit. Transition shall be protected by a concrete housekeeping pad that covers the transition coupling. No exposed RNC. Exception: RNC runs that turn up inside walls shall transition to EMT no greater than 60" above the slab or at the first box encountered, whichever comes first.
8. Slab area work: Conduit shall not be embedded in slabs except for the purpose of transitioning to above slab or serving boxes/equipment at that location. All other conduits shall be installed below slab, located in the stone base with at least 4" of concrete cover.
9.

G. 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.

H. 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.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

J. 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 (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

K. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

L. 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.

M. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

N. Install pull wires in empty raceways. 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 raceways designated as spare above grade alongside raceways in use.

O. All empty raceways shall be left clear of debris and dry on the inside. Conduit shall be ready for installation of wire or cable.

P. Surface Raceways:
   1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
   2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

Q. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, 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 raceway sealing fittings according to NFPA 70.

R. Install devices to seal raceway 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 raceways at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where an underground service raceway enters a building or structure.
   3. Where otherwise required by NFPA 70.

S. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

T. Expansion-Joint Fittings:
   1. Install in each run of aboveground RMC 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.
      a. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
      b. Attics: 135 deg F (75 deg C) temperature change.
   3. 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 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 support to allow for expansion movement.

K. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) 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 in damp or wet locations not subject to severe physical damage.

L. Mount boxes at heights indicated on Drawings. If the 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.

M. 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 rain tight connection between box and cover plate or supported equipment and box.

N. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

O. Locate boxes so that cover or plate will not span different building finishes.

P. 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.

Q. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

R. Electrical conduit, cabling, or electrical feeders shall not run above or through the MC, Data, IDF, MDF or any TR room. Only conduit and cabling serving the listed rooms will be permitted.

S. Conduit/pathways shall not be routed in a vapor barrier space (on the exterior of CMU between the outer surface). Conduit must be routed within the CMU and penetrate to the device.

3.3 INSTALLATION OF FLOOR BOXES

A. Set metal floor boxes level and flush with finished floor surface.

B. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.4 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
   1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
   2. Install backfill as specified in Section 31 20 00 "Earth Moving."
   3. 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 (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."
   4. 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 (75 mm) of concrete for a minimum of 12 inches (300 mm) 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 (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

5. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

3.5 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 (12.5-mm) sieve to No. 4 (4.75-mm) 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 (25 mm) above finished grade.

D. Install handholes with bottom below frost line. 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 lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut the 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.

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 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.8 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Ladder cable trays.
   2. Trough cable trays.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.
   1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

C. Delegated-Design Submittal: For seismic restraints.
   1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
   2. Design Calculations: Calculate requirements for selecting seismic restraints.
   3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
   2. Vertical and horizontal offsets and transitions.
   3. Clearances for access above and to side of cable trays.
   4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

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. Comply with NFPA 70, "National Electrical Code."

D. Comply with NECA/NEMA 105, "Standard for Installing Metal Cable Tray Systems."

E. Comply with NEMA VE 1, "Metal Cable Tray Systems."

F. Comply with NEMA VE 2, "Cable Tray Installation Guidelines."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design cable tray supports and seismic bracing.

B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles on individual cable tray types for specific values for the following parameters:
1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 LADDER CABLE TRAYS

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. Chalfant Manufacturing Company.
   2. Cooper B-Line, Inc.; a division of Cooper Industries.
   3. MonoSystems, Inc.
   4. MP Husky USA Cable Tray & Cable Bus.
   5. Legrand/Cablofil.

B. Description:
   1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
   2. Rung Spacing: 9 inches o.c.
   3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
   4. Minimum Cable-Bearing Surface for Rungs: 7/8-inchwidth with radius edges.
   5. No portion of the rungs shall protrude below the bottom plane of side rails.
   6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
   7. Minimum Usable Load Depth: 4 inches.
   8. Straight Section Lengths: 12 feet except where shorter lengths are required to facilitate tray assembly.
   9. Width: 18 inches unless otherwise indicated on Drawings.
   10. Fitting Minimum Radius: 24 inches, unless otherwise noted.
   11. Class Designation: Comply with NEMA VE 1, Class 12C.
   12. Splicing Assemblies: Bolted type using serrated flange locknuts.
   13. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633 or geomet-plated per ASTM F-1136.
   14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
   15. Cable tray shall be provided with dividers as follows:
      a. 12" tray shall be divided into 4" and 8" sections (where shown on the plans to be less than 18”).
      b. 18"tray shall be divided into 6" and 12" sections.

2.4 TROUGH CABLE TRAYS

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. Legrand/Cablofil.
   2. MonoSystems, Inc.
   3. MP Husky USA Cable Tray & Cable Bus.
   4.

B. Description:
   1. Minimum Usable Load Depth: 4 inches.
   2. A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air, fumes, and vapors, and heat dissipation, utilizing 75% or less of the plan area of the surface to support cables where the maximum open spacings between cable support surfaces of transverse

elements do not exceed 100 millimeter(mm) (4 inch) in the direction parallel to the tray side rails.

3. Straight Section Lengths: 12 feet except where shorter lengths are required to facilitate tray assembly.
4. Width: 12 inches 18 inches unless otherwise indicated on Drawings.
5. Fitting Minimum Radius: 24 inches, unless otherwise noted.
6. Class Designation: Comply with NEMA VE 1, Class 12C.
7. Splicing Assemblies: Bolted type using serrated flange locknuts.
8. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
9. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633 or geomet-plated per ASTM F-1136.
10. Cable tray shall be provided with dividers as follows:
    a. 12" tray shall be divided into 4" and 8" sections (where shown on the plans to be less than 18”).
    b. 18"tray shall be divided into 6" and 12" sections.

2.5 MATERIALS AND FINISHES

A. Aluminum:
1. Geomet-plated steel per ASTM F-1136 or stainless-steel type 316 for outdoor use**.**
2. Materials: Alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and Alloy 5052-H32 or Alloy 6061-T6 according to ANSI H35.1/H 35.1M for fabricated parts.

2.6 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as for cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.7 WARNING SIGNS

A. Lettering: 1-1/2-inch- high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

B. Comply with requirements for fasteners in Section 26 05 53 "Identification for Electrical Systems."

2.8 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA/NECA 105 NEMA VE 2.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
   1. Top clearance shall be 12 inches.
   2. Bottom clearance shall be 6 inches.
   3. Side clearance shall be 36 inches.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts or bolted type using serrated flange locknuts.

F. Fasten cable tray supports to building structure and install seismic restraints.

G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 26 05 48.16 "Seismic Controls for Electrical Systems."

H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

J. Support bus assembly to prevent twisting from eccentric loading.

K. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

L. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

M. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.

N. Make changes in direction and elevation using manufacturer's recommended fittings.

O. Make cable tray connections using manufacturer's recommended fittings.

B. Do not penetrate rated construction with cable trays. If cable trays are sized for future cables, specify provisions for penetrations with sleeves through fire-rated partitions or use "repairable" firestop-sealing material. Include this Section's specific firestopping requirements in a schedule developed in Section 078413 "Penetration Firestopping."

C. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

D. Install cable trays with enough workspace to permit access for installing cables.

E. Install barriers to separate cables of different systems, such as power, communications, and data processing. Data/voice/catv shall be located in the larger section, all other low voltage trades shall be located in the smaller section (intercom, video surveillance, access control, and security).

F. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.

G. Clamp covers on cable trays installed outdoors with heavy-duty clamps.

H. Install warning signs in visible locations on or near cable trays after cable tray installation.

I. Trough cable trays shall only be used for exposed installations, unless otherwise noted.

J. Cable tray installation shall be coordinated with all other trades prior to installation. No joints allowed in piping that crosses cable trays. Where water piping must cross a cable tray, a drip pan will be required to be provided.

K. Cable tray supports, trapeze systems, threaded rod and other means of supporting the cable tray shall be used to only support the tray and its approved cabling contents. No other system, cable, metallic low voltage cable, conduit, or high voltage cable shall connect, attach, drape across or otherwise use the cable tray support systems for its own means of support.

3.2 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding-bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

C. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, and "Size of Equipment Grounding Conductors."

3.3 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches.

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.

E. In existing construction, remove inactive or dead cables from cable trays.

3.4 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect raceways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed cable trays and cables.
1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION

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 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.

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 duct-bank 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 hand holes, and boxes.
   4. Include warning tape.

B. Shop Drawings:
   1. 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 INFORMATIONAL SUBMITTALS

A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
   1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
   2. Drawings shall be signed and sealed by a qualified professional engineer.

B. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C 858.

C. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.

D. Source quality-control reports.

E. Field quality-control reports.

1.6 MAINTENANCE MATERIALS SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7 CLOSEOUT SUBMITTALS

A. Show locations of all exterior underground power circuit wiring on the as-built drawings. Provide depth, X axis and Y axis coordinates to locate wiring measured in 15’ intervals minimum. Provide additional measured location for any bends above 45 degrees.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI/IEEE C2, "National Electrical Safety Code."

C. Comply with NFPA 70, "National Electrical Code."

D. Comply with NECA/MEMA 605, "Recommended Practice for installing Underground Nonmetallic Utility Duct."

1.9 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 Architect no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Architect's written permission.

B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

A. Comply with ANSI C2.

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.

2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CertainTeed Corporation.
2. ElecSys, Inc.
3. Kraloy.
4. ABB (Carlon).
5. Manhattan/CDT.
6. National Pipe and Plastics.
7. Queen City Plastics.
8. Cantex.
9.

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 26 05 53 "Identification for Electrical Systems."
a. Color: Red dye added to concrete during batching.

2.4 PRECAST CONCRETE HANDHOLES AND BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Christy Concrete Products.
2. Oldcastle Precast, Inc.
3. Utility Concrete Products, LLC.
4. Wausau Tile Inc.

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. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
3. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
a. Cover Hinges: Concealed, with hold-open ratchet assembly.
b. Cover Handle: Recessed.
4. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
a. Cover Hinges: Concealed, with hold-open ratchet assembly.
b. Cover Handle: Recessed.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

6. Cover Legend: Molded lettering, as indicated for each service.
7. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
8. 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.
9. 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.
10. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks, plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
    a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
    b. Window opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
    c. Window openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
11. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
    a. Type and size shall match fittings to duct or conduit to be terminated.
    b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
12. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

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. Color: Gray.
    2. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
    3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
    4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
    5. Cover Legend: Molded lettering, As indicated for each service.
    6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
    7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
    8. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

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 with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
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. Christy Concrete Products.
   d. Quazite: Hubbell Power Systems, Inc.
   e. Synertech Moulded Products.

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers made of 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. Quazite: Hubbell Power Systems, Inc.

E. High-Density Plastic Boxes: Injection molded of high-density polyethylene or copolymer-polypropylene. Cover shall be made of plastic.
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. Nordic Fiberglass, Inc.
   c. Quazite: Hubbell Power Systems, Inc.

2.6 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of ducts, 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 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 handholes, and as approved by Architect.

C. Clear and grub vegetation to be removed and protect vegetation to remain according to Section 31 10 00 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 31 10 00 "Site Clearing."

3.2 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables More than 600 V: RNC, NEMA Type EPC-40, in concrete-encased duct bank unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.

C. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank unless otherwise indicated.

D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank unless otherwise indicated.

3.3 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, H-20 structural load rating.
   2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
   3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
   4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
   5. Cover design load shall not exceed the design load of the handhole or box.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Section 31 20 00 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. 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. Comply with Section 32 92 00 "Turf and Grasses" and Section 32 93 00 "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting and Patching" Article in Section 01 73 00 "Execution."

3.5 DUCT INSTALLATION

A. Install ducts according to NEMA TCB 2.

B. Slope: Pitch ducts a minimum slope of 1:300 down toward handholes and away from buildings and equipment. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, 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 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 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 26 05 44 "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 as specified in Section 31 20 00 "Earth Moving" for pipes less than 6 inches in nominal diameter.
   2. Width: Excavate trench 12 inches wider than duct bank on each side.

3. Width: Excavate trench 3 inches wider than duct bank on each side.
4. 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.
5. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
6. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than four 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.
7. 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.
8. 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.
9. Elbows: Use 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. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
10. 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.
11. 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.
12. 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.
13. Concreting Sequence: Pour each run of envelope between 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.
14. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 03 30 00 "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 31 20 00 "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 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 duct bank at least 36 inches below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
7. 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.
8. 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.
9. 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 31 20 00 "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 6 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.

3.6 INSTALLATION OF CONCRETE HANDHOLES, AND BOXES

A. Precast Concrete Handhole Installation:
1. Comply with ASTM C 891 unless otherwise indicated.
2. Install unit’s level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:
1. Install handholes with bottom below frost line, below grade.

2. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
3. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Waterproofing: Apply waterproofing to exterior surfaces of and handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars.

D. Dampproofing: Apply dampproofing to exterior surfaces of handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 07 11 13 "Bituminous Dampproofing." After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, as required for installation and support of cables and conductors and as indicated.

E. Field-Installed Bolting Anchors in Concrete Handholes: Do not drill deeper than 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

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.

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 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 subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screed to top of box cover frame. Bottom of ring shall rest on compacted earth.
1. Concrete: 3000 psi, 28-day strength, complying with Section 03 30 00 "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep.

3.8 GROUNDING

A. Ground underground ducts and utility structures according to Section 26 05 26 "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.
   3. Handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

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.

END OF SECTION

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 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.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 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. 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, provide products by one of the following:

a. Advance Products & Systems, Inc.

b. Metraflex Company (The).

c. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Carbon steel.

4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, 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.

b. LINKSEAL

c. O-Z Gedney

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.

2. Sealant shall have VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Sealant 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. 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 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

SECTION 260548.16 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchor bolts.

B. Related Requirements:
1. Section 26 05 29 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.
1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic required to select seismic restraints and for designing vibration isolation bases.
a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
3. Seismic- Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

B. Qualification Data: For professional engineer and testing agency.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

4. The Electrical Contractor shall be responsible for providing restraints to resist the earthquake effects on the electrical system. The requirements for these restraints are found in the North Carolina State Building Code and ASCE 7.
5. The Electrical Contractor shall retain the services of a Professional Structural Engineer registered in the State of North Carolina to design seismic restraint elements required for this project. The engineer's computations, bearing their professional seal, shall accompany shop drawings which show Code compliance. Computations and shop drawings shall be submitted for review prior to the purchasing of materials, equipment systems, and assemblies.
6. For all existing electrical equipment noted to remain, the Electrical Contractor shall visit the site to document existing seismic restraints, or lack thereof. The Electrical Contractor shall provide this information to the Professional Structural Engineer retained to design seismic restraint elements for this project. The Professional Structural Engineer shall review the existing restraints and indicate any additional requirements. Computations and shop drawings shall include all existing electrical equipment noted to remain.
7. Seismic-Restraint Loading:
    a. Site Class as Defined in the NC State Building Code (Chapter 16) and ASCE 7, as determined by the project Structural Engineer of record.
    b. Assigned Seismic Use Group or Building Category as Defined in the NC State Building Code (Chapter 16) and ASCE 7.
        1) Component Importance Factor.
        2) Component Response Modification Factor.
        3) Component Amplification Factor.
    c. Design Spectral Response Acceleration at Short Periods (0.2 Second).
    d. Design Spectral Response Acceleration at 1-Second Period.
8.

2.2 RESTRAINT CHANNEL BRACINGS

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. Mason Industries, Inc.
    3. Unistrut; an Atkore International company.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT 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. Kinetics Noise Control, Inc.
    2. Loos & Co., Inc.
    3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT 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. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. TOLCO; a brand of NIBCO INC.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

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. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.6 ADHESIVE ANCHOR BOLTS

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. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for 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 Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Equipment and Hanger Restraints:
   1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
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 post connection 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 four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.

C. Seismic controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General 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, including arc-flash warning labels.
   8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1.

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.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at More Than 600 V:
   1. Black letters on an orange field.
   2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

B. Warning labels and signs shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.3 LABELS

A. Self-Adhesive Labels:
   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. Brother International Corporation.
      b. Ideal Industries, Inc.
      c. Marking Services, Inc.
      d. Panduit Corp.
   2. Preprinted, 3-mil-thick, polyester flexible label with acrylic pressure-sensitive adhesive.
      a. Self-Lamination: Clear; UV-, 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.
   3. Polyester, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
      a. Nominal Size: 3.5-by-5-inch.
   4. Marker for Tags: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

2.4 BANDS AND TUBES:

A. Snap-Around, Color-Coding Bands for Raceways and Cables: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters of raceways or cables they identify, and that stay in place by gripping action.
   1. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   2.
      a. Brady Corporation.
      b. HellermannTyton.
      c. Marking Services, Inc.
      d. Panduit Corp.
   3.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around cables they identify. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

1. 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. Brady Corporation.
   b. Panduit Corp.

2.5 TAPES AND STENCILS:

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
   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. Ideal Industries, Inc.
      b. Marking Services, Inc.
      c. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. emedco.
      c. Marking Services, Inc.

C. Underground-Line Warning Tape
   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. Brady Corporation.
      b. Ideal Industries, Inc.
      c. Marking Services, Inc.
   2. Tape:
      a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
      b. Printing on tape shall be permanent and shall not be damaged by burial operations.
      c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
   3. Color and Printing:
      a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
      b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
      c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
   4. Construction: 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.
      a. Width: 3 inches.
      b. Overall Thickness: 5 mils.
      c. Foil Core Thickness: 0.35 mil.

d. Weight: 28 lb/1000 sq. ft.
e. Tensile according to ASTM D 882: 70 lbf and 4600 psi.

2.6 Signs

A. Baked-Enamel Signs:
1. Preprinted aluminum signs punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
2. Thickness:
a. For signs up to 20 sq. inches, minimum 1/16-inch-.
b. For signs larger than 20 sq. inches, 1/8 inch thick.
c. Engraved legend with black letters on white face for instruction signs and white letters on a dark grey background for identification signs.
d. Punched or drilled for mechanical fasteners.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

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. Ideal Industries, Inc.
2. Marking Services, Inc.
3. Panduit Corp.

B. 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.

C. 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.

D. 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.
   4. Temperature Range: Minus 50 to plus 284 deg F.
   5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

G. 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.

H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

I. 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.

J. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway 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.

3.3 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high black letters on 20-inch centers. Stop stripes at legends. Apply stripes to the following finished surfaces:
1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Snap-around labels. Install labels at 10-foot maximum intervals.

C. 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 tape applied in bands. Install labels at 10-foot maximum intervals.

D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels containing the wiring system legend and system voltage. System legends shall be as follows:
1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

E. 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, Neutral, Ground 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) 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) 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.

F. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.

G. Install instructional sign, including the color code for grounded and ungrounded conductors using adhesive-film-type labels.

H. 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.

I. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes, self-adhesive, self-laminating polyester labels, or self-adhesive vinyl labels with the conductor designation.

J. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

K. 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 operation and maintenance manual.

L. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
   1. Install underground-line warning tape for direct-buried cables and cables in raceways.

M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Metal-backed, butyrate warning signs.
   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.

N. Arc Flash Warning Labeling: Self-adhesive thermal transfer vinyl labels.

1. Comply with NFPA 70E and ANSI Z535.4.
2. Comply with Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.

O. 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.

P. 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.

Q. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and 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 unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine plastic label, or Engraved, laminated acrylic or melamine plastic label, punched or drilled for mechanical fasteners. 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 labels are provided with self-adhesive means of attachment, fasten them with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
      e. Black background with white letters for normal power. Red background with white letters for emergency power.
   2. Equipment To Be Labeled:
      a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
      b. Receptacles: Identify panelboard and circuit number from which served. Receptacle identification shall be adhesive film label.
      c. Enclosures and electrical cabinets.
      d. Access doors and panels for concealed electrical items.
      e. Switchboards.
      f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
      g. Emergency system boxes and enclosures.
      h. Enclosed switches.
      i. Enclosed circuit breakers.
      j. Enclosed controllers.
      k. Variable-speed controllers.
      l. Push-button stations.
      m. Power-transfer equipment.
      n. Contactors.
      o. Remote-controlled switches, dimmer modules, and control devices.

p. Power-generating units.
q. Monitoring and control equipment.
r. UPS equipment.

R. Diagram and instructions:
1. Frame and mount under clear acrylic plastic on the front of switchgear or on nearest adjacent wall.
a. Operating instructions: Printed basic instructions for switchgear, including control and key interlock sequences and emergency procedures.
b. System power riser diagrams: Depict power sources, feeders, distribution components, and major loads.

END OF SECTION

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 Conditions and Division 01 Specification Sections, apply to this Section.

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.

1.3 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.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
   1. Arc-flash study input data, including completed computer program input data sheets.
   2. Arc-flash 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 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 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.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and 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.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers:
   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. CGI CYME.
      b. EDSA Micro Corporation.
      c. ESA Inc.
      d. Operation Technology, Inc.
      e. Power Analytics, Corporation.
      f. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

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. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

F. 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.

G. 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.

H. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 26 05 53 "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. Preparatory Studies:
1. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.
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.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. 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.

G. 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).

H. 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.

I. 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 and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. 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, conducted by qualified technicians and engineers.

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. 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. 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. Switchgear.
   4. Medium-voltage switch.
   5. Control panel.

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 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Time switches.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching controls.
4. Indoor occupancy sensors.
5. Lighting contactors.
6. Emergency shunt relays.

1.3 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.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Intermatic, Inc. (ET90215C is CMS preferred model)
2. Invensys Controls.
3. NSi Industries LLC.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: See plans and details.
3. Contact Rating: 20-A load, 120-/277-V ac.

4. Programs: See plans and detail for channels; each channel is individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
6. Astronomic Time: All channels.
7. Automatic daylight savings time changeover.
8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.
9. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.
10.
11. Independent time switches are required for exterior lighting zones. It does not interface with the BAS system. Interior lighting zones not controlled by occupancy or vacancy sensors are controlled by contactors and the BAS.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Intermatic, Inc.
   2. Leviton Manufacturing Co., Inc.
   3. NSi Industries LLC.

B. Description: Solid state, with SPST dry contacts rated for 1800-VA, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
   3. Time Delay: Fifteen second minimum, to prevent false operation.
   4. Surge Protection: Metal-oxide varistor.
   5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 DAYLIGHT-HARVESTING SWITCHING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Industries, Inc.
   2. Hubbell Building Automation, Inc.
   3. Leviton Manufacturing Co., Inc.
   4. Lithonia Lighting; Acuity Brands Lighting, Inc.
   5. Sensor Switch, Inc.
   6. Watt Stopper.

B. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.

C. Electrical Components, Devices, and Accessories:

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. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor is powered by the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast/driver load at 120- and 277-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. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
6. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc, with an adjustment for turn-on and turn-off levels within that range.
7. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc, with an adjustment for turn-on and turn-off levels within that range.
8. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
9. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
10. Test Mode: User selectable, overriding programmed time delay to allow settings check.
11. Control Load Status: User selectable to confirm that load wiring is correct.
12. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.4 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Industries, Inc.
   2. Hubbell Building Automation, Inc.
   3. Leviton Manufacturing Co., Inc.
   4. Lithonia Lighting; Acuity Brands Lighting, Inc.
   5. Watt Stopper.

B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
   1. Lighting control set point is based on two lighting conditions:
      a. When no daylight is present (target level).
      b. When significant daylight is present.
   2. System programming is done with two hand-held, remote-control tools.
      a. Initial setup tool.
      b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
   3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
   4. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.

2.5 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Industries, Inc.
   2. Hubbell Building Automation, Inc.
   3. Leviton Manufacturing Co., Inc.
   4. Lithonia Lighting; Acuity Brands Lighting, Inc.
   5. Sensor Switch, Inc.
   6. Watt Stopper.
   7. Sensorworx

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 30 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. Bypass Switch: Override the "on" function in case of sensor failure.
   8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.
   1. 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.
   2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
   3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.

D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
   1. Detector Sensitivity: Detect a person of average 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.
   2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.

E. 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 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 (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.6 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Switchbox mounted occupancy sensors are specified in Section 26 27 26 "Wiring Devices."

2.7 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Description: Electrically operated and electrically held, combination-type lighting contactors with, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.
5. Contactors shall fail closed.

C. Interface with DDC System for HVAC: Provide hardware interface and low voltage switching to enable the DDC(BAS) system for HVAC to monitor and control of lighting contactors.
1. Monitoring: On-off status, See plans and details.
2. Control: On-off operation, See plans and details.
3. Provide a bypass timer for each lighting zone. These timers will provide an input to the BAS while they are timing and have a maximum setting of 4 hours. They will be grouped at the front office. If a timer is activated, it will bypass the normal schedule for the set hours and close the lighting contactor. When the timer times out, it will cause the contactor state to revert to whatever is specified in the time base. Five

minutes before the timer is to time out, it will cause the contactor to drop out for an instant as a warning that if additional time is desired, the timer needs to be reset. Mechanical controls contractor to provide and install low voltage wiring from timers to BAS. Provide a phenolic label above each override switch in the office, that describes the zone controlled. (I.e. "CORRIDOR OVERRIDE")

4. Intrusion detection override.
5. An ON-OFF-AUTO switch will be provided. The Mechanical controls Contractor shall wire the switch to interface to the BAS to function as follows:
   a. AUTO: BAS control of lights. enabled with burglar alarm and bypass switch/time r override enabled.
   b. ON: BAS control of lights enabled with burglar alarm and bypass switch/timer o verrides disabled.
   c. OFF: BAS control of lights disabled with burglar alarm and bypass switch/timer overrides disabled. Lights under local switch control only.
6.

2.8 EMERGENCY SHUNT RELAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Lighting Control and Design.
   2. Watt Stopper.
   3. Bodine.
   4. Dual Lite
   5. IOTA
   6. Chloride

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: 120 or 277 V. Unless otherwise noted on plans.

2.9 ROOM LIGHTING CONTROLS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings (Watt Stopper) or a comparable product by one of the following:
   1. Hubbell Lighting.
   2. Leviton Mfg. Company Inc.
   3. Lithonia Lighting; Acuity Lighting Group, Inc.
   4. Lutron.

B. Switch Controller:
   1. Single Relay Room Controller: Watt Stopper Model LMRC-101.
   2. Dual Relay Room Controller: Watt Stopper Model LMRC-102.

C. Dimming (0-10V) Controller:
   1. Single Relay Room Controller: Watt Stopper Model LMRC-211.
   2. Dual Relay Room Controller: Watt Stopper Model LMRC-212.

D. Dimming (120V) Controller:
   1. Single Relay Room Controller: Watt Stopper Model LMRC-221.
   2. Dual Relay Room Controller: Watt Stopper Model LMRC-222.

E. Occupancy Sensor:
   1. Corner Mount: Watt Stopper Model LMDX-100.
   2. Ceiling Mount: Watt Stopper Model LMDC-100.

F. Push Button Stations:
   1. One Button: Watt Stopper Model LMSW-101 W.
   2. Two Button: Watt Stopper Model LMSW-102 W.
   3. Three Button: Watt Stopper Model LMSW-103 W.
   4. Four Button: Watt Stopper Model LMSW-104 W.

G. Dimming Stations:
   1. Dimming Wall Switch: Watt Stopper Model LMDM-101 W.

H. Digital Five Button Scene Switch:

   1. Watt Stopper Model LMSW-105.

I. Daylight Sensor:
   1. Ceiling Mount Watt Stopper Model LMLS-500.

J. Emergency Control Unit:
   1. Watt Stopper Model ELCU-200.

K. Wireless Configuration Tool:
   1. Provide one Digital Wireless Configuration Tool. Watt Stopper Model LMCT-100.

2.10 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 05 19 "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 Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 26 05 19 "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.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Section 26 05 19 "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 nonpower-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 26 05 53 "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 SENSOR SETTINGS

A. Occupancy and Vacancy sensor time settings (unless otherwise noted on the plans):
   1. Classroom: 30 mins
   2. Offices: 5 mins
   3. Storage and individual restrooms: 2 mins
   4. Conference rooms: 10 mins
   5. Other spaces: 15 mins

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   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.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial 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.
1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.8 DEMONSTRATION

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

END OF SECTION

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General 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. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.
   1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
   2. 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.
   2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
   3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
   4. Detail bus configuration, current, and voltage ratings.
   5. Short-circuit current rating of panelboards and overcurrent protective devices.
   6.
   7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   8. Include wiring diagrams for power, signal, and control wiring.

9.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "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.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1 "Panelboards."

F. Comply with NFPA 70, "National Electrical Code."

G. Comply with NECA 1, "Standard for Good Workmanship in Electrical Construction."

H. Comply with NECA 407, "Recommended Practice for Installing and Maintaining Panelboards."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

1.10 FIELD 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 23 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: 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 Architect no fewer than seven days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Architect's written permission.
3. Comply with NFPA 70E.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards 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 NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
      b. Outdoor Locations: NEMA 250, Type 3R.
      c. Kitchen and Wash-Down Areas: NEMA 250, Type 3R, if exposed. NEMA 1 for flush mounted applications.
      d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   2. Height: 84 inches maximum.
   3. Front: For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
   4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Cover to be secured with screws. Inner door to be secured to box with concealed trim clamps. Trims shall cover all live parts and shall have no exposed hardware. ("Door in Door" construction.)
   5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
   6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
   7. Finishes:
      a. Panels and Trim: 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: Galvanized steel.

G. Incoming Mains:
   1. Location: As indicated on the Drawings.

H. Phase, Neutral, and Ground Buses:
   1. Material: Hard-drawn copper, 98 percent conductivity.
      a. Plating shall run entire length of bus.
      b. Bus shall be fully rated the entire length.
   2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
   3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
   4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.

I. Conductor Connectors: Suitable for use with conductor material and sizes.
   1. Material: Hard-drawn copper, 98 percent conductivity.
   2. Terminations shall allow use of 75 deg C rated conductors without derating.
   3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
   4. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
   5. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.

6. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Compression type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

J. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. See plans for locations this is required.

K. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 FUSIBLE PANELBOARDS (Selective Coordination Panelboards)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bussman; Eaton Corporation.
2. Mersen.
3. Siemens
4. Littelfuse

B. PANELBOARD RATINGS
a. Panelboards shall be labeled with a short-circuit current rating equal to or greater than that indicated on the associated schedules or drawings.
b. Non-service entrance rated panelboards shall be UL and cULus Listed. Service entrance rated panelboards shall be UL Listed.
c. Panelboards shall be rated >= system voltages up to 600Vac/125Vdc and have a current rating as indicated on the associated schedules or drawings.
d. Panelboard overcurrent protective device interrupting ratings shall be fully rated for the maximum available fault current and have a UL Listed interrupting rating of 300kA and CSA Certified interrupting rating of 200kA.
e. Current ratings, configuration of poles and number of circuits shall be indicated on associated schedules or drawings.
f. Panelboard circuits 100A and less shall incorporate overcurrent protection and branch-circuit rated disconnecting means into a single integrated component.
g. Interiors shall be factory assembled.
h. Panelboard shall be equipped with a six-space spare fuse compartment for storing replacement branch circuit fuses. Spare fuse compartment shall be located behind locking panel door.

i. Bus bars shall be tin-plated copper with sufficient cross-sectional area to meet UL 67 temperature rise requirements.
j. 200A/400A rated neutrals shall be standard, 400A or 800A rated neutral shall be provided where indicated in the associated schedules or drawings.
k. Main lug conductor terminations:
l. NEMA 1 panelboards shall be field convertible for top or bottom incoming feed. NEMA 3R panelboards are bottom feed only.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.4 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company, (ABB)
3. Siemens Energy.
4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, distribution type.

C. Mains: As indicated on the Drawings.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company, ABB.
3. Siemens Energy.
4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only as indicated on the Drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Door-in-door construction with concealed hinges; outer door secured with screws and inner door secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Sector; Eaton Corporation.
   2. General Electric Company; GE Energy Management - Electrical Distribution.
   3. Siemens Energy.
   4. Square D; by Schneider Electric.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers:
      a. Inverse time-current element for low-level overloads.
      b. Instantaneous magnetic trip element for short circuits.
      c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic Trip Circuit Breakers:
      a. RMS sensing.
      b. Field-replaceable rating plug or electronic trip.
      c. Digital display of settings, trip targets, and indicated metering displays.
      d. Multi-button keypad to access programmable functions and monitored data.
      e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
      f. Integral test jack for connection to portable test set or laptop computer.
      g. Field-Adjustable Settings:
         1) Instantaneous trip.
         2) Long- and short-time pickup levels.
         3) Long and short time adjustments.
         4) Ground-fault pickup level, time delay, and I squared T response.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
   6. Subfeed Circuit Breakers: Vertically mounted.
   7. MCCB Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Breaker handle indicates tripped status.
      c. UL listed for reverse connection without restrictive line or load ratings.
      d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
      e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
      f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
      g. Shunt Trip: 120-V Insert voltage trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
      h. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
      i. Multipole units enclosed in a factory assembled to operate as a single unit.
      j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

k. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories:
a. Standard ampere ratings and number of poles.
b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.

2.7 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, AIC ratings, short-circuit rating, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits. Provide updated labeling based on room final identification.
2. Spare breakers shall be in the off position.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

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.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.

D. Equipment Mounting:
   1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
   2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
   3. Comply with requirements for seismic control devices specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

G. Mount top of trim 90 inches above finished floor unless otherwise indicated.

H. Mount panelboard cabinet plumb and rigid without distortion of box.

I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

J. Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in the following paragraph provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection.

K. Mount surface-mounted panelboards to steel slotted supports 5/8 inch or 1 1/4 inch in depth. Orient steel slotted supports vertically.

L. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.
   2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

M. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

N. Install filler plates in unused spaces.

O. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

P. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

Q. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

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. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1.
   2. 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 panelboard. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
      c. Instruments and Equipment:
         1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
      d. All circuit breakers rated 1200A or higher, capable of being rated 1200A or higher (I.e adjustable long-time pickup or replaceable trip/rating plug), shall be provided with an energy-reducing maintenance switch with local status indicator. The electrical contractor shall be responsible for performance testing (primary current injection or other approved method) and documentation required per NEC 240.87(c).

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. 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.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Wall-box occupancy sensors.
3. Twist-locking receptacles.
4. Tamper-resistant receptacles.
5. Weather-resistant receptacles.
6. Snap switches and wall-box dimmers.
7. Solid-state fan speed controls.
8. Wall-switch sensors.
9. Pendant cord-connector devices.
10. Cord and plug sets.
11. Floor service outlets, poke-through assemblies, service poles, and multi-outlet assemblies.

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.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Wiring Devices:
      a. Cooper Wiring Devices.
      b. Hubbell Incorporated; Wiring Device-Kellems.
      c. Leviton Manufacturing Co., Inc.
      d. Pass & Seymour/Legrand (Pass & Seymour).
   2. Wall Box Occupancy/Vacancy Sensors:
      a. Cooper Wiring Devices
      b. Hubbell Building Automation (Hubbell).
      c. Leviton.
      d. Sensorswitch.
      e. Legrand WattStopper/Pass & Seymour.
      f. Sensorworx

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, 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.

C. Commercial grade.

D. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
   1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
   2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Single receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper.
      b. Hubbell.

c. Leviton.
d. Pass & Seymour.

B. Duplex Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Cooper
b. Hubbell
c. Leviton.
d. Pass & Seymour.

C. 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. Products: Subject to compliance with requirements, provide one of the following:
a. Cooper.
b. Hubbell.
c. Leviton.
d. Pass & Seymour.
2. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, and "Pediatric Locations" Section.

2.4 GFCI RECEPTACLES

A. General Description:
1. Straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
4. Self-testing, specification grade.
5. Commercial grade.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Hubbell
b. Leviton
c. Pass & Seymour
d. Cooper
e.

C. Weather-Resistant Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Cooper
b. Hubbell.
c. Leviton.
d. Pass & Seymour.

D. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Cooper.
b. Hubbell.
c. Leviton.
d. Pass & Seymour.

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

B. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; L520R.
      b. Hubbell; HBL2310.
      c. Leviton; 2310.
      d. Pass & Seymour; L520R.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description:
   1. Matching, locking type plug and receptacle body connector.
   2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
   3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
   4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.7 CORD AND PLUG SETS

A. Description:
   1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
   2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
   3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A (rated for both voltages):
   1. Single Pole:
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) Cooper; CS120.
         2) Hubbell; CS120.
         3) Leviton; CS120-2.
         4) Pass & Seymour; CS20AC1.
   2. Two Pole:
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) Cooper; CS220.
         2) Hubbell; CS1222.

3) Leviton; CS220-2.
4) Pass & Seymour; CSB20AC2.

3. Three Way:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Cooper; CS320.
      2) Hubbell; CS320.
      3) Leviton; CS320-2.
      4) Pass & Seymour; CS20AC3.
4. Four Way:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Cooper; CS420.
      2) Hubbell; CS420.
      3) Leviton; CS420-2.
      4) Pass & Seymour; CS20AC4.

C. Pilot-Light Switches, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper
      b. Hubbell
      c. Leviton
      d. Pass & Seymour
   2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Key-Operated Switches, 120/277 V, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 2221L.
      b. Hubbell; HBL1221L.
      c. Leviton; 1221-2L.
      d. Pass & Seymour; PS20AC1L.
   2. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 2221L.
      b. Hubbell; HBL1221L.
      c. Leviton; 1221-2L.
      d. Pass & Seymour; PS20AC1L.

2.9 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
   1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "off."

2.10 OCCUPANCY/VACANCY SENSORS

A. Wall Box Occupancy Sensors:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Single level (One Relay):
1) Hubbell.
2) Leviton.
3) Sensorswitch.
4) Watt Stopper.
5) Sensorworx

2.11 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch-thick, satin-finished, Type 302 stainless steel.
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with lockable cover.

2.12 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand (Pass & Seymour).
3. Square D; by Schneider Electric.
4. Thomas & Betts Corporation, A Member of the ABB Group.
5. Wiremold / Legrand.

B. Description:
1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: Flush type with services indicated complying with requirements in Section 27 02 00 "Communications Cabling."
4. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 27 02 00 "Communications Cabling."

2.13 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:
1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold / Legrand.

B. Description:
1. Two-piece surface metal raceway, with factory-wired multi-outlet harness.
2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard finish.

D. Multi-outlet Harness:
1. Receptacles: 20-A, 125-V, NEMA WD 6 Configuration 5-20R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
2. Receptacle Spacing: 12 inches.
3. Wiring: No. 12 AWG solid, Type THHN copper, see plans for circuiting.

2.14 SERVICE POLES

A. Description:
1. Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
2. Poles: Nominal 2.5-inch-square cross section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.
3. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
4. Finishes: Manufacturer's standard painted finish and trim combination.
5. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, four-pair, Category 6 voice and data communication cables.
6. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.
7. Voice and Data Communication Outlets: Blank insert with bushed cable opening complying with requirements in Section 27 15 00 "Communications Horizontal Cabling."

2.15 USB Receptacles

A. Tamper-Resistant Duplex Straight-Blade Receptacle with USB Outlet to Power Class 2 Equipment.
1. Manufacturers:
a. Cooper.
b. Hubbell.
c. Leviton.
d. Pass & Seymour.
e.
2. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
3. General Characteristics:
a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
a. Configuration:
1) General-duty, NEMA 5-20R; one USB-A port; one USB-C port.

b. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
c. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

B.

2.16 FINISHES

A. Device Color:
1. Wiring Devices Connected to Normal Power System: Gray unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:
1. Protect installed devices and their boxes. 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 boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
a. Cut back and pigtail or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:
1. Replace devices that have been in temporary use during construction and that 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 in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. 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.

G. Dimmers:
1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service poles to suit arrangement of partitions and furnishings.

J. Tamper resistant receptacles:
1. Provide tamper resistant receptacles in all Elementary school facilities.

3.2 OCCUPANCY SENSORS

A. Sensors shall be set for vacancy mode of operation.

B. Minimum time of vacancy shall be set for 30 minutes.

3.3 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Label shall be applied inside the receptacle junction box, on the edge of the box closest to the face of the wall and visible after device is installed.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test Instruments: Use instruments that comply with UL 1436.
   2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display 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 unacceptable.
   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. 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.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Cartridge fuses rated 600 V ac and less for use in the following:
      a. Panelboards.
      b. Switchboards.
      c. Enclosed controllers.
      d. Enclosed switches.

1.3 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.
   6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. 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 PDF format.
   4. Coordination charts and tables and related data.

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. Comply with NEMA FU 1, "Low Voltage Cartridge Fuses."

C. Comply with NFPA 70, "National Electrical Code."

D. Comply with NECA 420, "Standard for Fuse Applications."

E. UL/CSA/ANCE 248

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly 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. Littelfuse, Inc.
3. Mersen

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: 250 or 600-V, zero- to 600-A rating, 200 kA IR, time delay.
2. Type RK-5: 250 or 600-V, zero- to 600-A rating, 200 kA IR, time delay.
3. Type J: 600-V, zero- to 600-A rating, 200 kA IR, time delay.
4. Type CF: 600-V, zero- to 400-A rating, 200kA IR, time delay
5.

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.

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 L, time delay, Class RK1, time delay, Class RK5, time delay.
3. Motor Branch Circuits: Class RK5, time delay, Class J, time delay, Class CF, time delay, Class RK1, time delay.
4. Power Electronics Circuits: Class J, high speed, Class CF.
5. Other Branch Circuits: Class RK1, time delay, Class CF, time delay, Class J, time delay.

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 26 05 53 "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

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Molded-case switches.
5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.5 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. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. 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.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. 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.

D. Manufacturer's field service report.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. 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.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Fuse Pullers: Two for each size and type.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. 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.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.10 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: 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 Architect and 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.

1.11 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 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Sector; Eaton Corporation.
   2. General Electric Company, ABB.
   3. Siemens Industry, Inc.
   4. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. 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. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Lugs: Compression type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. 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. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Lugs: Compression type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company, ABB.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. 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: Compression 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, provide products by one of the following:
1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

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: Compression 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.
5. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
6.

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 3R.
   3. Kitchen Areas: NEMA 250, Type 3R.
   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. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 26 05 53 "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. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. 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.

E. 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. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
      c. 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.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. 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.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

END OF SECTION

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes packaged engine-generator sets for emergency power supply with the following features:

1. Diesel engine.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

B. EPS: Emergency power supply.

C. EPSS: Emergency power supply system.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.

1. Include the following:
   a. Operating instructions laminated and mounted adjacent to generator location.
   b. Training plan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Caterpillar; Engine Div.

2.2 ENGINE

A. Fuel: Fuel oil, Grade DF-2.

2.3 DIESEL FUEL-OIL SYSTEM

A. Provide re-fueling of both generator sets after testing and training.

PART 3 - EXECUTION

3.1 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. Generator units are existing and the intent is for full testing and corrective measures to be taken so the units are in good working condition for the use of the upfit facilities.

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.

C. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs as specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

a. Visual and Mechanical Inspection

1) Compare equipment nameplate data with drawings and specifications.
2) Inspect physical and mechanical condition.
3) Inspect anchorage, alignment, and grounding.
4) Verify the unit is clean.

b. Electrical and Mechanical Tests

1) Perform insulation-resistance tests in accordance with IEEE 43.

a) Machines larger than 200 horsepower. Test duration shall be 10 minutes. Calculate polarization index.
b) Machines 200 horsepower or less. Test duration shall be one minute. Calculate the dielectric-absorption ratio.

2) Test protective relay devices.
3) Verify phase rotation, phasing, and synchronized operation as required by the application.
4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
5) Conduct performance test in accordance with NFPA 110.
6) Verify correct functioning of the governor and regulator.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.

a. Perform a 4 hour load bank test which shall be witnessed by owner's commissioning agent. On-site testing in the presence of the owner shall include testing of all safety devices and shall include a four hour running test first at 50% load for 1 hour, then at 75% load for 1 hour and last at 100% load for 2 hours. Then, after the cool down period the generator shall be started and after 10 seconds be applied 100% load for 30 minutes. The capability of the system to pick up full standby service load within 60 seconds of power outage shall also be demonstrated. Manufacturer approve service representative shall furnish load bank.

3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
   b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
   c. Verify acceptance of charge for each element of the battery after discharge.
   d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
7. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.

D. Coordinate tests with tests for transfer switches and run them concurrently.

E. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

F. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

I. Remove and replace malfunctioning units and reinspect as specified above.

J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.2 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

3.3 DEMONSTRATION

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

END OF SECTION

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with 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.

C. Comply with UL 1449, latest Edition.

D. MCOV of the SPD shall be the nominal system voltage.

E. Comply with IEEE C62.41.1: 2002, "Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits".

F. Comply with IEEE C62.41.2: 2002, "Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits".

G. Comply with IEEE C62.45: 2002, "Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits".

H. Comply with IEEE C62.62: 2000, "Standard Test Specifications for Surge Protective Devices for Low Voltage (1000V and Less) AC Power Circuits".

I. Comply with IEEE C62.72: 2007, "Guide for the Application of Surge Protective Devices for Low Voltage (1000V and Less) AC Power Circuits".

J. Comply with NEMA LS 1.

K. Comply with UL 769 9th Edition, Printed Wiring Boards".

L. Comply with UL 1283 5th Edition, "Electromagnetic Interference Filters".

2.2 SERVICE ENTRANCE SUPPRESSOR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASCO - Emerson
   2. Current Technology Inc.
   3. SOLA
   4. RayCap
   5. LEA International.
   6. ASCO/Schneider Electric

B. SPDs: Comply with UL 1449, Type 2.

C. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2
   1. SPDs with the following features and accessories:
      a. Indicator light display for protection status.
      b. Surge counter.

D. Comply with UL 1283.

E. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

F. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and/or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
   1. Line to Neutral: 1200 V for 480Y/277 V and/or 700 V for 208Y/120 V.
   2. Line to Ground: 1200 V for 480Y/277 V and/or 1200 V for 208Y/120 V.
   3. Line to Line: 2000 V for 480Y/277 V and/or 1000 V for 208Y/120 V.

G. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
   1. Line to Neutral: 700 V.
   2. Line to Ground: 700 V.
   3. Line to Line: 1000 V.

H. SCCR: Equal or exceed 100 kA.

I. Inominal Rating: 20 kA.

2.3 PANEL SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASCO - Emerson Current Technology Inc.
   2. SOLA
   3. LEA International.
   4. RayCap

B. SPDs: Comply with UL 1449, Type 2.
   1. Include LED indicator lights for power and protection status.
   2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Comply with UL 1283.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and/or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V and/or 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V and/or 700 V for 208Y/120 V.
3. Neutral to Ground: 1200 V for 480Y/277 V and/or 700 V for 208Y/120 V.
4. Line to Line: 2000 V for 480Y/277 V and/or 1200 V for 208Y/120 V.

F. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.
4. Line to Line: 1200 V.

G. SCCR: Equal or exceed 100 kA.

H. Inominal Rating: 20 kA.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

2.5 CONDUCTORS AND CABLES

A. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:
1. Power Wiring: Comply with wiring methods in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Coordinate with Owner’s testing agency which will perform the following tests and inspections with the assistance of a factory-authorized service representative.
1. Compare equipment nameplate data for compliance with Drawings and Specifications.

2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION

This Master Specification Section summarizes Charlotte-Mecklenburg Schools' standards and requirements for the Work of this Section. This document may be edited by holders of a valid Masterspec license: www.Masterspec.com. Design professional of record shall edit this document to correspond to Project requirements. Obtain CMS approval for manufacturers and products not listed in this Master Section.

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General 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. 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, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project IES LM-79 and IES LM-80.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

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, and required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lighting luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:
a. Other luminaires.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Ceiling-mounted projectors.
7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of luminaire.

F. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Fixtures will be required to be DesignLights Consortium compliant (DLC). Fixtures specified must meet DLC certification or the supplier will be responsible for submitting a DLC compliant fixture this is equal to the listed schedule fixture. Downlights must be "Energy Star" rated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

2.2 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. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. Comply with NECA/IESNA 500, "Standard for Installing Interior Commercial Lighting Systems."

D. Comply with NECA/IESNA 502, "Standard for Installing Industrial Lighting Systems."

E. Comply with UL 1598, "Standard for Luminaires."

F. Comply with UL 8750, "Standard for Safety for Light Emitting Diode (LED) Equipment for Use in Lighting Products."

G. Comply with IESNA LM-79, "Electrical and Photometric Measurements of Solid-State Lighting Products".

H. Comply with IESNA LM-80, "Measuring Lumen Maintenance of LED Light Sources."

I. Recessed Fixtures: Comply with NEMA LE 4.

J. CRI of minimum 80. CCT of 4000 K.

K. Rated L70 lamp life a minimum of 50,000 hours.

L. Lamps dimmable from 100 percent to 10 percent of maximum light output.

M. Internal driver. Provide quick disconnect for the driver and diode boards.

N. Nominal Operating Voltage: See lighting schedule.
   1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

O. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Powder-coat finish.

2.3 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.4 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 relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. 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.

2.5 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.

2.6 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "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.

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. Install lamps in each luminaire.

D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   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.

E. 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.

F. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.
   2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:
   1. Ceiling mount with pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
   2. Ceiling mount with hook mount.

H. 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 wire support for suspension for each unit length of luminaire chassis, including one at each end, unless otherwise noted on plans.
   4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaire Supports: Use grid as a support element.
   1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inches from luminaire corners.
   2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
   3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
   4. Install at least one independent support rod or wire from structure to a tab on luminaire. Wire or rod shall have breaking strength of the luminaire weight at a safety factor of 3.

J. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

K. High bay exposed lighting shall be supplied with a cord and plug assembly (lockable.)

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. 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.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
   1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
   2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

This Master Specification Section summarizes Charlotte-Mecklenburg Schools' standards and requirements for the Work of this Section. This document may be edited by holders of a valid Masterspec license: www.Masterspec.com. Design professional of record shall edit this document to correspond to Project requirements. Obtain CMS approval for manufacturers and products not listed in this Master Section.

SECTION 265219 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Emergency lighting units.
   2. Exit signs.
   3. Luminaire supports.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
   1. Include data on features, accessories, and finishes.
   2. Include physical description of the unit and dimensions.
   3. Battery and charger for light units.
   4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
   5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
      a. Testing Agency Certified Data: For indicated luminaires and signs, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires and signs shall be certified by manufacturer.

b. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment 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.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment will be attached.
5. Size and location of initial access modules for acoustical tile.
6. Items penetrating finished ceiling including the following:
a. Other luminaires.
b. Air outlets and inlets.
c. Speakers.
d. Ceiling-mounted projectors.
e. Sprinklers.
f. Access panels.
7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of luminaire.

D. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Test Reports: For each luminaire for tests performed by manufacturer and witnessed by a qualified testing agency.

F. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two year(s) from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Emergency Power Unit Batteries: 5 years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.
   2. Warranty Period for Emergency drivers and Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

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. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Comply with NECA/IESNA 500, "Standard for Installing Interior Commercial Lighting Systems."

F. Comply with NECA/IESNA 502, "Standard for Installing Industrial Lighting Systems."

G. Comply with UL 8750, "Standard for Safety for Light Emitting Diode (LED) Equipment for Use in Lighting Products."

H. Comply with IESNA LM-79, "Electrical and Photometric Measurements of Solid-State Lighting Products".

I. Comply with IESNA LM-80, "Measuring Lumen Maintenance of LED Light Sources."

J. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with driver.
   1. Emergency Connection: Operate LED lamp(s) continuously at an output of 1100 lumens upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
   2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
      b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
      c. Humidity: More than 95 percent (condensing).
      d. Altitude: Exceeding 3300 feet.
   4.
   5. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
      a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   6. Battery: Sealed, maintenance-free, nickel-cadmium type.
   7. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
   8. Remote Test: Switch in handheld 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. See plans for locations.
   9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

K. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.

1. Emergency Connection: Operate LED lamping continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire driver.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Battery: Sealed, maintenance-free, nickel-cadmium type.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the emergency power unit manufacturer, whichever is less.
6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
8. Remote Test: Switch in handheld 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. See plans for requirements.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.3 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units:

B. Single Manufacturer: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.4 External emergency power unit 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.
2. Operating at nominal voltage of see plans.
3. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
4. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.
5. Master/Remote Sign Configurations:
    a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply battery for power connection to remote unit.
    b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery, and test features. Arrange to receive full

power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.5 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:
1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.6 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:
   1. Sized and rated for luminaire and emergency power unit weight.
   2. Able to maintain luminaire position when testing emergency power unit.
   3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.
   2. Do not attach luminaires directly to gypsum board.

F. 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.

G. Ceiling Grid Mounted Luminaires:
   1. Secure to any required outlet box.
   2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
   3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service:

1. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:
   1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.
      a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   2. Conduct short-duration tests on all emergency lighting.

END OF SECTION

This Master Specification Section summarizes Charlotte-Mecklenburg Schools' standards and requirements for the Work of this Section. This document may be edited by holders of a valid Masterspec license: www.Masterspec.com. Design professional of record shall edit this document to correspond to Project requirements. Obtain CMS approval for manufacturers and products not listed in this Master Section.

SECTION 265619 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
   2. Luminaire supports.
   3. Luminaire-mounted photoelectric relays.

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. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.
   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaire.
   4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
   5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The

adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79.

a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

6. Wiring diagrams for power, control, and signal wiring.
7. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

C. Delegated-Design Submittal: For luminaire supports.
1. Include design calculations for luminaire supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
2. Structural members to which equipment and luminaires will be attached.
3. Underground utilities and structures.
4. Existing underground utilities and structures.
5. Above-grade utilities and structures.
6. Existing above-grade utilities and structures.
7. Building features.
8. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of the following:
1. Luminaire.
2. Photoelectric relay.

E. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

F. Source quality-control reports.

G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
   1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
   2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

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

F. Comply with IEEE C2, "National Electrical Safety Code."

G. Comply with NFPA 70, “National Electrical Code.”

H. Comply with NECA/IESNA 501, “Standard for Installing Exterior Lighting Systems.”

I. Comply with UL 1598, “Standard for Luminaires.”

J. Comply with UL 8750, “Standard for Safety for Light Emitting Diode (LED) Equipment for Use in Lighting Products.”

K. Comply with IESNA LM-79, “Electrical and Photometric Measurements of Solid-State Lighting Products”.

L. Fixtures will be required to be DesignLights Consortium compliant (DLC). Fixtures specified must meet DLC certification or supplier will be responsible for submitting an “equal” fixture to the listed schedule fixture.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.9 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including luminaire support components.
      b. Faulty operation of luminaires and accessories.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

2.3 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. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. UL Compliance: Comply with UL 1598 and listed for wet location.

D. CRI of minimum 80. CCT of 5000 K.

E. L70 lamp life minimum of 50,000 hours.

F. Lamps dimmable from 100 percent to 10 percent of maximum light output.

G. Internal driver. Provide a quick disconnect for driver and diode board.

H. Pole mounted fixtures shall be supplied with internal surge protection.

I.

J. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.4 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:
1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

G. Housings:
1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located 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.

2.5 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
   2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
      a. Color: Dark bronze.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
   2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
      a. Color: As selected from manufacturer's standard catalog of colors.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

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 electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

D. 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 substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Support luminaires without causing deflection of finished surface.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

H. Coordinate layout and installation of luminaires with other construction.

I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

J. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 03 30 00 "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Verify operation of photoelectric controls.

C. Illumination Tests:
   1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s), as applicable to the specific luminaire use:
      a. IES LM-5.
      b. IES LM-50.
      c. IES LM-52.
      d. IES LM-64.
      e. IES LM-72.
   2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.8 DEMONSTRATION

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

3.9 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
   1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
   2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 270101 - COMMUNICATIONS GENERAL REQUIREMENTS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Division 01 Specifications, apply to the work specified in this Section.

1.02 SUMMARY

A. Section Includes:
   1. General requirements for the 270110, 270105, and 270200 Sections.

B. Telecommunications Contractor Responsibilities
   1. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Construction Documents.
   2. All services shall commence in accordance with the master construction schedule. The Telecommunications Contractor will provide schedule information to the General Contractor to assist in the development of the Master Schedule.
   3. Federal, state, local codes, rules, regulations, ordinances, and current industry standards governing the work are as fully part of these specifications as if herein repeated or hereto attached. If the Telecommunications Contractor should note items in the Construction Documents or the Specifications, construction of which would be code violations or not adhere to current industry standards, then the Telecommunications Contractor shall promptly call the suspected violations or deviations to the attention of the Designer in writing.

1.03 SCOPE OF WORK

A. The work covered under this Section shall include but is not limited to furnishing and installing all equipment, materials, and labor to provide a complete telecommunications system within the intent of, and as shown on the drawings and herein specified for the distribution of networked data, and wireless access points signals.

B. All cables and related terminations cross-connects, equipment, support and grounding hardware shall be furnished, installed, tested, labeled, and documented by the Contractor.

C. Description of project

D. The Horizontal (Telecommunications rooms and workstations) Cabling System for Networked Data (For new schools, voice will be cabled as a data networked drop and designated as a data drop) (For existing schools with existing voice horizontal cables terminated on 66 blocks, 110 blocks, or the plug and play system terminated on patch panels, voice will cabled as a voice drop) shall consist of 4-pair unshielded twisted pair (UTP) copper cables to each work area outlet as noted on the Construction Documents (drawings). These cables shall be installed from the Work Area Outlets or wall outlets to the designated Telecommunications Rooms (TR's) (in renovations these telcom rooms may be labeled 'IC') as indicated on the Construction Drawings and routed to the appropriate data rack serving that area and terminated as specified in this document for data.

E. The Horizontal Cabling System for the Wireless Access Points shall consist of 4-pair UTP copper cables to each wireless access point location from the TR. At the TR, these cables will terminate on modular patch panels within the data racks on yellow RJ45 modules.

F. The Backbone Data Cabling System consists of Single-Mode Fiber from the main telcom room (MDF) to each intermediate telcom rooms (IDF or TR/IC).
   1. Provide 12 strand plenum armored fiber-Single-Mode to each TR (unless routing underground and/or between buildings, in that case provide water-blocking cables).
   2. Terminate each strand with LC connectors.
   3. Terminate in fiber enclosures mounted in the data racks.
   4. For loose-tube fiber terminations utilize fan out kits.

G. The Contractor shall install Owner provided wireless access points and directional antennas. Installation shall be in accordance with the manufacturer's installation guidelines. Provide all cores necessary for a complete install. Coordinate equipment pick-up with CMS Telecommunications' Field Managers.

H. Coordinate with Service Providers for entrance pathways and entrance services. Ensure that dial tone is received with other disciplines need for the dial-tone or the network circuit.

I. Contractor shall coordinate with electrical contractor (EC) prior to EC installing the telecom pathways.

J. Product specifications and installation requirements are provided under Division 27. Quantities of telecommunications outlets, typical installation details, cable routing, and outlet types will be provided on the Construction Drawings. The successful Contractor shall meet or exceed all requirements for the cable system described in this document.

K. The Construction Drawings are diagrammatic only. They are not intended to show every detail of the construction projector every item or material that is required. The intent of the Construction Documents includes constructing complete and working systems.

1.04 WORK NOT INCLUDED

A. Providing 120v wiring.

B. Providing outlets, unless otherwise noted.

C. Providing conduit, or cable tray pathways, unless otherwise noted.

D. The telephone switch, telephone instruments, network electronics, including servers, routers, computers, and other active devices. These items will be provided and installed by the Owner.

E. Cross-connecting to the network electronics will be performed by the Owner.

F. Category 6 patch cords, Voice jumper cables, and Fiber Patch cords, unless otherwise noted.

1.05 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Floor mounted cabinets, racks and cable pathways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1.06 DEFINITIONS

A. AHJ Authority Having Jurisdiction

B. BICSI Building Industry Consulting Service International

C. EC Electrical Contractor

D. EMI Electromagnetic Interference

E. GC General Contractor

F. IDF (TR/IC) Intermediate Distribution Frame

G. IP Internet Protocol

H. MC MDF/Main Telecom Room

I. MDF Main Distribution Frame

J. MHz Megahertz

K. NEC National Electric Code

L. NEMA National Electrical Manufacturers Association

M. PoE Power Over Ethernet

N. TC Telecommunications Contractor

O. TGB Telecommunications Grounding Bus Bar

P. TMGB Telecommunications Main Grounding Bus Bar

Q. TR (IC) Telecommunications Room

R. UL Underwriters Laboratory, Inc

S. UTP Unshielded Twisted Pair Cable

T. WG Wire Guard Cages

1.07 PRODUCT DATA SHEET SUBMITTAL REQUIREMENTS

A. Product data sheet submittals are required and shall include the following for review. Submittals not containing all the information listed below will be rejected. (Note: product data submittals will not be reviewed until the TC submits acceptable contractor qualification submittal. See Section 270101-1.08.)

B. Before submitting a product sheet or related material, the TC shall
   1. Review each such submission for conformance with the TC's means, methods, techniques, sequences and operations of construction and safety precautions, and programs incidental thereto, all of which are the sole responsibility of the TC.
   2. Review and coordinate each such submission with other related or affected work.
   3. Approve each such submission before submitting same.

C. Submittals shall include the following.

1. The Contractor shall submit shop drawings detailing the room layouts, rack elevations, as well as any deviations from the documents and drawings.
   a. Contractor shall create shop drawings utilizing the Contractor's titleblock and sheet format.
   b. Contractor shall note the RCDD responsible for the creation of the shop drawings and submittal documentation.
2. Provide product data (including cut sheets and catalog information), and samples required by the Contract Documents for the networking main and intermediate distribution frames including the equipment, racking, rack elevations, wall mounted equipment and all associated accessories, components, and equipment to be installed therein.
3. Manufacturer's data sheets for the telecommunications outlets, jacks, faceplates, all terminations, and termination equipment
4. Racks and racking
5. Horizontal and backbone cables
6. Wire management
7. Fire-rated plywood
8. Optical fiber loss calculations
9. Over voltage protection equipment
10. Cabling supports
11. Stinger Ringers
12. Grounding equipment including conductors and connecting equipment provided by the TC.

D. By submitting product data (spec sheets), and samples, the TC represents that he or she has carefully reviewed and verified materials, quantities, field measurements, and field construction criteria related thereto. It also represents that the TC has checked, coordinated, and verified that information contained within product data conform to the requirements of the work and of the Contract Documents.

E. Designer Action
1. Designer will review all submittals and return comments promptly.
2. The Designer will issue a summary review indicating acceptance and indicate items that are not acceptable and indicate action needed by the contractor.
3. Rejected items are not permitted to be used on the project.

F. Contractor Action
1. Contractor to submit complete and correct submittals.
2. Contractor shall submit all required documentation.
3. For initial submission and for resubmission required for acceptance, submit electronic copies of each required item. Combine all electronic files into one final electric file for each submittal.
4. Submit materials by Specification Sections.
5. Any corrected submittals to be issued for re-review, the corrected sheets shall be denoted by the Contractor and the sheet number of the PDF document will be identified.
6. Any submittal sent to Designer to be reviewed that deviate from this format will be rejected and not reviewed.
7. If a submittal is rejected or must be re-submitted for any reason, the contractor shall revise, change and/or correct submittal as required by the Designer and resubmit rejected items or items requesting resubmittal until all items are accepted.

8. If re-reviews numbering four or more are required due to the Contractor repeatedly submits incorrect or incomplete submittals, the Contractor shall reimburse the Designer for all time spent re-reviewing submittals.

G. The acceptance of submittals, product data, and samples shall not relieve the TC of responsibility for adhering to the requirements of the Contract Documents. Nor shall the acceptance relieve the TC of responsibility for errors or omissions in such shop drawings, product data, or samples.

H. The review and acceptance, or other appropriate action upon the submittals product data sheets is for the limited purpose of checking for conformance with information given and design concept illustrated in the contract documents. Review of such submittals is not conducted for the purpose of determining accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the TC as required by the Contract Documents. The review shall not constitute approval of safety precautions or of construction means, methods, techniques, sequences, or procedures. The acceptance of a specific item shall not indicate approval of an assembly of which the item is a component.

I. Illegible submittals will not be checked.

J. If a submittal deviates from the drawings and project manual because of standard shop practice, substitutions (approved in accordance with General Conditions, amended), or any other reason, the Designer shall be advised in an attached separate written instrument. Deviations shall be acknowledged by Designer in writing. Unless acknowledged by the Designer in writing the Contractor will not be relieved of the responsibility for executing the work in accordance with the Contract Documents.

L. If contractor continues to submit incomplete or incorrect re-submittals, the Contractor will be responsible for Designer costs for reviewing multiple submittals.
1. Designer will review a total of three submittals (initial and two re-submittals). If shop drawings submitted by the Contractor are still not correct and acceptable, the Contractor will reimburse the Designer the labor cost for reviewing each additional submittal.

1.08 CONTRACTOR QUALIFICATION DOCUMENTS SUBMITTAL (THIS IS THE FIRST SUBMITTAL FOR DESIGN/OWNER ACCEPTANCE. SUBMIT THIS SUBMITTAL PRIOR TO SUBMITTING SHOP DRAWINGS OR MATERIAL SPEC SHEETS.)

A. Contractor shall not be awarded the project without possessing the required certifications.
1. Contractor shall submit qualification document submittal prior to the material shop drawing submittals.
2. Material submittals will not be reviewed until the Contractor Qualification Document Submittal is accepted by the Designer.
3. Refer to the Quality Assurance section of this document for more information.

B. Contractor upon being awarded the project shall submit all required certifications, insurance certificates, project roster, previous experience, and reference documents. This shall be submitted within 10 days of award of contract.
1. Contractors not possessing the required certifications required to perform the project upon the initial submittal, the Contractor will have ten (10) days (calendar) from the notice from the Architect/Designer of rejection of the qualification documents to resubmit the corrected required certifications. If at that time the Contractor does not submit all certifications

required, the Contractor will not be allowed to perform the work and must be replaced by the General Contractor.

C. Contractor shall submit the following copies of current certifications. (Refer to Section 270101-1.11.)
1. Technician certifications
2. Company certifications
3. Company North Carolina Electrical Low Voltage License
4. RCDD certificate(s)
5. List of public-school experience and completed two or more public school projects of similar size and complexity in North or South Carolina in the last three years. Include reference contact information.
6. Project roster of technicians and staff assigned to the project.
   a. Any change in the roster, the TC shall resubmit the roster as a submittal prior to enacting the change in the field.
   b. The percentage of certified technicians working on site shall comply with the Owner's requirements regarding number of certified technicians to the number of non-certified technicians on site and any and all times.

1.09 CLOSE OUT DOCUMENT SUBMITTAL-NOTE THE SELECTIVE ITEMS DUE PRIOR TO CLOSE-OUT DOCUMENTS, AT SUBSTANTIAL COMPLETION

A. Upon completion of the project and/or at the time specified, Contractor shall provide all required documentation as listed in the specifications.

B. The Completion Date of the Project is defined as the date that all documentation obligations have been met under the Construction Documents and these specifications.

C. Provide electronic files of the following
1. Calibration sheets for all testers being used on the project. PDF format
   a. Include test equipment name, manufacturer, model number, serial number, software version and date of last calibrations.
   b. Submit calibration sheets prior to testing.
2. Electrical permit inspection detail. PDF format
3. Patch panel logs (PDF and Excel file) (Due at Substantial Completion)
   a. Patch panel logs to include the following
      1) Cable ID
      2) Roomname and number
      3) Patch Panel ID
      4) Patch Panel port number
      5) Telcom Room Designation, ex. 'TR-1'
4. Asbuilt drawings.
   a. AutoCAD drawings in version no earlier than 2010-dwg file format. PDFs and DWG formats.
   b. The drawings shall include
      1) Final room names and numbers
      2) Legend identifying linetypes and symbols
      3) Cable IDs
      4) Cable routing, horizontal and backbone
      5) Final rack and equipment locations
      6) Junction box locations
      7) Any changes that occurred during the project

8) Conduit and sleeve pathways and cable tray.

5. Test results
   a. Copper Permanent Link, PDF format and software of the tester
      1) Summary PDF format and software of the tester
      2) Detail software of the tester
   b. Fiber OTDR results, PDF format and software of the tester
   c. Fiber Basic Link results, PDF format and software of the tester

D. Provide hard copies of the following
1. Redline asbuilts that include all cable labeling numbers. (Due at substantial completion) Oversize E1, 30"x42".
2. The following documents are required to be laminated (Due at Substantial Completion)
   a. Patch panel logs (this is in addition to the paper copy listed above) Install these in related IDF/TRs (Due at Substantial Completion)
   b. Asbuilt drawings in 11"x22", 'C' size. These are to be installed in every telcom room. (Install only areas of the drawing within the TR zone.) (Due at Substantial Completion)
3. Manufacturer warranty (PDF format)
4. Contractor warranty (PDF format)
5. Manufacturer manuals or Operating instruction, if applicable (PDF format)

1.10 DRAWINGS AND SPECIFICATIONS

A. It is understood that while drawings will be followed as closely as circumstances will permit, the TC is held responsible for the installation of the system according to the true intent and meaning of the drawings. Anything not completely clear in the Construction Documents will be explained upon request to the Designer. However, if conditions arise where, in the judgment of the TC, certain changes will be advisable; the TC will communicate through the proper channels and obtain review and approval of these changes before proceeding with the work.

B. The drawings are not to be scaled. The TC must refer to the architectural drawings for building construction and dimensions and material, finish and construction method of walls, floor and ceiling in order to insure proper installation of work.

C. If there is a conflict between the Drawings and the Specifications, the most stringent requirement shall apply.

1.11 QUALITY ASSURANCE

A. The Architect/Engineer shall have the right to reject any proposed Telecommunications Contractor that, in the opinion of the Architect/Engineer, does not have the qualifications to perform the work to the satisfaction of the Architect/Engineer.

B. Contractor required qualifications
1. The TC shall employ qualified and certified technicians on this project that have experience with the installation of low voltage cabling infrastructures and provide appropriate supervision to all technicians on site. Required qualifications and certifications are as follows:
2. Contractor shall employ a RCDD to oversee the project and shall attend, in person, progress walks with the Designer or Owner's Representative to review project milestones and quality checks.
3. TC shall possess a current North Carolina Electrical Low Voltage License.

4. Telecommunications Contractor shall have demonstrated public school experience and completed two or more public school projects of similar size and complexity in North or South Carolina in the last three years.
5. TC shall possess a current North Carolina Electrical Low Voltage License.
6. Telecommunications Contractor shall have demonstrated public school experience and completed two or more public school projects of similar size and complexity in North or South Carolina in the last three years.

C. Contractor required certifications
Percentage ratios noted below shall be observed and adhered to for the entire project.
1. BICSI RCDD
2. Technician certifications from the connectivity and cable manufacturers, to include fiber manufacturer installed on the job.
   a. 30% of technicians assigned to the project and assigned to work on site shall hold these certifications.
3. TC shall hold company certifications from the connectivity and cable manufacturers to include fiber manufacturer installed on the project.
4. The lead technician assigned to the project shall have the following certifications.
   a. BICSI certified installer at the technician level.
   b. Technician certifications from the connectivity and cable, including fiber manufacturer installed on the project.
   c. BICSI Technician shall be on site whenever work is being performed.
5. 30% of all Technicians on site at all times shall be BICSI certified installers.
6. BICSI certifications DO NOT supersede manufacturer training or certifications. Manufacturer training is unique to the product line and is required.

D. Permits
1. It shall be the responsibility of the Telecommunications Contractor to obtain a Low Voltage Permit required by Mecklenburg County Engineering and Building Standards in accordance with County requirements. The Contractor must acquire a permit for low voltage cabling prior to starting the project. A copy of this permit will be submitted to the CMBE quality manager. It shall be the responsibility of the Contractor to obtain necessary work permits required by the city or county in which the work is to be performed. Installation shall conform to all local, state, and federal codes, standards and recommendations of authority having jurisdiction including, but not limited to BICSI, NEC, FCC, UL, IEEE, NEMA, ICEA, ANSI, NC State STS1000, and TIA 568 standards.

E. Equipment and materials of the type for which there are independent standard testing requirements, listings, and labels, shall be listed and labeled by the independent testing laboratory, ie. UL.

F. Where equipment and materials have industry certification, labels, or standards (i.e., NEMA – National Electrical Manufacturers Association), this equipment shall be labeled as certified or complying with standards.

G. Material and equipment shall be new, and conform to grade, quality, and standards specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout. Materials and equipment are to be installed per industry standards and manufacturer's recommendations.

H. The Designer retains the right of inspection of the work at any time. Any material or work, which does not comply with the specifications, current industry standards will be subject to

rejection. Any such rejected work or material shall be reworked and/or replaced and made to conform with said specifications at no additional cost to the Owner.

I. Any stoppage, delay, suspensions, or forfeiture due to a rejection shall in no way invalidate any terms of the Contract, and no additional charges will be allowed to the TC.

J. The TC site superintendent shall submit a weekly report due each Monday detailing the previous week's accomplishments and providing a two-week forecast of areas where work will be performed and expected accomplishments. This report will be copied to the Owner and the Designer.

K. The TC shall inspect all installation materials and workmanship and ensure contract compliance for final acceptance.

L. The TC is responsible for all damages to persons or property that occurs as a result of his fault, omission, or negligence in connection with the prosecution of the work. The TC is responsible for the proper care and protection of all work performed until completion and final acceptance, whether the same has been covered in whole or in part by payments made by the Owner.

M. The TC must remove all debris and packaging resulting from the delivery and installation of equipment and materials. The TC must leave the premises in the same condition as found. The TC will leave all work areas and classrooms clean and free of debris.

N. Any damage done to the premises by the TC, the TC's agents, vendors or employees will be repaired at his own expense. If the TC fails to repair any such damages, then the Owner may affect such repairs at TC's expense and offset any payments made by the Owner relating to such repairs against amounts payable by the Owner to the TC.

O. Property of the Owner, as well as any other property disturbed in the process of the work, will be restored to the original condition that existed prior to the beginning of work. Restoration shall be at the TC's expense.

1.12 REGULATORY REQURIMENTS

A. The following latest editions of the industry standards are the basis for the structured cabling system described in this document. The standards listed shall be adhered to in the same manner as if they were codes:
   1. TIA/EIA
      a. Articles 526,568, 569, 606, 607
   2. BISCI
      a. Telecommunications Distribution Methods Manual
      b. Cabling Installation Manual
      c. Customer-Owned Outside Plant Design Manual
   3. NFPA
      a. NFPA 70 National Electric Code (NEC)
   4. Division 26-Electrical
   5. CMS A&E Guidelines

B. If there is a conflict between applicable regulatory industry standards, then the more stringent requirement shall apply. The TC has the responsibility to determine and adhere to the latest editions when developing the proposal for installation.

C. State or local authorities having jurisdiction.

1.13 WARRANTY

A. The TC shall warrant for a period of one (1) year that the material and workmanship of the data, voice and wireless infrastructure system shall be entirely free from defects and operates as intended. Any materials, equipment, or workmanship in which defects may develop before or during the warranty period shall be repaired or replaced at the TC's expense. The TC shall further warrant that all material, equipment, and workmanship used in the installation, but not specifically mentioned in the Construction Documents are the best of their respective kinds and that the construction and installation was performed in accordance with the best accepted standard practices in the industry. The warranty shall begin at the system acceptance date and remain in effect for a period of one (1) year from that date. The Telecommunications Contractor shall agree to repair, adjust and/or replace any defective equipment, materials, or other parts of the system at the Telecommunications Contractor's sole cost. The Owner will incur no costs for service or replacement of parts during the warranty period. All third-party warranties shall be passed through from Telecommunications Contractor to Owner.

B. The Telecommunications Contractor must provide a twenty (20) year manufacturer's warranty on the "Network Cabling Infrastructure" that consists of all cable and connectivity components.

C. The Telecommunications Contractor must provide a twenty (20) year extended manufacture warranty for the premise fiber cable solution.

D. The Telecommunications Contractor shall warrant that all materials and equipment furnished under the contract are in good working order, free from defects and in conformance with system specifications. All installed equipment must conform to the manufacturer's official published specifications.

E. The Telecommunications Contractor shall warrant and supply evidence that the installation of materials and hardware will be made in strict compliance with all applicable provisions of the National Electric Code, the rules and regulations of the Federal Communications Commission and state and/or local codes or ordinances that may apply.

F. The Telecommunications Contractor shall warrant that the system will function as specified in the approved manufacturer's Technical Description Guide.

G. The Telecommunications Contractor shall warrant that the system shall accommodate traffic at the levels specified.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 270105 - DEMOLITION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

B. The requirements of Section 27 01 01 govern the work specified in this section.

C. Refer to the following sections for related work:
1. 27 01 10 – Equipment Room Fittings
2. 27 02 00 – Cabling

1.2 SUMMARY

A. Section Includes:
1. Demolition requirements for the Communications Division 27.
2. Removal of existing cabling
3. Removal of existing equipment

B. Telecommunications Contractor Responsibilities
1. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Construction Documents.

C. Related Requirements
1. Refer to Section 270101

1.3 DEFINITIONS

A. Refer to Section 270101

1.4 SCOPE OF WORK

A. The communications demolition work is indicated on the drawings and herein.

B. Total demolition of all data, voice and catv cabling and equipment shall be performed.

C. Remove single outlet surface mounted raceways.

D. Contractor shall examine existing conditions and coordinate all work with all other trades and include all work required to perform the demolition required per the Contract Documents.

E. Contractor shall take care to not disturb other trades' existing systems to remain in this project.

F. Contractor shall agree that field conditions may be encountered while performing this scope of work with a building of this age and type which may require removing devices and repairing surfaces to match existing conditions that might not be specifically shown on the drawings. It is the intent of the Contract Documents that this work is included and expected.

G. Contractor shall remove and demolish all existing data, voice and catv cabling, horizontal and

backbones, related equipment and hardware. All cables shall be removed in their entirety. All abandoned equipment shall be removed.

H. The Construction Drawings are diagrammatic only. They are not intended to show every detail of the construction projector every item or material that is required. The intent of the Construction Documents includes constructing complete and working systems.

1.5 ACTION SUBMITTALS

A. Refer to Section 270101

1.6 WORK NOT INCLUDED

A. Providing 120v wiring.

B. Providing outlets, unless otherwise noted.

C. Providing conduit, or cable tray pathways, unless otherwise noted.

D. The telephone switch, telephone instruments, network electronics, including data concentrators, hubs, servers, computers and other active devices, as well as catv headend equipment including modulators, sub-channel return system, televisions, and DVD's shall be installed and furnished by the Owner.

PART 2 – PRODUCTS

2.1 MATERIALS

A. The Division 27 Contractor shall provide all tools and equipment, labor, etc. to perform the communications demolition portion of these Contract Documents.

PART 3 – EXECUTION

3.1 DEMOLITION

A. Contractor shall coordinate with the General Contractor on all demolition work.

B. Coordinate with the Owner to return any removed items per their request. Items requested to be returned to the Owner shall be carefully removed, cleaned, and stored in a clean, dry area until the exchange of the equipment to the Owner is performed.

C. All cables denoted in the Construction Documents shall be removed in their entirety. Remove all hangers if they are not to be reused. No abandoned cabling in the ceiling is permitted.

D. When removing cabling in the ceiling cavity take care not to disturb any other cabling, conduit, piping, etc. that is to remain.

E. Remove all jacks, wall racks, cabinet and floor racks, and wall mounted equipment denoted in the Construction Documents.

F. Remove all single outlet surface mounted raceways denoted in the Construction Documents. Patch wall to match existing conditions. Coordinate with General Contractor.

G. Provide stainless steel blank cover-plates on all existing outlets not being reused.

H. Dispose of all removed cabling and equipment not requested to be returned to the Owner.
   1. The contractor is encouraged to recycle any and all equipment as possible at reputable recycling centers.

I. Return all surfaces where demolition has occurred to match existing conditions. This includes cleaning, patching, and painting. Coordinate this activity with the architect.

J. Refer to architectural specification sections for further requirements.

END OF SECTION

SECTION 270110 - EQUIPMENT ROOM FITTINGS

PART 1 – GENERAL

1.01 RELATED SECTIONS

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

B. The requirements of Section 27 01 01 govern the work specified in this section.

C. Refer to the following section for related work:
   1. 27 02 00 – Cabling

1.02 SUMMARY

A. Section Includes:
   1. Communications mounting elements
   2. Backboards
   3. Communications equipment racks and cabinets
   4. Cable management
   5. Communications ladder racks
   6. Grounding
   7. Power Strips
   8. Fire-rated split sleeves

1.03 REGULATORY REQUIREMENTS

A. The following latest editions of the industry standards are the basis for the structured cabling system described in this document. The standards listed shall be adhered to in the same manner as if they were codes:
   1. TIA-Telecommunications Industries Association
      a. Articles 526,568, 569, 606, 607, TSB-140
   2. ANSI-American National Standards Institute
   3. BISCI-Building Industry Consulting Service International
      a. Telecommunications Distribution Methods Manual
      b. Cabling Installation Manual
      c. Customer-Owned Outside Plant Design Manual
   4. ETL-Electrical Testing Laboratories
   5. UL-Underwriters Laboratories
   6. NEMA-National Electrical Manufacturers Association
   7. OSHA-Occupational Safety and Health Standards
   8. NFPA-National Fire Protection Association
      a. NFPA 70 National Electric Code (NEC)
   9. Division 26-Electrical

B. All current state and local codes.

C. If there is a conflict between applicable regulatory industry standards, then the more stringent requirement shall apply. The TC has the responsibility to determine and adhere to the latest editions when developing the proposal for installation.

1.04 DEFINITIONS

A.	AHJ	Authority Having Jurisdiction
B.	BICSI	Building Industry Consulting Service International
C.	EC	Electrical Contractor
D.	EMI	Electromagnetic Interference
E.	GC	General Contractor
F.	IDF/TR	Intermediate Distribution Frame/Telecommunications Room
G.	IP	Internet Protocol
H.	MC	MDF/Main Telecom Room
I.	MDF	Main Distribution Frame
J.	MHz	Megahertz
K.	NEC	National Electric Code
L.	NEMA	National Electrical Manufacturers Association
M.	PoE	Power Over Ethernet
N.	RU	Rack Unit
O.	TC	Telecommunications Contractor
P.	TGB	Telecommunications Grounding Bus Bar
Q.	TMGB	Telecommunications Main Grounding Bus Bar
R.	TR	Intermediate Distribution Frame/Telecommunications Room
S.	UL	Underwriters Laboratory, Inc.
T.	UTP	Unshielded Twisted Pair Cable
U.	WG	Wire Guard

1.05 SUBMITTALS

A. Refer to Section 270101-Communications-General Requirements

1.06 QUALITY ASSURANCE

A. Refer to Section 270101-Communications-General Requirements

1.07 DELIVERY, STORAGE AND HANDLING

A. Environmental Limitations: Do not deliver or install equipment frames and cable trays/ladder racks until spaces are enclosed and weather tight, wet work in spaces is complete and dry and work above ceilings is complete.

1.08 PROJECT CONDITIONS

A. Environmental limitations
   1. Do not deliver or install cables and connecting materials until wet workspaces are complete and dry and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.09 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner.

B. Adjust arrangements and locations of distribution frames, cross-connects and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of Owner provided equipment and LAN equipment.

C. Coordinate all work with other trades.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Floor mounted racks and cabinets and cable pathways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term 'withstand' means 'the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.

B. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard, and the requirements of TIA-568-C.4.

C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

D. Grounding: Comply with TIA-607-D.

2.02 APPROVED PRODUCTS AND MANUFACTURERS

A. 84” High Foot Aluminum floor Mounted Data Rack, 45 rack units, 19" wide, Black
   1. High strength aluminum construction
   2. Minimum 1200 lb capacity
   3. Pre-punched base angles for floor mounting.
   4. Top angles to allow J-bolt attachment without interfering with top rack-mount spaces
   5. EIA-310-E Standard Universal 5/8" - 5/8"-1/2" alternating hole pattern
   6. Six web channel holes per side to enable multiple racks to be mounted together side by side

7. High strength roll-formed threaded mounting holes
8. Rack-mount unit marks.
9. Thirty (30) pilot point #12-24 mounting screws with combination Phillips/Straight heads to reduce cross-threading
10. UL listed.
11. Products
    a. CPI 19" Universal Black rack - #46353-703, or equal
    b. Saunders/Cooper B-Line - #SB-556-084-XU

B. Four Post Equipment Rack for Security Headend Equipment
1. Rack shall be located at the security head-end.
2. 19″ 4-post frame with #12-24 tapped hole extruded aluminum mounting rails.
3. 84″ Height
4. Load Rating 2000 lb.
5. UL listed to UL60950 Standard-File No. E171936
6. Flat black powder coat color.
7. Adjustable depth 24″-30″.
8. Products
    a. Cooper B-Line - #SB837084BFB, or equal
    b. Chatsworth Products Adjustable Server Rack - #15217-703

C. Wall Mounted Telcom Cabinet, 19″ wide, Black
1. Dual hinged
2. Fully welded, minimum 16 gauge cold rolled steel construction
4. Swing out section
3. Heavy duty
4. Load rating, minimum 200 lb
5. EIA/ECA-310-D/E compliant mounting rail system with #12-24 tapped rails.
6. UL listed to UL60950 standard-file number E235184.
7. Fan kit to be included
8. Plexiglass front door
9. Lock included
10. Width 24.7″
11. Depth 30″
12. Heights
    a. 24″ with 12 rack units
    b. 36″ with 19 rack units
    c. 48″ with 26 rack units
13. Products
    a. Cooper-B-Line V-Line Dual Hinge Wall Mount Cabinets-#VLWM####, or equal
    b. Chatsworth Products Cube-IT Plus Cabinet-#12419-7##
    c. Emcor-#DWM-##U30S-P

D. Wall Mount Shallow Cabinet
1. Accepts EIA 19″ rack mountable equipment
    a. Customizable rails allowing rotation to either vertical or horizontal equipment mounting.
2. Removable side and top panels
3. 4″ x 6″ knockout on rear of cabinet
4. ¾″ & 1 ½″ knockouts
5. Tie down points built in
6. See drawings for size of cabinet

7. Minimum 6 ru capacity
8. Products
    a. Chatsworth Products ThinLine II Wall-Mount Cabinet - #13050-XXX, or equal

E. Data Rack Wire Management
1. 7 foot Vertical Manager
    a. Provide 6" wide double-sided managers for outside end of data racks. Provide 10" wide double-sided managers for installation between two data racks.
    b. 80.5" x 6" x 16.6" (6" wide), 80.5" x 10" x 17.5" (10" wide).
    c. 38 rack units.
    d. Steel mid panels and splice plates and plastic sides. Covers on 6" wide shall be plastic, the covers on 10" shall be steel with plastic hinges.
    e. Four vertical sections with T-shaped cable guides spaced 1 ru apart.
    f. Four mid panels with attachment points for cable management accessories.
    g. Two splice plates used to assemble the top and bottom side sections.
    h. Four half-height covers that snap onto the T-shaped cable guides.
    i. Dual hinged doors shall be provided.
    j. Color shall be black.
    k. Products
        1) 6" Wide Vertical Wire Manager
            (a) Chatsworth Velocity Double-Sided - #13912-703, or equal
            (b) Panduit – #PR2VD06
        2) 10" Wide Vertical Wire Manager
            (a) Chatsworth Velocity Double-Sided - #13914-703, or equal
            (b) Panduit - #PR2VD10
2. Horizontal Wire Manager-19" width
    a. 3.47"H x 19"W x 9.75"D
    b. Snap on rear cover
    c. Cable management for front and rear
    d. 2 rack units
    e. Plastic construction
    f. Front cover hinge shall open 180 degrees up or down
    g. Curved surfaces
    h. Pass-through holes for front to rear cabling
    i. Built in cable retainers
    j. Products
        1) Panduit - #NCMH2, or equal

F. Universal Cable Runway (Ladder Rack) and Accessories
1. 3/8" x 1-1/2" x.065" wall rectangular steel tubing
2. Cross members welded at 12" intervals.
3. 12" and 18" width, unless otherwise noted.
4. To be supported every 5'.
5. Runway elevation kits shall be provided to enable securing to top of data racks.
6. Runway installed along perimeter of Telecom Rooms shall be secured to the fire-rated plywood mounted on the walls utilizing triangular support brackets sized for the runway being installed.
7. When mounting ladder racking along a wall, install the ladder racking to cover the entire length of the wall, whether shown this way on the Construction Documents or not, UON.
8. Contractor shall provide radius intersections when changing directions.
9. All material parts are not listed or illustrated in the Contract Documents. Contractor responsible for acquiring all parts and materials required for a complete runway system.

10. Black in color.
11. Runway
    a. Products
        1) CPI 12" Wide Black Universal Ladder Rack - #10250-712, or equal
        2) CPI 18" Wide Black Universal Ladder Rack - #10250-718, or equal
12. Radius Corner Bracket
    a. Products
        1) CPI Cable Runway Corner Bracket - #11959-715, or equal
13. Runway Support
    a. Products
        1) CPI Wall Mount Triangular Support Brackets - #11746-712, or equal
        2) CPI Wall Mount Triangular Support Brackets - #11746-718, or equal
14. Equipment rack to runway mounting plates
    a. Products
        1) CPI - #10595-712, or equal
        2) CPI - #13730-718, or equal
15. Runway over rack elevation kits-6"
    a. Products
        1) CPI - #10506-706, or equal
16. Wall angle support
    a. Products
        1) CPI 12" wall angle support kit - #11421-7-12
        2) CPI 18" wall angle support kit - #11421-7-18
17. Junction Splice
    a. Products
        1) CPI junction splice kit - #11302-701
18. Butt-Splice
    a. Products
        1) CPI butt splice kit - #11301-701, or equal
19. Concrete mounting kit for equipment racks
    a. Products
        1) CPI - #40604-001, or equal
20. Vertical wall brackets
    a. Products
        1) CPI vertical wall brackets - #10608-701
21. Protective end caps for cable runway
    a. Products
        1) CPI protective end caps - #10642-001

G. Waterfall kit-required when bringing cables over the side of a raceway and into rack wire management.
    1. Provide waterfall accessories to provide bend radius control in both vertical and horizontal directions when transferring cables from standard ladder rack.
    2. Shall be a side and straddle applications.
    3. Products
        a. CPI-#1201-X11, or equal.

H. Backboards
    1. Plywood, fire-retardant treated 3/4" x 48" x 96" A-C Grade, unpainted. Comply with requirements for plywood backing panels specified in Architectural specifications.
    2. Install with 'A' side facing outward.

3. When a wall is designated to have fire-rated plywood mounted, Contractor shall install fire-rated plywood to cover the entire length of the wall, whether shown and designated on the drawings or not.

J. Power strips
1. 20 amp surged-to be installed at the top of each data rack or enclosure and under the horizontal ground bus bar.
2. ETL listed to UL standard 1419, UL 60950-1 and UL 60065.
3. 3 year manufacture warranty
4. 19" rack mounted.
5. 120V
6. Maximum Derated Load 16 Amps
7. (8) NEMA 5-20R-rear
8. 20' service tail with 5-20P
9. Breakered
10. Power switch
11. 1 rack unit
12. Products
    a. Middle Atlantic Products-#PD-920RC-20, or equal

K. Fire-Rated Split Sleeves
1. To be used when existing cabling is penetrating a wall that is being replaced.
2. Shall come as a kit, with all metallic sleeves, split mounting escutcheons, split intumescent escutcheon gaskets, wall labels and putty.
3. Sleeves shall be sized as standard EMT and shall be sized to fit EMT accessories such as bushings.
4. Sleeves shall be sized to accommodate present cable bundle diameters and leave room for future growth.
5. The split sleeve devices shall be UL certified.
6. Shall exceed the testing requirements of ASTM E814 (UL1479).
7. Shall be UL tested for larger and irregular shaped openings and include provisions for mounting in such openings.
8. Shall be available for cable penetrations through common wall constructions up to and including 4 hours and concrete floors up to 3 hours.
9. Putty shall be non-hardening to facilitate the future removal or addition of cables.
10. Shall be available in 1", 2" and 4" sizes.
11. Products
    a. SpecSeal Ready Split Sleeve, or equivalent
        1) 1" – FSR100
        2) 2" – FSR200
        3) 4" – FSR400

L. Grounding
1. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
2. Telecommunications Main and Intermediate Grounding Bus Bars wall mounted in the telcom rooms shall be provided by the EC.
3. Rack mount ground bus bar provided by the TC.
4. Provide two-hole irreversible lugs on bonding conductors.
5. Refer to 270200 3.02 E. Grounding and Bonding
6. Provide horizontal rack mounted ground bus bars on each telecommunications rack.
7. Products
    a. CPI - #10610-019, or equal

Part 3 – EXECUTION

3.01 INSTALLATION

A. Coordinate layout and installation of communications equipment in each telcom room with CMS IT Field Managers prior to installation.

B. Coordinate service entrance configuration with service provider.

C. Coordinate location of receptacles with locations of the communications equipment requiring electrical power to operate.

D. Coordinate the location of sleeves at penetration of wall assemblies and floor assemblies with the EC prior to their installation.

3.02 CABLE TRAYS

A. Comply with NEMA VE 2 and TIA 569-B.

3.03 EQUIPMENT LAYOUT

A. Comply with TIA-569-B for equipment room layouts.

3.04 BEND RADIUS

A. Bundle, lace ad train conductors and cables to termination points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.05 TELECOMMUNICATION ROOM (IDF/MDF)

A. Data Racks/Enclosures
   1. Data racks and runways contained within the telecom rooms and shown on the Construction Drawings are for the purpose of providing a base installation requirement in each telecom room and for the TC to perform take offs for their cost estimating.
   2. Racks shall be heavy duty EIA complaint 2-post nineteen (19) inch wide, 84" tall equipment racks, unless otherwise noted. Racks shall have a black finish. Side channels shall be drilled and tapped on both sides.
      a. Provide 4 post rack for security head end equipment in the MDF. See drawings for information.
   3. Racks shall be anchored to type of floor or wall being installed upon with proper rack mount hardware from the rack manufacturer and approved for the rack installation environment.
   4. Racks to be secured overhead with minimum 12" wide runway and supported on runway elevation kits installed on the racks. Runway over the racks shall secured to the wall, and mounted to the plywood. These runways are to be used to route cables to racks for termination.
   5. When mounting racks in a row, maintain a minimum of 36" clearance from the walls and on one side at the end of a row, and then 42" behind the racks.

6. Wall mounted data racks or enclosures shall be mounted on fire-rated plywood and secured to the plywood per manufacturer recommendations.
7. Unused rack equipment mounting screws shall be bagged and attached to the racks upon completion of the project for Owner's future use.
8. All racks and enclosures shall be have a horizontal grounding bus bar installed at the top of each rack. See Grounding and Bonding below.
9. Coordinate all work with Owner.

B. Ladder racking systems
1. Ladder racks system shall be installed on the perimeter of the room and shall be installed at 8'-6" AFF and shall be 18" in width, UON.
   a. Perimeter room runways are to be installed along telecom room walls as shown on the Construction Drawings and are to be supported utilizing triangular support brackets sized for the runway installed.
   b. The triangular support brackets are to be installed within 3' on center.
2. The 12" ladder rack securing the data racks to the wall shall be mounted flush to the top of the ladder rack elevation kits data racks and the height shall be 7'-6" AFF.
3. Ladder racking mounted to the walls, shall be secured to fire-rated plywood on the walls.

C. Cable Management
1. Horizontal and Vertical Wire Management shall be provided and utilized by the TC for the floor mounted racks. The system provided shall be comprised of equipment to manage cables on both the front and rear of the rack. The Wire Management shall protect network performance by controlling bend radius and providing cable strain relief.
   a. All cable management channels shall have covers or doors-dual hinged.
   b. Refer to Construction Drawings for placement of Horizontal Wire Managers. The Horizontal Wire Managers shall intersect with the Vertical Wire Managers seamlessly.
2. Install 18" ladder rack vertically, mounted on wall to support cabling routing between the floors.
   a. From conduit stub ups to the upper tier ladder racking, when terminating the cabling stubbing up in the same telcom room as the stub up.
   b. From 10' AFF to 6" below the 4" conduits installed penetrating the floor above.
3. D-rings shall be metallic and used in areas where cables are not supported by cable runway or cable tray. The D-Rings shall be a minimum size of 4 inches and placed 6" on center. The TC shall be responsible for determining quantity and the placement of D-Rings at strategic points throughout the Telecommunications Room.
4. Contractor shall also provide blank flat black horizontal panels to be placed above and below each patch panel.

D. Power Strips
1. Provide 20-amp power strips as specified above. Install at the top of each data rack, and below the horizontal ground bus bar.

E. Plywood Backboards
1. The telecom room is to have 3/4" fire retardant A/C plywood installed with fire rated stamped band and A side of plywood facing outwards. Plywood is to remain unpainted.
2. 3/4" fire retardant plywood shall be installed vertically starting at 24" AFF to a complete height of 110" AFF. Refer to Communications Drawings for plywood locations.
   a. When the drawing indicates plywood on a wall, the entire length of the wall will be covered whether indicated on the drawing or not.
3. All wall mounted equipment shall be secured to fire-rated plywood mounted on the

telcom room walls.

F. Grounding and Bonding
   1. Grounding shall be installed per NEC and TIA-607-B and manufacturer's grounding requirements as minimum.

   2. Bond and ground equipment racks (each rack shall be individually bonded to the bus bar), housings, messenger cables, ladder racks, and metallic raceways with a #6 AWG stranded green insulated conductor. #12 AWG stranded insulated green conductor shall be used to bond surface mounted metallic raceways. However, in plenum areas, the grounding conductor shall be a bare, solid conductor for all grounding applications. Coordinate with electrical contractor. Electrical contractor (E.C.) to bond or ground all pathways provided by electrical contractor.
      a. Bond each section of ladder rack with runway ground straps that shall consist of # 6 AWG stranded green insulated conductors with two-hole long barrel irreversible crimp lugs with 1/4" bolt holes spaced on 5/8" centers. Straps shall be 11" in length. Provide home-runned #6 AWG stranded green insulated conductor to wall mounted bus bar.
   3. All grounding lugs shall be two-hole long barrel irreversible crimp with 1/4" bolt holes spaced on 5/8" centers.
   4. Provide horizontal rack busbars at the top of each data rack or enclosure. Connect rack bus bars to wall mounted bus bar via home-runned stranded #6 AWG stranded green insulated conductor.
   5. Wall mounted bus bar provided by E.C. See electrical drawings for details.
      a. TMGB (Telecommunications Main Grounding Busbar) and TGB Telecommunications Grounding Busbar) shall be provided by the E.C. unless otherwise noted. Electrical Contractor shall bond the ground bus bars to the electrical service equipment ground and to building steel with a #6 AWG green conductor unless otherwise noted on the Electrical Construction Documents.

G. Fire-rated Split Sleeve Assemblies
   1. Provide split sleeves at walls that are either being replaced or being repaired in some way that affects existing cabling routing through or above those walls.
   2. Bundle existing cabling if possible and provide sizing as necessary, leaving 40% spare capacity.
   3. Install per manufacturers specifications.

H. Firestop
   1. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate fire-stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways that are specifically designated for the data/video/voice infrastructure shall be properly fire-stopped. The contracting discipline installing the sleeve or slot, shall be responsible for sealing the area on the exterior of the sleeve or slot. The TC shall be responsible for fire-stopping the interior annular area.
   2. Fire-stop systems utilized shall be dictated by this project's Professional Electrical Engineer's UL design. See Electrical Drawings and specifications for exact details. If a Professional Engineer's UL design is not available, the Contractor shall provide appropriate UL design for penetrations through rated walls and properly firestop penetrations. These documents shall be submitted to the Designer.

3.05 IDENTIFICATION AND LABELING

A. Refer to TIA 606-B and Owner requirements to coordinate labeling schemes.

B. Font size on labels shall be consisted throughout facility for each type of materials.

C. Coordinate the labeling scheme with the Owner prior to labeling.

D. All labels shall be machine printed.

E. Label each data rack MC-1, MC-2, etc., TR1-1, TR1-2, etc., TR2-1, TR2-2, etc.

F. Label each data enclosure MC-E1, MC-E2, etc.

G. For Telecommunications Bonding Conductors, label cables on each end and at each point of connection. The Telecommunications Bonding Conductor the label shall read "TBC-MC-1" where the 'TBC' indicates it is a telecommunication bonding conductor. The 'MC-1' indicates telcom room and bonding conductor #1.

H. Labels shall be visible during installation and after project completion.

END OF SECTION

SECTION 270200 – CABLING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. UTP cabling
   2. Fiber optic cabling
   3. UTP and Fiber connecting equipment
   4. UTP and Fiber connectors
   5. Grounding
   6. Other equipment
   7. Cabling requirements
   8. Labeling requirements
   9. Testing requirements

1.02 RELATED SECTIONS

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

B. The requirements of Section 27 01 01 govern the work specified in this section.

C. Refer to the following sections for related work:
   1. 27 01 05 – Communications-Demolition
   2. 27 01 10 – Communications-Equipment Room Fittings

1.03 REGULATORY REQUIREMENTS

A. The following latest editions of the industry standards are the basis for the structured cabling system described in this document. The standards listed shall be adhered to in the same manner as if they were codes:
   1. TIA-Telecommunications Industries Association
      a. Articles 526,568, 569, 606, 607, TSB-140
   2. ANSI-American National Standards Institute
   3. BISCI-Building Industry Consulting Service International
      a. Telecommunications Distribution Methods Manual
      b. Information Technology Systems Installation Methods Manual
      c. Customer-Owned Outside Plant Design Reference Manual
   4. ETL-Electrical Testing Laboratories
   5. UL-Underwriters Laboratories
   6. NEMA-National Electrical Manufacturers Association
   7. OSHA-Occupational Safety and Health Standards
   8. NFPA-National Fire Protection Association
      a. NFPA 70 National Electric Code (NEC)

B. Division 26-Electrical

C. All current state and local codes.

D. If there is a conflict between applicable regulatory industry standards, then the more stringent requirement shall apply. The TC has the responsibility to determine and adhere to the latest editions when developing the proposal for installation.

1.04 DEFINITIONS

A.	AHJ	Authority Having Jurisdiction
B.	BICSI	Building Industry Consulting Service International
C.	EC	Electrical Contractor
D.	EMI	Electromagnetic Interference
E.	GC	General Contractor
F.	IDF	Intermediate Distribution Frame
G.	IP	Internet Protocol
H.	MC	MDF/Main Telecom Room
I.	MDF	Main Distribution Frame
J.	MHz	Megahertz
K.	MM	Multi-mode Fiber
L.	NEC	National Electric Code
M.	NEMA	National Electrical Manufacturers Association
N.	PoE	Power Over Ethernet
O.	PBB	Primary Grounding Bus Bar
P.	SBB	Secondary Grounding Bus Bar
Q.	SM	Single-mode Fiber
R.	TC	Telecommunications Contractor
S.	TR	Telecom Room
T.	UL	Underwriters Laboratory, Inc
U.	UON	Unless Otherwise Noted
V.	UTP	Unshielded Twisted Pair Cable
W.	WG	Wire Guard Cage

1.05 SUBMITTALS

A. Refer to Section 270101-Communications-General Requirements

1.06 QUALITY ASSURANCE

A. Refer to Section 270101-Communications-General Requirements

1.07 DELIVERY, STORAGE AND HANDLING

A. Test cables upon receipt at Project site.
   1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical loss test set.
   2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects including the loss value of each. Retain test data and include the record in the Close Out Document submittal.
   3. Test each pair of the UTP cable for open and short circuits.

1.08 PROJECT CONDITIONS

A. Environmental limitations
   1. Do not deliver or install cables and connecting materials until wet work spaces are complete and dry and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.09 COORDINATION

A. EC to provide pathways. Review with EC prior to his installation.

B. Coordinate layout and installation of communications equipment with Owner.

C. Coordinate installation with other trades.

PART 2 – PRODUCTS

2.01 UNSHIELDED TWISTED PAIR CABLE

A. UTP 4-pair Plenum-rated Cable for voice, data and wireless: Category 6 Cable, Blue colored jacket for voice and data and yellow colored jacket for wireless. Green jackets will be used for video surveillance IP cabling, white for access control IP cabling.
   1. Cable shall be rated to 400 MHz minimum.
   2. All cable shall conform to the requirements for communications circuits defined by NFPA 262. Cable shall be listed to NEC Type CMP (NFPA 800.179.A) for plenum installations.
   3. The cable shall meet or exceed the requirements as described in CENELEC EN 50288-6-1, TIA 568-C.2 Category 6, and ISO/IEC 11801 Class E.
   4. RoHS Complaint Directive 2011/65/EU
   5. Third party performance verified.

6. The cable shall have a flexible jacket that strips cleanly and resists kinking.
7. Color codes
    a. Blue for IP data/IP voice, analog voice
    b. Yellow for IP wireless access point
    c. Green for IP video surveillance
    d. White for IP access control
8. Products
    a. CommScope – Ultra Media CS37P
        1) Blue - #UN874043014
        2) Yellow - #UN874029514
        3) Green - #UN874046314
        4) White - #UN874049784
    b. Siemon-System 6
        1) Blue - #9C6P4-E3-06 RXA
        2) Yellow - #9C6P4-E3-05-RXA
        3) Green - #9C6P4-E3-07-RXA
        4) White - #9C6P4-02-RXA
    c. Panduit
        1) Blue - #PUP6004BU-UTG
        2) Yellow - #PUP6004YL-UTG
        3) Green - #PUP6004GR-UTG
        4) White - #PUP6004WH-UTG

B. UTP 4-pair Outside Plant Cable: Category 6.
1. Cable shall be rated to 250 MHz minimum.
2. Shall have water/moisture blocking components to protect the cable in potentially wet areas.
3. The cable shall meet or exceed the requirements as described in CENELEC EN 50288-6-1, TIA 568-C.2 Category 6, and ISO/IEC 11801 Class E.
4. RoHS Complaint Directive 2011/65/EU
5. 24 AWG
6. Solid conductors
7. The cable shall have a flexible jacket that strips cleanly and resists kinking.
8. Jacket color black.
9. Products
    a. CommScope - #CS34O – Outdoor, #UN884019984/30, or equal
    b. Siemon-OSP - #9C604-E1

C. High pair count UTP Plenum-rated Cable, Category 3
1. Cable shall be rated to 16 MHz minimum.
2. Shall conform to the requirements for communication circuits as defined by the National Electrical Code. Cable shall be listed to NEC Type CMP (NFPA (NFPA 800.179.A) for plenum installations.
3. The cable shall meet or exceed the requirements as described in ICEA S-90-661 Category 3, TIA 568-C.2 Category 3.
4. RoHS Complaint Directive 2002/95/EC
5. The cable shall meet or exceed the requirements as described in TIA 568-C Category 3.
6. 24 AWG, solid bare annealed copper conductors.
7. Insulation: Flame-retardant semi-rigid PVC.
8. Rip cord applied longitudinally under jacket.
9. Jacket color white.

10. Products
    a. General Cable 25 pair, #2131505, or equal
    b. General Cable 50 pair, #2131757, or equal

D. High Pair UTP OSP (Outside Plant) Cable-Category 3
1. Rated to 16 MHz.
2. Cable shall have water blocking and be rated safe for outdoor or wet locations.
3. Shall meet or exceed the requirements as described in TIA 568-C Category 3.
4. 24 AWG, solid bare annealed copper conductors.
5. Rip cord applied longitudinally under jacket.
6. Products
    a. General Cable 25 pair, #7525785, or equal
    b. General Cable 50 pair, #7525793, or equal

2.02 OPTICAL FIBER CABLE

A. Single-Mode
1. Optical Plenum-Rated Armored Fiber Cable -Single-Mode
    a. Shall conform to the requirements for communications circuits as defined by the National Electrical Code. Cable shall be listed to NEC Type CMP (NFPA 800.179.A) for plenum installations.
    b. Tight buffered.
    c. Interlocking aluminum armored jacket
    d. Jacket color is yellow.
    e. 10.8MM OD
    f. Flame test listing NEC OFCP (ETL)
    g. Flame test method FPA 262
    h. Acceptable for installation in air handling spaces
    i. Heat age to -20 Celsius to +85 Celsius (-4 degrees Farenheight to +185 degrees Farenheight)
    j. ROHS 2011/65/EU compliant
    k. Products
        1) CommScope TeraSPEED-#P-0##-DZ-8W-FSUYL, #760127803 (## indicates strand count)
        2) Corning MIC - #0##E88-33131-A3
2. Optical Indoor/Outdoor Plenum Armored Cable, Single-Mode, Yellow/Black
    a. Shall conform to the requirements for communications circuits as defined by the National Electrical Code. Cable shall be listed to NEC Type CMP (NFPA 800.179.A) for plenum installations.
    b. The cable shall meet or exceed the requirements as described in TIA 568-C.3, ANSI/ICEA S-104-696-2001 and EN 187105.
    c. Cable shall be tight buffered, armored and provide gel-free water blocking.
    d. Products
        1) CommScope-P-0##-LZ-8W-F12BK, with interlocking armor, or equal
        2) Corning-#0##E8P-31131-A3 with interlocking armor.
3. Optical Loose Tube OSP cable, Single-Mode, Black
    a. Shall conform to the requirements for communications circuits as defined by the National Electrical Code.
    b. The cable shall be an accepted product of the United States Department of Agriculture rural Utilities Service (RUS) 7CFR 1755.900 (PE-90) and meet the

requirements of NSI/ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-7-640-2006 and GR-20-CORE.

c. Shall meet or exceed the requirements as described in TIA 568-C.3, ANSI/ICEA S-87-640-2006 and EN 187105.
d. The cable shall provide gel-free water blocking and be non-armored.
    1) Each buffer tuber will contain water blocking material.
e. Stranded loose tube construction.
f Fan out kits are required
g. Fibers shall be placed inside a loose buffer tube, with the OD approximately 2.5 mm.
    1) Each buffer tube shall contain up to 12 fibers.
    2) The central member will consist of a dielectric, glass reinforced plastic rod.
    3) Buffer tubes containing fibers shall be color coded according to TIA/EIA-598-B "Optical Fiber Cable Color Coding"
    4) Buffer tubes shall be stranded around the dielectric central member using the reverse oscillation, or "S-Z", stranding process.
    5) Cables shall contain a ripcord under the sheath for easy sheath removal.
h. PE or polyethylene sheath with a minimal nominal jacket thickness of 1.3 mm.
i. Products
    1) CommScope TeraSpeed Single/ Jacket All-Dielectric, Gel-Free Outdoor Stranded Loose Tube Cable
        a) 6 Strand=#760053835-D-006-LN-8W-F06NS
        b) 12 Strand = #760053843-D-012-LN-8W-F12NS
    2) Corning ALTOS Lite Loose Tube, Gel-Free, Single-Jacket, Single-Armored Cables with Fast Access Technology
        a) 6 Strand=006ZU4-T4F22D20
        b) 12 Strand=#012ZU4-T4F22D20

B. OM3-50/125 um
1. Optical Fiber Cable for distances up to 300 meters
    a. Plenum-rated Tight-Buffered Cable, 12-strand, Multi-Mode, 10G, 50/125 um, jacket constructed with aluminum interlocking armor, NEC/CEC compliant (OFCP listed).
    b. Shall conform to the requirements for communications circuits as defined by the National Electrical Code. Cable shall be listed to NEC Type CMP (NFPA (NFPA 800.179.A) for plenum installations.
    c. The cable shall meet or exceed the requirements as described in TIA 568-C.3, ANSI/ICEA S-104-696-2001 and EN 187105.
    d. Fibers to be grouped into jacketed subunits and surrounded by a dielectric central member.
    e. The core to be protected by a flexible, spirally wrapped, aluminum interlocking armor that offers easy, one-step installation provides crush protection.
    f. Flame-retardant outer jacket.
    g. Products
        1) CommScope P-012-DZ-5L-FSUAQ, #760127647 or equal
        2) Corning - #012T88-33180-A3
2. Optical Indoor/Outdoor Plenum-rated Armored Cable, 10G, 50/125 um, Aqua
    a. Shall conform to the requirements for communications circuits as defined by the National Electrical Code. Cable shall be listed to NEC Type CMP (NFPA (NFPA 800.179.A) for plenum installations.
    b. The cable shall meet or exceed the requirements as described in TIA 568-C.3, ANSI/ICEA S-104-696-2001 and EN 187105.
    c. Cable shall be tight buffered, armored and provide gel-free water blocking.

d. Products
1) CommScope–P-0##-LZ-5L-F12BK - #760162883 with interlocking armor and P-012-LN-5L-F12BK without interlocking armor (inner duct will be used in lieu), or equal
2) Corning - #012T8P-31180-A3 with interlocking armor.

3. Optical Outdoor Fiber Cable, 10G, OM3-50/125 um, Loose Tube.
a. Shall conform to the requirements for communications circuits as defined by the National Electrical Code.
b. The cable shall meet or exceed the requirements as described in TIA 568-C.3, ANSI/ICEA S-87-640 and EN 187105.
c. The cable shall be gel-free water blocking and be non-armored and stranded loose tube.
d. Fiber cable that is not armored will be installed within innerduct per industry standards.
e. Products
1) CommScope–D-0##-LN-5L-F12NS- #760054171
2) Corning - ###SWF-T4180D20

C. OM1 62 micron
1. Optical Indoor Plenum-rated Armored Cable OM1, 62.5 um, Orange
a. Shall conform to the requirements for communications circuits as defined by the National Electrical Code.
b. Cable shall be listed to NEC Type CMP (NFPA 800.179.A) for plenum installations.
c. Interlocking aluminum armor
d. Adheres to ANSI/ICEA S-83-596
e. Meets NEC OFCP flame test listing
f. Products
1) CommScope OptiSPEED – P-###-DZ-6F-FSUOR, or equivalent
2) Corning – MIC - ###K88-T3130-A3

2. Optical Indoor/Outdoor Plenum-rated Armored Cable, 1G, 62.5 um, Orange
a. Shall conform to the requirements for communications circuits as defined by the National Electrical Code.
b. Cable shall be listed to NEC Type CMP (NFPA 800.179.A) for plenum installations.
c. The cable shall meet or exceed the requirements as described in TIA 568-C.3, ANSI/ICEA S-104-696-2001 and EN 187105.
d. Cable shall be tight buffered, armored and provide gel-free water blocking.
e. Products
1) CommScope–P-0##-LZ-5M-F12BK LazrSPEED - with interlocking armor, or equal
2) Corning - #0##K8P-31130-A3 with interlocking armor.

2.03 CONNECTORS AND JACKS

A. Optical Fiber Connectors
1. Optical Fiber Single-mode LC connectors
a. UniCam Connector
b. Factory pre-polished
c. Ceramic ferrule
d. Insertion loss .2dB/.5dB; typical
e. Blue boot color
f. Products
1) CommScope Uniprise-#STC-LCF-09-8X, #760117895 or equal

2) Corning-#95-200-99

2. Optical Fiber Multi-mode 50 Micron, OM3 LC connectors
   a. UniCam Connector
   b. Laser optimized 50 um Multi-mode
   c. Ceramic ferrule
   d. 0.5 dB typical maximum insertion loss
   e. Aqua boot color
   f. Products
      1) CommScope Uniprise-#MFC-LCF-09-5X, #760117887 or equal
      2) Corning- #95-050-99-X
3. Optical Fiber Multi-mode 62.5/125 Micron LC Connectors
   a. Unicam Connector
   b. Ceramic ferrule
   c. .01/.05 typical maximum insertion loss
   d. Amber housing color
   e. Beige boot color
   f. Products
      1) CommScope Uniprise-#MFC-LCF-09-6X, #760117937, or equal
      2) Corning-#95-000-99
4. Fiber Fan Out Kits-to be utilize with all loose tube fiber
   a. Shall be of the same manufacturer of the fiber connectivity.
   b. Will help with a unified manner to install fan-out solution than that required for terminating tight-buffered cables.
   c. Color coded assembly that matches the fiber color scheme.
   d. Available in 25" and 47" units.
   e. Products
      1) CommScope Loose Tube Breakout Kit
         a) 6 Fibers - #760018820, or equal
         b) 12 Fibers - #760018838, or equal
      2) Corning Buffer Tube Fan-Out Kits, indoor
         a) 6 Fibers - #FAN-BT25-06
         b) 12 Fibers - #FAN-BT25-12

B. UTP Category 6 jacks
   1. All products must meet or exceed TIA 568-C.2 Category 6 performance standards, ISO 11801 (Class E), EN50173-1 (Class E).
   2. Meets requirements of IEEE 802.3af and IEEE 802.3at for PoE requirements.
   3. UL 1863 approved.
   4. Backwards compatible.
   5. Modular jacks shall be unshielded, 4 pair, RJ-45.
   6. Modular jacks shall terminate using 110-style pc board connectors, color-coded for T568B wiring.
   7. Each modular jack shall be wired to T568B.
   8. Color codes
      a. Blue for IP data/IP voice, analog voice
      b. Yellow for IP wireless access point
      c. Green for voice backbone and horizontal analog voice
      d. White for IP video surveillance
      e. White for IP access control
   9. Products
      a. CommScope Uniprise - #UNJ600

1) Blue - UNJ600-BL - #760237778, or equal
   a) Interactive TV/Promethean board locations-rotate the jack in the faceplate 45 degrees
2) Yellow - #UNJ600-YL - #760237783
3) Green - #UNJ600-GR-#760237780
4) White - UNJ600-WH-760237788

b. Siemon
   1) Angled-for interactive TV location
      a) Blue -MX6-06
   2) Flat
      a) Blue – #MX6-F06
      b) Yellow - #MX6-F05
      c) Green - #MX6-F07
      d) White-#MX6-F02

c. Panduit-non keyed
   1) Blue - #CJ688TGBU
   2) Yellow - #CJ688TGYL
   3) Green-#CJ688TGGR
   4) White-#CJ688TWH

2.04 FACEPLATES FOR RECESSED APPLICATIONS

A. Duplex style, single gang faceplate.

B. Shall be available in 1, 2, 3, 4 and 6 vertical outlet configurations.

C. Provide faceplate with 1 spare port to allow for growth.

D. Ivory in color.

E. Shall be provided with mounting screws, label covers and label cards.

F. Provide blank dust covers for all blank ports.

G. Applications
   1. Interactive board outlets in the classrooms (promethean boards, smart boards, etc.)
      a. Provide either angled faceplate or RJ45 jack in flat faceplate and angle the jack 45 degrees.
   2. Data outlets, other than the interactive TV locations
      a. Provide flat faceplates.
   3. Surface mounted raceways
      a. Provide angled faceplates

H. Data (NOT POWER FAIL PHONE) Products
   1. Commscope Uniprise – White color
      a. 2 Port – M12L-262 - #108168469
      b. 4 Port - M14L-262
      c. 6 Port - M16L-262
   2. Siemon
      a. 2 Port - #MX-FP-S-02-02
      b. 4 Port - #MX-FP-S-04-02
      c. 6 Port - #MX-FP-S-06-02

3. Panduit
    a. 2 Port-#CFPE2IWY
    b. 4 Port-#CFPE4IWY
    c. 6 Port-#CFPE6IWY

I. Power fail phone – provide one in reception area at site denoted on the construction drawings.
1. Stainless steel faceplate
2. Single gang
3. Products
    a. Commscope Uniprise – M10LW4SP 1 Port 1-Gang Tel Faceplate - #760100891
    b. Siemon - #WPJP
    c. Panduit - #KWP6PY

2.05 FACEPLATES FOR WIREMOLD 700 AND WIREMOLD 2000 APPLICATIONS

A. Duplex style, single gang faceplate.

B. Faceplates shall work seamless with the raceway to be installed.

C. Colors shall match the raceway to be installed.

D. All fittings, modules and bezels necessary shall be provided.

E. Faceplates shall accept the same manufacturer of jacks that are being installed on the project.

F. Shall be provided with mounting screws, label covers and labeling cards.

G. Provide blank dust covers for all blank ports.

H. Products
1. Panduit - #CFPSE4IW, or equal

2.06 FACEPLATES FOR WIREMOLD 4000 OR EQUAL APPLICATIONS

A. Duplex style, single gang angled faceplate.

B. Faceplates shall work seamless with the raceway to be installed.

C. Colors shall match the raceway to be installed.

D. All fittings, modules and bezels necessary for the installation shall be provided.

E. Shall accept the same manufacturer of jacks that are being installed on the project.

F. Shall be provided with mounting screws, label covers and labeling cards.

G. Provide blank dust covers for all blank ports.

H. Products
1. Wiremold-#CM-ARA, or equal

2.07 106 FRAMES

A. Mounting frames used to mount behind standard 106 NEMA faceplates.

B. Frames will accept modules for STP, UTP, fiber optic and audio/video cabling.

C. Ability to snap in and out to allow for moves, adds and/or changes.

D. Products
   1. CommScope-White
      a. 2 Port-#M106FR2-262 - #106622251
      b. 4 Port - #M106FR4-262 - #106622285
   2. Siemon, or equal
      a. 2 Port - #MX-E2F-02
      b. 4 Port - #MX-E4F-02
   3. Panduit
      a. 2-Port - #CF1062IWY
      b. 4-Port - #CF1064IWY

2.08 PATCH PANELS

A. Modular panels shall accept the modules specified.

B. Modular patch panels for data, voice, wireless, security IP, and/or voice feeders 24 or 48 port (Renovations where the existing facility to remain currently has 66 blocks or 110 blocks for voice terminations in the telcom rooms, the Designer shall specify terminations for voice on 66 or 110 blocks-dependent to match the existing conditions of the facility.)
   1. Accepts Category 6 jacks specified.
   2. Mounts to standard TIA 19 inch rack.
   3. Stainless steel construction.
   4. Angled panel.
   5. Area for labels and icons.
   6. Products
      a. 24 port – One rack unit
         1) Commscope Uniprise-UNP-6-DM-1U-24 - #760180042
         2) Siemon - #MX-PNL-24
         3) Panduit – #CPP24FMWBLY
      b. 48 port – Two rack units
         1) Commscope Uniprise- UNP-6-DM-2U-48 - #760180059
         2) Siemon - #MX-PNL-48
         3) Panduit - #CPP48FMWBLY

2.09 SURFACE MOUNTED BOX FOR ABOVE CEILING TERMINATIONS (BISCUIT JACK)

A. Compliant with UL 2043 and appropriate for use in air handling spaces.

B. Shall have cable raceway entries

C. Cable tie anchor points

D. Rated for Category 6 4 pair UTP cables

E. Two Ports Capacity

1. Terminate the Wireless Access Point cables and their adjacent ceiling data cable in one biscuit jack.
    a. The requirement to leave 1 port open in faceplates and other connectivity products is waived for this application only.

F. Must be securely supported to building structure.

G. Products
1. CommScope - #760057349 M202SMB-003, or equal
2. Siemon - #MX-SM2-02

2.10 CONSOLIDATION POINT ENCLOSURES, CAT 6

A. Plenum-rated adhering to UL 2043

B. Meet or exceeds TIA 568-C Category 6 standards

C. Adheres to the following industry standards
1. UL 508A Listed
2. cUL Listed per CSA C22.2 No. 94
3. NEMA/EEMAC Type 4, 4X, 12 and 13

D. Hinged enclosure, removable

E. Wall/ceiling mount per plans

F. Molded in-place threaded brass inserts and plated steel screws to mount termination blocks

G. Knockout padlock provisions for each latch

H. All halogen free

I. Accepts or includes ¾" plywood for mounting equipment

J. Solid Door

K. Products
1. Specified on plans.

2.11 FIBER OPTIC ENCLOSURES

A. Fiber Optic Enclosures: Telecommunications Contractor is responsible for providing and installing all necessary coupling panels, couplings, connectors, and all other devices needed per manufacturers' recommendations.

B. 19 Inch Rack Mounted Enclosure & Closet Splice Housing
1. Commscope Uniprise
    a. 36 port Enclosure Adapter Panel Shelf (1 RU) - (accepts 3 PNL 6 packs) #SD-1U/#760231449, or equal
    b. 144 port Standard Sliding Panel Enclosure– SD-4U (4 RU)

#SD-4U/#760231464, or equal
1) LC Connector 12 Fibers, Shuttered
   a) 50/125 micron - #PNL-BK-012-MFA-LC02-AQ, #760067173
   b) 62.5/125 micron - #PNL-BK-012-MFA-LC02-BG #760067157
   c) Single-mode - #PNL-BK-012-SFA-LC02-BL #760067165
2) 6-Pack Blank – #PNL-BK-BLANK-6-PACK

2. Corning
   a. Enclosure
      1) 24 port - #CCH-01U (holds 2 connector panels)
      2) 72-144 port - #CCH-04U (holds 12 connector panels)
   b. Connector Panels
      1) LC Connector 12 Fibers, Shuttered
         a) 50/125 micron (OM3) - #CCH-CP12-AD
         b) 62.5/125 micron (OM1) - #CCH-CP12-AB
         c) Single-mode - #CCH-CP12-AE
   c. Blank panels included with enclosures

2.12 VOICE TERMINATION BLOCKS FOR VOICE BACKBONE AND HORIZONTAL TERMINATIONS, if applicable

A. Type of blocks to match existing conditions in renovations.

B. New construction shall receive 110 blocks.
   1. Install 110 block next to voice demarcation block in main telcom room.

C. 110 Blocks
   1. Materials must meet or exceed Category 5e requirements of ISO/IEC 11801 (Class E), EN50173-1 (Class E) and TIA 568 latest edition.
   2. Wall mount
   3. 100 pair configurations
   4. Provide 4 and 5 pair connecting blocks as needed.
   5. Wire management shall be provided to contain the cabling both horizontally and vertically completely around the 110 blocks.
   6. Label holders to contain labeling
   7. Products
      a. CommScope Uniprise
         1) 100 pair base with legs kit, C4 and C5 Clips – #569439-1
         2) 4 pair connecting blocks, #558401-1
         3) Label holder, 10 count - #558417-1
      b. Siemon
         1) 100 pair base with legs, 4 pair connecting blocks with labels kit-#S110AB2-100FT
         2) 100 pair base with legs, 5 pair connecting blocks with labels kit-#S110AA2-100FT
      c. Panduit
         1) 100 pair base with legs-#P110BW100-X
         2) 4 pair connecting blocks-#P110CB4-XY
         3) 5 pair connecting blocks-#P110CB5-XY

4) Label holder-#P110LH

D. 66 Blocks
1 Install wall mounted at the voice service provider demarcation. This block will be cross-connected by the Owner to the voice demarcation to complete the analog voice signals.
2 50 Pair terminations
3 Category 5e or greater
4 Terminates 22-26 AWG solid insulated cable
5 High impact flame retardant thermoplastic
6 Fanning strips to provide management for horizontal cabling and cross-connect jumper wires and to provide a labeling surface for circuit identification
7 Provide mounting backboards, brackets and wire spools for wire management
8 Products
a. Siemon - #S66M1-50, or equivalent
b. Hubbell - #HPW66, 150

2.13 BUILDING ENTRANCE TERMINALS/PROTECTORS-VOICE APPLICATIONS-SOLID STATE-CAT 3

A. Circa Protectors, or equal
1. Terminals
a. 12 pair, #2612QC/QC
b. 25 pair, #1890ECT1/NSC-25
c. 50 pair, #1890ECT1/NSC-50
d. 100 pair, #1890ECT1/NSC-100
2. Modules – Solid State, 5 pin
a. Data - #4B3S-75
b. Voice - #3B1FS-240

B. Porta Systems Protectors
1. Terminals
a. 10 pair, #24025-66-M66
b. 25 pair, #24025-66-M66
c. 50 pair, #24050-66-M66
d. 100 pair, #24100-66-M66
2. Modules – Solid State, 5 pin
a. Data - #113-6C3S75-N
b. Voice - #105-3C1FS-N

2.14 BUILDING ENTRANCE TERMINALS/PROTECTORS-DATA APPLICATIONS-CAT 6

A. 4 pair UTP
1. ITWLINX - #CAT 6-LAN or equal
2. Porta Systems-#CAT 6-Series 606

2.15 EXTERNAL RINGER

A. Provide and install a stinger ringer outside of the café manager's office. Provide one Category 6 cable and terminate with a data jack (new construction only-renovations this jack will be a voice jack). See construction drawings for details.
1. Output=109 dB Piezo speaker
2. UL Standard 1950, CSA, IC, DOC, FCC registered
3. Interrupted ring voltages from 18-30VDC-36-60VDC

4. Weather resistant backbox
5. Volume control
6. Coordinate terminations to equipment and configurations with Owner and manufacturer's instructions.
7. Products
    a. Eaton UTA-1, or equal

B. Provide and install a stinger ringer for the school's after school program (ASEP). Provide surface mounted raceway and outlet box as necessary. Provide one Category 6 cable and terminate with a data jack (new construction only- in renovations this jack will be a voice jack). Coordinate exact location with Owner's school personnel.
1. Output=109 dB Piezo speaker
2. UL Standard 1950, CSA, IC, DOC, FCC registered
3. Interrupted ring voltages from 18-30VDC-36-60VDC
4. Weather resistant backbox
5. Volume control
6. Coordinate terminations to equipment and configurations with Owner and manufacturer's instructions.
7. Products
    a. Eaton UTA-1, or equal

2.16 WIRE GUARDS FOR WIRELESS ACCESS POINTS

A. Provide wire-guards for wireless access points in gymnasiums and multi-purpose rooms.

B. Clear coated for corrosion resistance

C. #3-gauge wire material.

D. Welded tabs with mounting holes or looping foot attachments for easy installation.

E. Dimensions=26 ¼" x 15 ¾" x 6 ¾" deep with a 13"x3" opening

F. Products
1. Basis of design
    a. American Time #G2063

PART 3 - EXECUTION

3.01 HORIZONTAL DISTRIBUTION CABLING

A. Horizontal cabling is installed in a star topology.

B. Bridged taps and splices are not permitted as part of the copper horizontal cabling.

C. All connectivity products such as patch panels, faceplates and data jacks shall be of the same manufacturer (see approved products list).

D. All cables shall be plenum rated, unless running underground or between buildings then cables shall contain a water blocking powder, otherwise noted. (Avoid providing gel-filled blocking.)

E. Twisted pair cabling shall be terminated to T568B standard.

F. Contractor shall install all cabling according to latest industry standards, manufacturer's recommendations and best practices. Cabling shall be installed in an orderly and neat manner. Cables shall be installed parallel and perpendicular to building lines.

G. Horizontal cables shall terminate to the closest Telecommunications Room (TR) on the same floor.

H. Horizontal cable links shall not exceed 90 meters. If TC discovers any cable shall exceed 90 meters, then TC shall contact designer and coordinate best course of action to reduce length of cable.

I. UTP cable shall be installed so that there are no bends smaller than 4 times the cable's outside diameter at any point in the cabling run and the termination area. If cables are kinked or the cable jacket is damaged during the construction project, the cable will be removed and replaced with new cables at no additional cost to the Owner.
   1. Confirm all bend radius with manufacturer.

J. Fiber optic cable bend radius shall not exceed:
   1. Nonconductive fiber cables' minimum bend radius is 10 times the cables' outer diameter when under no load and 15 times the cable's outer diameter when being pulled.
   2. Conductive fiber cables' minimum bend radius is 10 times the cables' outer diameter when under no load and then 20 times the cable's outside diameter when being pulled.
   3. Confirm all bend radius with manufacturer.

K. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.

L. A pull cord (nylon; 1/8 inch minimum) shall be co-installed with all cables installed in any homerun conduit and conduits exceeding 1" in diameter.

M. Cable raceways shall not be filled greater than the TIA/EIA-569 maximum fill for the particular raceway type or 40%.

N. Where transition points or consolidation points are required, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose. Coordinate with AHJ (authority having jurisdiction) on locations and further requirements for the installations to be accepted for required inspections.

O. Slack required
   1. Data room
      a. 10 feet minimum for UTP
      b. 20 feet minimum for Fiber, not including the 15 feet of workable fiber wound inside fiber cabinet
   2. Work area outlets – 12 inch minimum for UTP
   3. Wireless Access point locations – 20 feet minimum for UTP
   4. Ceiling mounted outlet locations – 20 feet minimum for UTP

P. Pathways
   1. Electrical contractor shall provide all raceways including conduit, cable tray (not the ladder racking in the telcom room. TC provides the ladder racking), outlet boxes, and sleeves, UON.

a. Telcom Contractor to provide all pathways not provided by others.

2. Contractor shall coordinate with electrical contractor to ensure all pathways intended for the TC are installed according to the contract documents and best aid the TC in his work.
3. The ceiling cable support throughout most of the facility will be accomplished by utilizing open areas above ceilings and cable trays when available.
   a. There shall be a minimum of three inches of clearance between the cable support system and the ceiling tile support grid.
4. Install pathways where cable is routing above all water piping, electrical conduit, and duct work. Coordinate any conflicts with the Owner.
5. All equipment and materials installed in plenum environment shall be UL rated acceptable for plenum environments.
6. Conduits sleeves
   a. All penetrations through walls, floors and any kind of partition must be sleeved.
   b. Conduit sleeves inside the buildings shall be EMT conduit.
      1) EC to provide bushings on all conduits and sleeves they provide.
   c. Size and quantities of sleeves are denoted on the Construction Drawings.
   d. Conduit sleeves shall align with cable tray when walls need to be penetrated to allow a continuous cabling pathway.
   e. Provide fire-rated split sleeve kits where existing walls with existing cables penetrate the wall and that wall is to be demolished and re-built. This will enable to protect the existing cabling to remain while fire-stopping the new wall.
7. Cable trays
   a. Cable trays are to be installed by the electrical contractor.
   b. 12″ to 18″ cable trays with 1 divider are to be provided. (See drawings for correct sizing.) The tray shall be divided in a 12″ section and a 6″ section for the 18″ tray, and for the 12″ tray, divider shall create an 8″ section and a 4″ section.
   c. TC to coordinate with E.C. and all other disciplines with their work in the location of the cable trays prior to installation.
      1) TC to call a meeting on site with EC and CMS IT Field Managers prior to installation of the cable tray to coordinate locations.
   d. A minimum of 12″ clearance above the tray and 36″ clearance to access the tray from one side is always required. A minimum of 6″ clearance below the tray is required.
   e. Contractor to coordinate with all other disciplines in the location of their water piping, duct work, conduits, mc cable, etc. being installed in the vicinity of the cable trays.
   f. Piping carrying liquids.
      1) Shall not be installed above the cable tray, in the cable tray, etc. It shall not route above the tray within 2′ from center of tray.
   g. If this is unavoidable due to the constraints of the ceiling space, a drip pan with installed drains must be installed under the piping to protect the cables from water damage.
      1) This requirement will not be required where there are no joints in any piping less than 2″ in diameter that do not have any joints in the pipes 2′ from the top of the cable tray dimensioning from each side of the tray.
      2) However, piping shall not be installed running parallel with the tray but above and less than 2′from the center of the tray. This is to protect the cabling from damage.
   h. The data, voice, and wireless cables shall occupy the larger section of the partitioned cable tray.
   i. Intercom, video surveillance, access controls and security cables shall occupy the smaller section of the partitioned cable tray.

j. Mechanical controls cable shall not be installed in the cable tray, nor be supported by the cable tray or the cable tray supports.
k. Electrical conductors are not allowed to be routed in the tray or be supported by the cable tray. They shall not be routed parallel within 12" of the tray due to susceptibility of EMI.
l. Duct work and any piping shall not obstruct the tray and must leave the tray accessible throughout its routing.

8. Conduit
   a. No cables shall run exposed. In areas of no accessible ceiling and where a pathway is not being provided by others, the Contractor shall provide the pathway. The pathway shall be EMT conduit in commons areas, or surface metallic raceway in classroom/office areas.
   b. TC shall provide all necessary sleeving of walls and floors where sleeves or openings are not being provided by others.
   c. Cables in conduits shall not exceed 40% fill ratio.
   d. Conduits routing between buildings shall have flex fabric innerduct installed in each conduit.
9. Non-continuous hangers and supports
   a. In areas where support structure is not available, cables will be supported with metallic J-brackets at regular 4-5-foot intervals.
   b. Each discipline is responsible for providing their own independent support systems except for the cable tray, which is provided by the E.C. and is for data, voice, security and intercom cabling use.
      1) Provide non-continuous hangers and supports for cabling exiting conduits and entering the cable tray.
      2) Provide support within 2' for cables entering or exiting the cable trays or conduit sleeves
   c. Installation of hangers shall abide by current industry standards and manufacturer recommendations.
   d. Install all hangers and supports where cabling will be installed above any water piping, electrical conduits and even duct work.
      1) Clearances and other requirements as stated in the cable tray section above, apply to non-continuous hangers and supports. Refer to 3.01 P.7.
   e. Do not bend cables, in handling or in installing to smaller radii than minimums recommended by the manufacturer.
   f. Follow manufacturers and industry standards for allowable fill capacity for each hanger or support.
   g. Provide support 4'-5' on center but vary the distance.
   h. Route parallel and perpendicular to building lines.
   i. All hangers and supports shall be secured to structure and must be tied off at the bottom. If tying to existing ceiling grid, these support wires must be tagged or painted and must be distinguishable from the ceiling grid support wires.
   j. Groom cables within supports with tie-wraps.
   k. No more than 12" of cable sag is allowed between supports.
10. Access Panels
   a. Access panels shall be provided as needed to gain access for installation and for Owner's future use in typically non accessible ceiling areas.
   b. The respective finish trade shall provide and install all access panels needed for the project.
   c. Refer to the requirements of Division 08 Section "Access Doors and Frames".

Q. Cable Installation
1. Contractor shall coordinate all work with all other trades.
2. Cables shall be installed parallel and perpendicular to the building structures.
3. If cable trays or sleeves are available, the TC must use the cable trays and sleeves as their pathway, unless the TC has received formal approval from the Designer
4. No more than 12" of cable sag is allowed between supports.
5. Install cables where the cable jackets and conductors will not be damaged.
6. Cabling shall be coordinated with other trades prior to installation.
    a. In addition to the cabling requirements as related to the cable tray, those requirements are implemented for cabling in j-hooks and conduit pathways. Refer to 3.01.P of this document.
7. Cabling shall not be installed under water piping, electrical conduit, mechanical piping, or sprinkler piping.
    a. Cabling shall keep a 2' clearance from all piping to minimize damage to cabling if a pipe burst is experienced.
8. Provide support for cables exiting a sleeve within 2' of the cables leaving the sleeve.
9. Do not install cabling where it is obstructing access to other disciplines valves, junction boxes, controls, etc.
10. Always try to install the cabling above piping carrying liquids.
11. In areas where support structure is not available, cables will be supported with metallic J-brackets at regular 4-5-foot intervals.
12. Cables may only be supported by building structure when the cable spans do not exceed 5-foot intervals.
13. Cables SHALL NOT be supported on top of walls or I-beams or in areas where the cable is susceptible to damage or EMI.
14. Cables shall not be attached to ceiling grid or lighting fixture wires. At no point shall cable(s) rest on acoustic ceiling grids or panels.
15. Contractor shall install cables above the fire-sprinkler system. Attaching cables or cabling supports to the fire-sprinkler system is not allowed.
16. Contractor shall not install cabling where it would block access to any junction box, valve, control devices or any other materials that require maintenance.
17. TC must ensure that TIA/EIA recommended minimum separation distances are maintained between the newly installed cabling and high-energy sources that may interfere with data transmission. Cables shall never come into contact with any ceiling grids or lighting sources or any devices that emit EMI.
18. During the course of the project, any cable that gets paint on its cable sheath, shall either be cleaned immediately (the same day), or must be replaced. Cables with paint on them are not eligible for the manufacturer's warranty.
19. Contractor shall observe and adhere to the standards regarding bend radii and the limit of a 40% fill ratio in a pathway.

R. Bundling Cables
1. Cables inside the accessible ceiling space shall be secured together via plenum rated cable ties or plenum rated Velcro cable wraps.
2. Cable ties are not allowed below ceiling in the data rooms. Bundling cables in this scenario will be achieved via Velcro cable wraps.
3. Horizontal distribution cables shall be bundled in groups of no more than 40 cables. Cable bundle quantities in excess of 40 cables may cause deformation of the bottom cables within the bundle and degrade cable performance. This includes cable bundles supported in J-Hooks.

S. Cables routing under slab or outside shall be rated outside plant and provide water blockage.
   1. Outdoor Rated cables shall be installed according to the latest industry standards and in adherence of state and local codes.
   2. Backbone-Outdoor Rated cables routing from underground shall, upon entering the building and exiting the conduit, be transitioned to a plenum rated cable if the point of termination is beyond 50' upon entry into the building's accessible ceiling space.
   3. Horizontal-Outdoor Rated cables routing under slab from floor boxes shall be transitioned to plenum cable at the conduit stub up location if the conduit stub up location is not in the telcom room.
      a. Provide transition points in accessible locations to transition the cable from OSP to Plenum.
   4. Coordinate with AHJ. It is the ultimate responsibility of the TC to install these cables and provide transition that will be accepted by the AHJ.
   5. Conduit pathways for low voltage cabling routing under slab or underground shall be sealed.
      a. 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.

T. Firestopping
   1. Firestopping will be performed by an installer who specializes in this work.
   2. Refer to the requirements of Division 07 Section "Penetration Firestopping".
   3. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways that are specifically designated for the data/video/voice infrastructure shall be properly fire stopped. The contracting discipline installing the sleeve or slot, shall be responsible for sealing the area on the exterior of the sleeve or slot. The TC shall be responsible for firestopping the interior annular area.
   4. Firestop systems utilized shall be dictated by this project's Professional Electrical Engineer's UL design. See Electrical Drawings and specifications for exact details. If a Professional Engineer's UL design is not available, the Contractor shall provide appropriate UL design for penetrations through rated walls and properly firestop penetrations. These documents shall be submitted to the Designer.

U. Provide over voltage protection on both ends of cabling exposed to lightning or accidental contact with power conductors.

V. Coordinate with Owner and Service Provider for dial-tones required for construction inspections.

W. Any cable damaged or not adhering to recommended installation parameters during construction shall be replaced by the TC prior to finial acceptance at no additional cost to the Owner.

3.02 TELECOMMUNICATION ROOM (TR)

A. Data Racks
   1. Provide 7'x19" floor mounted two post data racks in the telcom rooms. See construction drawings for details.
      a. Provide one 4 post rack in MDF for security contractor's head-end equipment.

2. Data racks shall be installed where there is a minimum 42" clearance behind the racks and a minimum of 36" in front of the racks. Racks shall have a minimum of 36" to the side of a rack to maintain access to the rear of the racks. Racks shall not be located under any equipment, pipes, conduit or ductwork. Consult with the CMS Information Systems and Support Department and Designer on rack lay-outs if these conflicts are present.
3. Racks shall be heavy duty EIA complaint nineteen (19) inch wide, seven (7) foot tall equipment racks, unless otherwise noted. Racks shall have a black finish. Side channels shall be drilled and tapped on both sides.
4. Racks shall be securely anchored to the floor slab using 3/8" expansion anchors. The rack shall tie to the wall via a 12" ladder cable runway for routing cables.
5. Wall mounted racks or enclosures shall be mounted on plywood backboards located in the telcom rooms and installed per manufacturer's recommendations.
6. Unused rack equipment mounting screws shall be bagged and attached to the racks upon completion of the project.
7. Leave three rack units free above and below each patch panel.
    a. Provide flat blank panels in these rack units.

B. UTP Cable Termination Hardware
1. Each horizontal or backbone cabling run will be terminated using appropriate connectors or connecting blocks depending upon the cable type. Matching patch cords, provided by the Owner, unless otherwise noted, will be used to perform cross-connect activities or to connect into the networking hardware.
    a. Cross-connecting activities will be provided by the Owner.
2. Horizontal data and wireless access point cabling will be terminated on dedicated modular patch panels installed in the racks or enclosures. (New construction only. In renovations where a voice system is existing to remain, terminate new voice cabling in the manner of the existing voice cabling is terminated.)
    a. Data cables shall be terminated on dedicated modular patch panels designated for data.
    b. Wireless access point cables shall be terminated on dedicated modular patch panels designated for wireless access points.
    c. Security IP cabling shall be terminated on dedicated modular patch panels for security.
        1) This cabling is provided by others.
3. Analog voice connectivity will be via cross-connects at the racks provided by the Owner. (New construction only.)
4. Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568-B standard, manufacturer's recommendations and best industry practices.
5. Pair untwist at the termination shall not exceed .5".
6. Bend radius shall not exceed 4 times the outside diameter of the cable.
7. Splitting the pairs prior to termination is not acceptable.
8. Cables shall be neatly bundled and dressed into their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
    a. Separate cables bundles in the rack into two bundles. Each bundle will route into the patch panel from the opposite sides of the panels.
    b. Neatly dress the bundles.
9. The cable jacket shall be maintained as close as possible to the termination point.
10. Each cable will be clearly labeled on the cable jacket behind the patch panel. Labels shall be machine printed and clearly visible within the bundle.

11. Terminate the voice backbone cabling on modular patch panels with green Category 6 modules. (New construction only. Match existing conditions on renovations.)
    a. In the MDF, provide one 24 port patch panel for each IDF on the campus.
        1) Provide one 25 pair UTP Category 3 cable and route from these patch panels in the MDF to each IDF and terminate on dedicated modular patch panels.
    b. In IDF, provide one 24 port patch panel for Backbone Voice cable (25 pair Category 3 UTP).
12. Four-pair Category 6 UTP cabling shall be terminated with a four-pair Category 6 module. All modules shall be terminated using the T568B (B) wiring scheme. The eight position module shall exceed the connector requirements of the TIA/EIA Category 6 standard.
13. Patch Panels (angled) shall be of the manufacturer and part number as listed in these specifications.
    a. Rack mountable patch panels shall mount to standard EIA 19"W floor mounted data racks.
    b. Cables shall be neatly groomed with Velcro Integral cable ties.
    c. Port and panels shall be easy to identify with write-on areas.
14. See labeling section of these Specifications for labeling requirements.

C. Fiber Termination Hardware
1. All fiber optic cables are to be terminated utilizing LC duplex connectors for the type and mode of the fiber optic cable being terminated.
2. All fiber optic terminations shall be accomplished by fusion or no epoxy/no-polish field terminations.
3. Loose tube fiber cables shall be spliced to fan-out kits.
4. The terminated strands shall be secured within fiber optic enclosures. Provide extra 10’ of Fiber slack and neatly coil and secure within the fiber splice tray or enclosure.
5. The cables strength member shall be securely attached to the cable strain relief bracket in the enclosure.
6. Telecommunications Contractor will supply the appropriate number of fiber coupler panel blanks for each fiber enclosure where fiber optic terminations are not made.
7. When terminating the fiber via splicing, each fiber bundle shall be stripped upon entering the splice tray and then route the individual fibers in the splice tray.

D. Voice Patch Panel for Tie to Demarcation (New construction only.)
1. Provide and install one 24 port modular patch panel in the MC in the data rack as shown on the Construction Drawings dedicated for cross-connecting the Voice Demarc.
2. Provide a wall mounted 110 block with appropriate wire manager, including spools and managers around all sides of the block and install adjacent to the voice service provider demarcation.
3. Coordinate with service providers on the type of cable and type of termination for the 110 block to the patch panels, prior to installation.
4. Provide and install cable from wall mounted 110 block to this patch panel and terminate for connectivity to the demarcation. Typically, this cable is a 25 pair Category cable. But contractor to verify with service provider the type of cable and the connector on the voice service provider demarcation block.

E. Grounding and Bonding
1. Grounding shall be installed per NEC and ANSI/TIA/EIA-607-A and manufacturer’s grounding requirements as minimum.

2. Bond and ground equipment racks (each rack shall be individually bonded to the bus bar), housings, messenger cables, ladder racks, and metallic raceways with a #6 AWG stranded green insulated conductor. #12 AWG stranded insulated green conductor shall be used to bond surface mounted metallic raceways. However, in plenum areas, the grounding conductor shall be a bare, solid conductor for all grounding applications. Coordinate with electrical contractor. Electrical contractor (E.C.) to bond or ground all pathways provided by electrical contractor.
    a. Bond each section of ladder rack with runway ground straps that shall consist of # 6 AWG stranded green insulated conductors with two-hole long barrel irreversible crimp lugs with 1/4" bolt holes spaced on 5/8" centers. Straps shall be 11" in length. Provide home-runned #6 AWG stranded green insulated conductor to wall mounted bus bar.
3. All grounding lugs shall be two-hole long barrel irreversible crimp with 1/4" bolt holes spaced on 5/8" centers.
4. Provide horizontal rack busbars at the top of each data rack or enclosure. Connect rack bus bars to wall mounted bus bar via home-runned stranded #6 AWG stranded green insulated conductor.
5. Wall mounted bus bar provided by E.C. See electrical drawings for details.
    a. PBB (Primary Grounding Busbar) and SBB (Secondary Grounding Busbar) shall be provided by the E.C. unless otherwise noted. Electrical Contractor shall bond the ground bus bars to the electrical service equipment ground and to building steel with a #6 AWG green conductor unless otherwise noted on the Electrical Construction Documents.

F. Entrance Conduits
1. The EC will install 2-4" conduits for telephone service entrance and 1-2" conduit for cable television service entrance routed underground from the property line where dictated by the service providers into the main data room. They shall be stubbed up tight in a corner as designated on the construction documents.
2. All temporary power must be removed by the EC from the entrance conduits prior to service providers' cable installations. Coordinate with Owner, service provider and EC.
3. Sealing
    a. TC is responsible for sealing the unused conduits to prevent rodents, water, or gases from entering the building. Provide temporary closure at termination conduits that have cables pulled in.
    b. Contractor shall use rubber conduit plugs, water plugs, or duct sealers depending upon the conditions. Sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

G. Conduits for Feeders Between Free-Standing Buildings.
1. The GC will install underground conduits for the routing of backbone cables between buildings.
2. Stub these conduits tight in a corner as designated on the construction documents.
3. These conduits shall be sealed. See Section 'F' above.

H. Plywood Backboards
1. The telcom room is to have 3/4" fire retardant A/C plywood installed with fire rated stamped band, A side, of plywood facing outwards. Plywood is to remain unpainted.
2. 3/4" fire retardant plywood shall be installed vertically starting at 24" AFF to a complete height of 110" AFF.
3. Install plywood on all walls as illustrated on the drawings.

a. When a wall is indicated to receive fire-rated plywood, provide plywood for the entire length of the wall.

I. Above Ceiling Requirements
1. No piping, electrical piping, mc cabling, etc., duct work of any kind shall route above or through the telcom rooms as a pass through to feed other areas.
a. This includes feeding through the room while feeding a device, such as a sprinkler head.
2. No electrical feeders or branch circuits shall route across the top or through the room as a pathway to feed other areas.
3. Duct work shall not route across the telcom room as a pass through to feed any other areas.
4. Sprinkler piping shall not route through the room. Install wall mounted sprinkler heads instead of ceiling mount.
a. Mount sprinkler heads on walls not in ceilings. This is to prevent the sprinkler piping entering the telcom rooms.
5. Contractor shall coordinate with all other trades to ensure the above ceiling area of the telcom rooms and any other areas of the telcom rooms remain free and clear of any obstructions and clear access to all equipment, and cable routing.
6. Only services (duct, piping, electrical of any kind, etc.) allowed in the ceiling space of the telcom rooms or into the telcom rooms are those services feeding the telcom rooms.
7. The intent of this requirement is to prevent all other disciplines from entering the telcom rooms, from ceiling to floor, to use this space to pass through in route to feed other areas of the building. All other disciplines shall route all of their circuits, duct, piping, conduit around the telcom room and shall not enter the telcom room space unless a service is feeding only that telcom room. For instance, only an electrical conduit with power circuits, shall enter the telcom space to feed a receptacle. Duct work feeding the telcom room only, is allowed to enter the space. There will be no exceptions to this requirement.

3.03 WORK AREA OUTLETS

A. Cable slack shall be neatly coiled above the ceiling near the conduit stub up. Neatly coil the cable slack and support with j-hooks above the accessible ceiling. If no ceiling exists in this area, then the cable slack shall be neatly coiled in an appropriately sized junction box to conceal the cable. The cable coil shall not exceed the manufacturer's bend radius recommendations.

B. Pair untwist at the termination shall not exceed .5".

C. Bend radius of the cable in the termination area shall not be less than 4 times the outside diameter of the cable.

D. The cable jacket shall be maintained to as close as possible to the termination point.

E. Data, voice and wireless cables (wall mounted outlets) shall be terminated on a RJ45 jacks and inserted in modular faceplates.
1. Jack colors are:
a. Blue for data
b. Green for analog voice
c. Yellow for wireless
d. White for IP security, IP access controls, and Helios cabling
2. A blank cover shall be installed on all unused positions within each faceplate.

3. All RJ45 jacks shall meet or exceed the TIA-568 standard for Category 6. (Renovations where voice is existing to remain and new voice cabling is being added, the voice cabling will be terminated on Green RJ45 jacks.)
4. Populate the faceplates with modules from the top left positions.
   a. When voice cabling is being terminated in an outlet, voice jacks shall be installed in the top left position in the faceplate.
5. Leave one spare port free in the workstation faceplates at the outlet. This does not apply to voice only outlets, or outlets mounted above 18" AFF, unless otherwise noted.
6. For data and voice cabling provide 1' of cable slack neatly coiled (adhering to bend radius requirements) and supported with independent support to structure near the conduit stub up location.

F. Wireless Access Points and other cables that are to terminate in the accessible ceiling space shall be terminated on a plenum rated Biscuit Jack-Category 6.
   1. Biscuit jack to be permanently secured to structure.

G. At the power fail phone location, provide a wall phone faceplate populated with a USOC jack. See construction drawings for locations.

H. 106 Frames, if required, shall be a 2 or 4 port frame that mounts onto U.S. NEMA standard junction boxes and wall board adapters with screw-to-screw dimensions of 3.28" (83.3mm) and behind NEMA standard "106" duplex electrical faceplates. Frame shall accept individual modules that can be individually inserted and removed as required.

I. For surface mounted raceway equivalent to Wiremold 4000 and power poles, provide angled connector faceplates. The TC to provide all necessary fittings and additional materials to adhere to manufacturer's installation guidelines.

J. Stainless steel blank cover plates for all unused Telecommunications Outlets shall be provided by others unless otherwise specified on the Construction Drawings.

K. Provide and install stinger ringers for the after-school program and for the cafeteria manager's office. Provide service mounted raceway and outlet boxes as necessary. Provide a data cable for each.
   1. ASEP-the after-school program voice connectivity
      a. The ASEP bell location must be confirmed by the principal of the school.
      b. Once that location is known, contractor to provide a surface mounted raceway and outlet at that location, if no recessed outlet is present.
      c. Provide the CAT 6 data cable and terminate in the surface mounted outlet.
      d. If this location is identified early enough in construction, the EC then can provide a regular outlet for this purpose.

3.04 WIRELESS ACCESS POINT CABLING

A. Provide one 4 pair Category 6 yellow plenum rated cable to locations denoted on drawings.

B. Terminate in ceiling in a plenum rated surface mount box (biscuit jack).
   1. Secure Biscuit Jack permanently to structure.

C. Provide 20' of slack, neatly coiled and supported to structure.

D. Label according to the labeling section later in this document.

E. Provide wire-guards on wall mounted wireless access points and directional antennas located in gymnasiums and multi-purpose rooms, and any other area where the wireless access points and directional antennas can be susceptible to damage.
   1. Install with hardware that corresponds to the structure being installed upon.
   2. Install per manufacture's recommendations.

3.05 CEILING DATA DROP

A. Provide one 4 pair Category 6 blue, plenum rated cable to locations as denoted on drawings.
   1. Install this cable in the ceiling where it is located adjacent to the wireless access point cable.

B. Terminate in ceiling on plenum rated biscuit jack. Support biscuit jack securely to structure.

C. Provide 20' of slack, neatly coiled and supported to structure.

D. Label according to the labeling section later in this document.

3.06 BACKBONE CABLE INSTALLATION

A. All cables shall be plenum rated, unless otherwise noted.

B. A pull cord (nylon; 1/8 inch minimum) shall be co-installed with all cable installed in any conduit.

C. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be bundled separately from the horizontal distribution cables.

D. All backbone cables shall be securely fastened to the sidewall of the Telecommunications Rooms on each floor with metallic D-Rings on the fire-rated plywood behind the data racks.

E. Backbone cables feeding between floors shall be fastened securely to a vertically installed ladder rack.

F. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.

G. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.

H. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

I. The use of plenum rated tie wraps are permitted in ceiling cavity only. Bundling cables below ceiling must be accomplished with Velcro cable wraps.

J. Provide armored fiber inside the buildings when routing in the ceiling space. Any fiber routing underground or between buildings, if not armored, contractor to provide innerduct for protection of the fiber.

K. Provide over voltage protection on both ends of cabling exposed to lightning or accidental contact with power conductors.

L. Refer to PART 3.1 – Horizontal Distribution Cabling of this section for additional cabling requirements.

3.07 IDENTIFICATION AND LABELING

A. All cables, faceplates, patch panels, ports, grounding conductors and junction boxes shall be labeled with self-adhesive printed labels. Cables shall be labeled on each end. Refer to TIA 606-B and Owner requirements to coordinate labeling schemes. Font size on labels shall be consisted throughout facility. Label placement on faceplates shall be consistent throughout facility.

B. All labels shall be black lettering on white labels.

C. Labels on cables shall be placed 6" from the termination point on each end of the cables. Labels shall be clearly visible during and after construction has completed.

D. Data Racks/Enclosures
   1. Label each data rack/enclosure room designations, ie. TR1-1, TR2-2, etc.

E. Patch Panels
   1. Data modular patch panels
      a. Label the face of data patch panel 'Data A', 'Data B', etc.
   2. Wireless modular patch panels
      a. Label the face of the wireless patch panel 'Wireless A', 'Wireless B', etc.
      b. The 'A' and 'B' are designating the alphanumeric numbering of the wireless patch panels which will be numbered sequentially within the telcom room.

F. Horizontal cables
   1. The label on data horizontal cables and faceplates shall read "TR1-A-12" where TR or MC determines the Telecommunications Room; the 'A' designates the patch panel and the '12' designates the port on the patch panel.
   2. The label on wireless access point cables shall read "TR1-AP-01" where 'TR#' or 'MC#' determines the Telecommunications Room; the AP designates that it is a wireless access point cable, and the 1 shall designate the number of the access point. The access points shall be numbered sequentially according to telecommunications rooms. If the access point is in the ceiling, then the Contractor shall label the ceiling grid below the access point as well as the access point and cable for the access point.
   3. On backbone copper cables, the label shall read" MC-TR1" where 'MC' determines the Telecommunications Room where the cable originates and the 'TR#' determines the destination of the backbone cable.
   4. The label shall read on fiber cables "MC-TR1" where 'MC' determines the Telecommunications Room where the cable originates and the 'TR#' determines the destination for the fiber. These cables shall be labeled after exiting the junction box outside of the MC and before entering the fiber enclosure at the opposite end.
   5. The following cables shall be identified on the patch panel as described below:
      a. BAS-building automation cable shall be clearly identified on the front of the patch panel as 'BAS'. If multiple addressable controllers or panels, then label them sequentially, i.e., 'BAS-1', 'BAS-2'
      b. Helios-video doorbell cable shall be clearly labeled 'VIA-1'.

c. Helios outlet in the faceplate of the main telecom room (typically) shall be labeled 'VIA-Relay'.
d. Elevator cable shall be clearly labeled on the patch panel port 'V-1', 'VD-1', where 'VD-1' is for the video circuit to the elevator and the 'V-1' is for the analog circuit.
e. Power fail jack for analog telephone shall be clearly labeled on the patch panel port-POWER FAIL.
f. Two-way communications cables at the main panel shall be clearly labeled on the patch panel port, '2 WAY COMM-1', 2 WAY COMM-2'.
g. Security alarm panel cables, label the front of the patch panel at the port 'SEC AL PNL-1', 'SEC AL PNL-2'.
h. Safari Montague network cable (typically located in the TV Studio in K-8 facilities and in the Control Room of High School facilities), label the front of the patch panel port 'SAFRI'
i. The loud bells circuits, the cable for the kitchen manager's office will be labeled 'K-Bell', the cable for the after-school program loud bell will be labeled 'ASEP'.

G. Ceiling grids
1. When cables are terminated in the ceiling cavity, the ceiling grid below must be labeled as well.
2. Label the grid with machine printed labels with the font size at least twice the size of the cable labels.

3.08 TESTING

A. The Owner reserves the right to test all delivered goods, and to use a portion of any goods before the results of the tests are delivered, without prejudice to any final adjustments, rejecting the unused portion of the delivery, and making payment on an adjusted basis for the used portion. The cost of inspections and test of any item, which fails to meet the advertised specifications, shall be borne by the TC.

B. All cables and termination hardware shall be 100% tested for defects to verify cabling system performance under installed conditions according to the requirements of TIA-568-C and 526-14B. The field test equipment shall meet the requirements of TIA-568-C. Testing shall be accomplished using level IIIe field testers for copper, and a power meter and light source tester and a OTDR for fiber.

C. Test each pair and shield of each cable for opens, shorts, grounds, and pair reversal. Correct grounded and reversed pairs. Examine open and shorted pairs to determine if problem is caused by improper termination.

D. Testing equipment shall be calibrated prior to testing. (Calibration results from the manufacturer are required in the Close Out Document submittal for each tester used on the project.)

E. Test results shall be submitted within ten (10) days of the completion of each testing phase.
1. Test results shall include a record of test frequencies, cable type, conductor pair and identified in the same format as required in the "Identification and Labeling" section of this specification. Results shall also include measurement direction, reference setup and crew member name. Results shall have all cables listed sequentially. Document the test method used and the specific settings of the equipment during the testing.

F. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented and included in the final close out documents submittal.

G. All '*Pass' results are deemed unacceptable to the Owner.

H. The Designer and/or Owner may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the TC, additional testing can be requested to the extent determined necessary by the Designer and/or Owner, including a 100% re-test by outside agency. This re-test shall be at no additional cost to the Owner.

I. Copper Permanent Link Testing
   1. Perform testing of copper cables with testers meeting TIA-568 standard for Category 6.
   2. If horizontal cables contain bad conductors or shield, remove and replace cable.
   3. *Pass results will not be accepted.
   4. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
   5. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the TIA-568 standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. This documentation shall be in a sequential format. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.
   6. Category 6 Performance
      a. Follow the Standards requirements established in TIA-568.
      b. A level III test unit is required to verify category 6 performances.
      c. Required tests
         1) Wire Map
         2) Insertion Loss
         3) Length
         4) NEXT loss, pair-to-pair, measured from local end
         5) NEXT loss, pair-to-pair, measured from far-end
         6) NEXT loss, power sum, measured from local end
         7) NEXT loss, power sum, measured from far-end
         8) Return Loss, measured from local end
         9) Return Loss, measured from far-end
         10) ELFEXT, pair-to-pair
         11) ELFEXT, power sum
         12) Propagation Delay
         13) Delay skew
         14) ACR
         15) Power Sum (PSACR)
   7. Category 3 Performance

a. Follow the Standards requirements established in TIA-568.
b. Required tests
    1) Polarity
    2) Length
    3) Reversal of pairs
    4) Wire transpositions
    5) Continuity
    6) Opens
    7) Shorts

J. Fiber Testing
    1. All backbone and horizontal cabling, which is terminated by the TC, shall be tested to applicable TIA Standards.
    2. The insertion loss for each mated fiber optic connector pair shall be ≤ 0.75 dB. Reflectance for single-mode single fiber UPC cable assemblies shall be ≤ -55dB. Mated connector pair loss testing shall be based on one unidirectional OTDR inspection in accordance with the OTDR operating manual for systems greater than 100 meters.
    3. In addition to connector insertion loss for each mated pair, the TC shall perform end-to-end insertion loss testing for each multimode fiber at 850 nm and 1300 nm from one direction for each terminated fiber span in accordance with EIA/TIA-526-14A (OFSTP 14) and single-mode fibers at 1310 nm and 1550 nm from one direction for each terminated fiber span in accordance with TIA-526-7 (OFSTP 7). For spans greater than 90 meters, each tested span must test to a value less than or equal to the value determined by calculating a link loss budget. For horizontal spans less than or equal to 90 meters, each tested span must be ≤ 2.0 dB.
    4. Inspect each terminated multimode fiber span for continuity and anomalies with an OTDR at 1300 nm from one direction in accordance with the OTDR operating manual for systems greater than 100 meters. Inspect each terminated single-mode fiber span for continuity and anomalies with an OTDR at 1550 nm from one direction in accordance with OTDR operating manual for systems greater than 100 meters.

3.09 SYSTEM DOCUMENTATION AND OWNER ACCEPTANCE

A. The Contractor shall maintain at the site, one (1) record copy of all Contract Documents in good order and marked currently to record all changes made during construction. Also, it is required to maintain at the site, copies of all accepted shop drawings and product data.

B. The final inspection by the Designer and/or Owner shall be the closure of all previously listed punch list items.

C. The Completion Date of Project is defined as the date that all documentation obligations have been met under the Construction Documents and these specifications.

D. The final inspection by Building Standards shall be the closure of required Electrical Permits.

E. Upon completion of the installation, the TC shall provide electronic copies of all close-out document submittals.

F. Close-Out Documents Submittal
    1. Refer to Section 270101 for requirements.

3.10 SITE CLEAN UP

A. All classrooms, offices, labs or anywhere work is conducted shall be cleaned up on a daily basis.

3.11 TELECOMMUNICATIONS ROOM/CABINET CLEAN UP

A. All room locations must be broom or vacuum swept. This includes the space between the racks and the trough between the base footprint of the rack.

B. All data racks and enclosures shall be wiped clean.

C. All cabinet locations must be broom or vacuum swept. This includes the bottom space of the cabinet.

**** END OF SECTION ****

This Master Specification Section summarizes Charlotte-Mecklenburg Schools' standards and requirements for the Work of this Section. This document may be edited by holders of a valid Masterspec license: www.Masterspec.com. Design professional of record shall edit this document to correspond to Project requirements. Obtain CMS approval for manufacturers and products not listed in this Master Section.

SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Sleeves for pathway 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.

B. Sustainable Design Submittals:
   1. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products 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."

1.4 QUALITY ASSURANCE

A. Comply with NFPA 70, “National Electrical Code.”

B. Comply with NECA 1, “Standard for Good Workmanship in Electrical Construction.”

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. Sleeves for Rectangular Openings:
1. Material: Galvanized-steel sheet.
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 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. HOLDRITE.
   d. Metraflex Company (The).
   e. Pipeline Seal and Insulator, Inc.
   f. Proco Products, Inc.
2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel 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.
   2. Sealant 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. 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 pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "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 pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
   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.
      a. Any sleeve not flush with wall shall have a bushing installed to protect cable.
   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.
   3. Any sleeve not flush with wall shall have a bushing installed to protect cable.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Above-ground, 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 pathway 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 pathway entries into building.

B. Install 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.

3.3 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

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SECTION 275123.10 – TWO WAY COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Vandal resistant and ADA-compliant hands-free speakerphone communications system with a unit Master Station.
   2. Outlet boxes, conduit, wiring, and all other equipment necessary to provide a complete and operating two-way communication system.
   3. Equipment furnished under the terms of this specification shall be the standard product of a single manufacturer.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Arrangements of components.
   2. Single line drawing of the system.

C. Wiring diagrams detailing wiring for power, signal and control differentiating clearly between manufacturer installed wiring and field installed wiring. Identify terminal numbers and wiring color codes to facilitate installation, operation and maintenance.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For two-way communication systems to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 01 77 00 "Closeout Procedures" and Section 01 78 23 "Operation and Maintenance Data," include the following:
      a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
      b. Operating instructions laminated and mounted adjacent to operating console location.
      c. Training plan.
      d. Provide owner's manuals complete with operating instructions, wiring diagrams, and as built installation drawings.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
   1. The Contractor shall be from an established business which has been operating in the area for a minimum of five years.
   2. Installer shall maintain a fully staffed and equipped service office within 50 miles of the project that regularly offers maintenance and service for systems this design and size.
   3. The Contractor shall provide a one-year guarantee of the installed system against defects in material and workmanship. All contractor labor and materials shall be provided at no expense to the Owner. Guarantee period shall begin on the date of acceptance by the Owner or Site Representative.
   4. The System Manufacturer shall warrantee the installed system's components against defects in material and manufacturer's workmanship for a period of one year from date of acceptance by the Owner or Site Representative. Replacement or repair of system components only (job-site labor not included) shall be at the Manufacturer's discretion and provided at no expense to the Owner.
   5. The supplying Contractor shall have attended the Manufacturer's installation and service school or have been authorized by the Manufacturer to install the equipment.

1.6 WARRANTY

A. Installer's Special Warranty: Installer agrees to repair, restore, or replace system components and work that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, component and system failure, including the need for excessive maintenance.
   2. Perform warrant service on 24-hour, 7 days per week basis, with response time to not exceed 4 hours.
   3. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide one of the following systems or pre-approved equal (minimum 10 station capacity):
   1. ARCU-10, ADA-1000
   2. RATH 2500 Series 10 Call box base station.
   3. Talkaphone CU-16.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. When in use the system shall provide two-way audio communications between the Master control station unit, remote area station and/or a call to "9-1-1". Communication at the remote area station shall be hands-free after initial contact from the area station. Call out to "9-1-1" shall be a timed occurrence when the master station has not been picked up after a call from a remote station.

B. When an emergency call is placed by the master unit, it provides the following indications at the area remote station to assure the caller that the call is being processed. After pressing the "PUSH FOR HELP" call button:
   1. Audio and visual confirmation:

a. A "HELP REQUESTED" LED shall illuminate.
b. An audible alarm shall sound.

C. The Master control unit allows Emergency Personnel to check status of each area station and to talk with each area station on an individual basis or all of them together.

D. A lighted green LED labeled "RESCUE SERVICES" indicates that an emergency is in progress.

E. If an emergency call is in progress, by lifting the handset on the master control unit you can automatically join the conversation. At this point you can place any or all remote stations on hold by pushing the hold button corresponding to that unit, which will leave them talking to the called party. Or you can disconnect the called party by pressing the "DISCONNECT TO CALL SERVICES" button, which will leave you talking to the remote area unit.

F. If there is no emergency call in progress you can call into any or all remote area unit by pressing the corresponding talk button to that unit.

G. By hanging up the master station you disconnect from the conversation while leaving the remote area station continuing any ongoing conversation with the called party.

2.3 COMMUNICATIONS EQUIPMENT

A. Basis-of-Design Product: Subject to compliance with requirements, provide products of ARCU or comparable product line listed above.

B. Remote area station speakerphone:
1. Flush mounted.
2. Vandal proof 16-guage 304 stainless steel construction with engraved lettering.
3. 3" diameter button:
   a. Engraved with "PUSH FOR HELP" lettering backfilled in red.
   b. Capable of being activated from any angle with a minimum of effort.
   c. No other hardware shall protrude from the station as high as the pushbutton.
4. Red LED indicator confirms transmission of the "HELP REQUESTED" SIGNAL.
5. Piezoelectric alarm.
6. 3" Mylar 45 ohm speaker.
7. Dual audio and visual alarms for the hearing and visually impaired.
8. Clear protective cover.

C. Master two-way communication system:
1. Stainless Steel
2. Flush Mounted
3. Handset for Talk/ Listen
4. LED for each area
5. Talk & Hold buttons for each area
6. Power Led (red)
7. Battery Back-up w\ light
8. Green Led to indicate outgoing call initiated from any area station
9. Override button to cancel any outgoing call
10. Audio alert signaling for outgoing call from the area station

D. Cellular capability

1. Provide 4G Supervised Cellular Gateway or Cellular system approved by respective manufacturer.
2. RS232 cabling or equal. RJ11 phone line from cellular gateway to main unit. Hardwired also acceptable.
3. Provide with External Antenna. Locate antenna to maximize coverage in concealed location. Antenna to be provided as part of manufactured assembly.
4. Gateway to be located in local electrical room closest to Master station. Basis of design is 120V to gateway and single pair cable from gateway to master station.
5. Provide minimum 2-year prepaid SIM card with cellular service from a major cellular provider (AT&T, Verizon, etc).
6.

E. Wiring
   1. System wiring shall be in accordance with good engineering practices as established by the EIA and NEC.
   2. Wiring shall meet all established state and local electrical codes. All wiring shall test free from shorts and grounded as specified.
   3. Wiring shall be accomplished using labeled, captive screw, plug-in connectors and 22 AWG shielded twisted pairs for all connections.
   4. All cable shall be as recommended by the manufacturer or an approved equivalent.
      a. Area Station wiring to master station shall be a 4 conductor overall shielded twisted pairs.
      b. Master station wiring shall be 2-wire analog telephone line, and shall have 120vac power (provided by electrical contractor).

2.4 PATHWAYS

A. Conduit and Boxes: Comply with Section 26 05 33 "raceways and boxes for electrical systems."
   1. See manufacturer for all required junction box sizing and rough-in requirements.
   2. Physical Protection: Wiring and cabling shall maintain a 2 hour rating for pathway survivability of communication cabling. Basis of design shall be 2 hour fire rated MC cable.
      a. Manufacturers:
         1) VITALink
         2) Lifeline
         3) RATH
         4) Or equal

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in pathways and cable trays except within consoles. Conceal pathway and cables except in unfinished spaces.
   1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
   2. Comply with requirements for pathways and boxes specified in Section 26 05 33 "raceways and boxes for electrical systems" and section 2.4 A 2.

B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

C. System field wiring diagrams shall be provided to the Contractor by the system Manufacturer prior to installation.

3.2 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. Open-Cable Installation:
1. Suspend cable not in a wireway or pathway a minimum of 8 inches above ceiling by cable supports not more than 60 inches apart.
2. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
3. Exposed installations shall use conduit.

3.3 INSTALLATION

A. Coordinate layout and installation of system components 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. Mounting height:
1. Remote area station: call button centered at 40" AFF unless otherwise noted.
2. Master station: Top call button centered at 40" AFF unless otherwise noted.

3.4 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

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. 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. Schedule tests with at least seven days' advance notice of test performance.
2. After installing the two-way system and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: Perform tests that include master station and remote area stations properly communicate. Verify the call out function to "9-1-1" properly calls out after the set duration.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the two-way communication system and equipment. Refer to Section 01 79 00 "Demonstration and Training." A minimum four-hour training system shall be provided on a single coordinated day.

END OF SECTION

SECTION 275123.50 - INTERCOM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Microprocessor-switched intercom systems with the following components:
1. Master stations.
2. Call control console.
3. All-call amplifier.
4. Intercommunication amplifier.
5. Paging amplifier.
6. Loudspeakers/speaker microphones.
7. Conductors and cables.
8. Raceways.
9. Control Equipment, Modules and Enclosures.
10. Power Supplies.
11. Interface Devices and Modules.
12. Software and Programming.
13. Surge Protection.
14. Telephones with Dial pad.
15. Emergency and Bell Tones.

1.3 ACTION SUBMITTALS

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

B. Delegated-Design Submittal: For supports and seismic restraints for control consoles, equipment cabinets and racks, and components indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of supports and seismic restraints for control consoles, equipment cabinets and racks, and components.

C. Shop Drawings: For intercom systems. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
2. Include scaled drawings for station arrangement of built-in equipment, where applicable.
3. Wiring Diagrams: For power, signal, and control wiring.
a. Identify terminals to facilitate installation, operation, and maintenance.
b. Single-line diagram showing interconnection of components.
c. Cabling diagram showing cable routing.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated with each other, using input from installers of the items involved.

B. Qualification Data: For qualified Installer.

C. Seismic Qualification Certificates: For control consoles, equipment cabinets and racks, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Include qualification data for testing agency.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For intercom systems to include in operation and maintenance manuals. Include the following:
   1. A record of final matching transformer-tap settings and signal ground-resistance measurement certified by Installer.
   2. A record of Owner's equipment-programming option decisions.
   3. All software, related hardware and manuals necessary for the programming and I/O diagnostics of the Intercom System shall be provided by the distributor/installer.
   4. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
   5. Operating instructions laminated and mounted adjacent to operating console location.
   6. Training plan.
   7. Provide owner's manuals complete with operating instructions, wiring diagrams, and as built installation drawings.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturers' authorized distribution and installation representative who is trained and approved by principle equipment manufacturers for installation of units required for this Project.
   1. Show satisfactory evidence, upon request, that Installer maintains a fully-equipped factory approved and authorized service organization with minimum five-year record of successful installations and of furnishing adequate inspection and service to the system, including replacement parts.
      a. Indicate capability of providing warranty and service work within four hours of notification of such requirements.
   2. Upon request, able to offer a service contract for the maintenance of the system following expiration of the warranty period.

B. Testing Agency Qualifications: Qualified agency, with the experience and capability to conduct testing indicated.
   1. Testing Agency's Field Supervisor: Currently certified by NICET at Level III to supervise on-site testing.

1.7 COORDINATION

A. Coordinate layout and installation of ceiling-mounted speaker microphones 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.

1.8 WARRANTY

A. Installer's Special Warranty: Installer agrees to repair, restore, or replace sound system components and work that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, component and system failure, including the need for excessive maintenance.
   2. Perform warrant service on 24-hour, 7 days per week basis, with response time to not exceed 4 hours.
   3. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Reference Standard Compliance:
   1. NFPA 70.
   2. EIA 160 for Sound Systems.
   3. EIA 299A for Speakers.
   4. EIA 310C for Racks, Panels, and Associated Equipment.
   5. UL 50 for Enclosures.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a UL or other qualified testing agency acceptable to authorities having jurisdiction and marked for location and application.

2.2 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following systems:
   1. Telecor: Telecor II Series with CPU 4 console card.
   2. Bogen: Multi-Com 2000 Series
   3. ThreeSixty Inc., Galaxy Series

B. Source Limitations: Obtain intercom system equipment from single source and from single manufacturer to the greatest extent practicable.

2.3 SYSTEM REQUIREMENTS

A. The intercom system shall be a complete microprocessor based system for amplifying sound signals from microphones or telephone handsets and distributing them to loudspeakers at various locations. Provide all material and labor necessary for the proper operation of the system.

1. Install components in compliance with system manufacturer's requirements as required by Project conditions.
2. Delegated Design: Provide system designed, installed, adjusted, tested, certified and guaranteed by qualified Installer. Installer shall be responsible for the completeness of the parts lists and the suitability of the devices and wiring to meet the intended purpose of the specifications and drawings. Design shall take into account all field conditions.
    a. System Power: Indicate location for dedicated 120V AC circuit. Use "Generator backed up Power" if available at school. The name, location of the AC panel and circuit breaker number shall be permanently labeled on the Intercom console.
    b. Provide surge protection devices on all power wiring and on all signal lines at the system headend.
    c. Provide system capable of interfacing with Owner's Cisco VoIP Telephone System.
    d. Provide devices to match existing components to new system equipment.

2.4 FUNCTIONAL DESCRIPTION OF INTERCOM SYSTEM

A. Global Switching
1. The system shall be a global switching system; there shall be no linking within the system that would restrict or block telephone communications.

B. Central Switching Exchange
1. The switching exchange shall be a microprocessor controlled unit and shall provide the memory, logic, sensing, and control circuitry for the system. The system shall lend itself to modular expansion to a total of at least 250 stations.
2. The switching exchange shall utilize standard dual-tone multi-frequency (DTMF) signaling for conformance with standard practices. Those systems which utilize instruments which do not generate DTMF tones shall not be considered equal.
3. The system shall provide direct dialing, full duplex telephone communications between all locations equipped with administrative or staff telephones. The system shall provide a minimum of thirty-two (32) simultaneous full duplex telephonic conversion paths available for use between system telephones. Systems, which provide less than thirty-two (32) simultaneous links or which use non-standard telephonic audio, shall not be accepted.
4. The switching exchange shall provide and RS-232 serial data port for connection to a computer for on or off site diagnostic functions via a modem. It shall be possible to determine circuit and software faults via these diagnostic functions and to facilitate remote software changes.
5. Minimum diagnostic functions shall include:
    a. Check active list of activity within the system.
    b. DTMF test, to check the DTMF registers.
    c. I/O diagnostics shall enable the checking of each line, and each device connected in the circuit.
    d. Capability of checking each link, and ability to remotely block a link from the system if found defective.

C. Intercom and Public Address Operation
1. Provide sufficient speakers for every occupied space.

2. The system shall provide the capability of assigning speaker locations to any one or more of the eight software programmable zones for zone paging or time signal reception. Systems which use switches to assign zones shall not be acceptable.
3. Provide for distribution of emergency announcements and for distribution of manually activated tones to all locations with speakers from any authorized telephone. Through programming, it shall be possible to exclude selected speakers from the reception of paging announcements.
4. Provide capability of restricting the origination off all page, zone page, and alarm signal origination to specific assigned telephones. The system shall provide for "personal identification numbers" (PIN) for selected administrators. By dialing their "PIN" at any system telephone, the administrator shall have access to the same capabilities assigned to their office telephone, regardless of the restrictions on the phone he/she is currently using.
5. The system shall provide for up to eight independent digital readout displays upon which incoming calls are identified by their designated numbers. Emergency calls shall override normal calls and shall annunciate with the letters "EMER" and the calling station number.
6. The system shall provide a minimum of two (2) administrative console telephones.
7. System must have the capability of initiating all call from any handset.

D. The system shall be equipped with ports to allow for:
1. Diagnostics via any standard computer terminal.
2. Interface connection with the Meridian Telephone System.

2.5 SYSTEM MASTER CLOCK

A. The system shall contain a built-in master clock and programmer which shall be capable of performing the following functions:
1. Displaying the time of day in either 12- or 24-hour format at the main console.
2. Providing 255 discrete time event entries for programming functions based on:
a. The time of day in hours and minutes.
b. The day or combination of seven (7) days of the week the event is to occur.
c. Selection of any one or any combination of eight (8) zones or outputs to be activated.
d. Selection of any one of four (4) schedules to allow for maximum flexibility due to special circumstances or seasonal changes.
3. Provide for user selectability of both tone and duration time of tone signal.
4. Capable of correcting compatible brands of secondary clocks
5. The time display shall be protected by a built-in lithium battery.

2.6 TELEPHONE INTERFACE

A. The telephone interface shall provide the required circuitry to interface intercom system to Owner's Cisco VoIP Telephone System. There shall be no less than two (2) lines of communication between the Intercom and the telephone system.

B. The interface shall be capable of performing the following telephone functions as required by the system, including: line seize, line hold, hookswitch flash, ring detection, and the generation of DTMF signals for dialing.

C. The interface shall provide the Cisco Telephones the capability to perform the following functions from any Cisco administrative telephone:

1. Make all-call or zone pages.

2.7 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.

C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz. Comply with UL 813.

D. Weather-Resistant Equipment: Listed and labeled by an NRTL for duty outdoors or in damp locations.

2.8 MASTER STATION FOR MICROPROCESSOR-SWITCHED SYSTEMS

A. 12-Digit Keypad Selector: Transmits calls to other stations and initiates commands for programming and operation.

B. Volume Control: Regulates incoming-call volume.

C. Tone Annunciation: Momentary audible tone signal announces incoming calls.

D. Lamp Annunciation: Identifies calling stations and stations in use. Lamp remains on until call is answered.

E. Speaker Microphone: Transmits intercom voice signals when used via a voice-operated switch.
1. Minimum Speaker Sensitivity: 91 dB at one meter, with 1-W input.

F. Link Button: To transfer calls.

G. Reset Control: Cancels call and resets system for next call.

H. Digital Display: 16-digit alphanumeric LCD readout to register up to four three-digit station numbers.

I. Central-Equipment Cabinet: Comply with TIA/EIA-310-D. Lockable, ventilated metal cabinet houses terminal strips, power supplies, amplifiers, system volume control, and other switching and control devices required for conversation channels and control functions.

2.9 CALL CONTROL CONSOLE

A. Microprocessor-based instrument to process outside and internal calls with a 12-digit keypad selector.

B. 20-character alphanumeric display for the following:
1. Simultaneous display of up to three calling stations plus last station dialed.

2. Display of calls in order received with emergency calls taking precedence on the display.
3. Review of calls stored in groups of four.
4. Display of prompt messages to assist in system operation.

C. Programmable Keys: Minimum of 20 with LED indicators for ringing/busy status; programmable for trunk and operator functions.

D. Transfer Button: Calls to busy extensions and unanswered calls automatically returned to call control console.

E. Hold Button: With reminder feature every 30 seconds for parked calls or calls placed on hold.

F. Release Button: For use with parked calls or calls placed on hold.

G. Page Button: For engaging system paging functions.

H. Programmable for night answer, remote answer, and remote pickup features.

I. Programmable for distribution of emergency announcements, all-page announcements, zone-page announcements, and emergency/evacuation alert.

J. Central-Control Cabinet Equipment: Central switching equipment, central office adapter module, line link modules, power supplies, chassis adapters, and other switching and control devices required for trunk and internal conversation channels and control functions.

2.10 ALL-PAGE AMPLIFIER

A. External paging amplifiers shall be provided as required to meet the load requirements of the system when activated in the "ALL-PAGE" mode. The system shall be wired accordingly to operate on a 25V output.
1. Amplifier performance criteria:
a. Continuous Output Power: 125/250 Watt
b. Frequency Response: 20 TO 20,000 HZ. @ 3db
c. Mounting: EIA 19 inch rack
d. Distortion: Less than 0.5% at rated output.
e. Sensitivity: 100MV TO 1V RMS. Adjustable for rated output.
f. Output Level: 25V, 70V, or 8 OHM balanced.

2.11 PROGRAM - AUXILIARY SOURCES

A. The paging/intercom system shall provide the necessary equipment to provide for an alternate program channel. The equipment shall consist of:
1. Program Sources:
a. All Call Microphone
b. Compact Disc Player (Automotive type units or "boom boxes" are not acceptable.)
c. Audio jack to connect MP3/WAV player with 3.5mm audio cable.

B. A mixer/preamplifier to provide individual line level control.

C. A line amplifier shall be supplied as required.

2.12 EQUIPMENT RACK

A. The central equipment shall be housed in a standard EIA 19" rack. The rack shall be equipped with a locking rear door. All unused front panel space shall be fitted with the appropriate size blank panels and proper cover panels necessary for the auxiliary equipment.

B. The equipment rack shall be provided with multiple receptacle strips equipped with surge suppression devices and a master ON-OFF switch for connection of all 120 VAC loads.

C. The equipment rack shall be located adjacent to a wing wall to partially conceal if at all possible.

2.13 INTERCOMMUNICATION AMPLIFIER

A. Minimum Output Power: 15 W; adequate for all functions.

B. Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to one station connected to output terminals.

C. Minimum Signal-to-Noise Ratio: 50 dB, at rated output.

D. Frequency Response: Within plus or minus 3 dB from 70 to 10,000 Hz.

E. Output Regulation: Maintains output level within 2 dB from full to no load.

F. Input Sensitivity: Matched to input circuit and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on microphones in master stations, speaker microphones, or handset transmitters.

G. Amplifier Protection: Prevents damage from shorted or open output.

2.14 EQUIPMENT INTERFACE – SITE ALL CALL

A. Provide interface module so that all (3) sites have connectivity and can produce an "All call" from each respective building.

B. Provide the building intercom systems with inputs for audio and contact to initiate call.

C. Unit shall connect to intercom "all call" bus/emergency bus for audio feed and a contact closure to initiate the call.

D. Provide integration with module, this will require additional coordination with CMS IT department to make VLAN connections.

E. Unit would be accessed via CMS IP phone system via VLAN connection. This would enable paging from single building or "all call" all (3) buildings.
   1. Equipment basis:
      a. Telecor eSIP
      b. Telecor eAMP
   2.

2.15 INTERIOR CONE-TYPE LOUDSPEAKERS

A. The speakers shall meet the following minimum requirements:
   1. Power handling capacity: 8 Watts.
   2. Impedance: 25 V matching transformer.
   3. Power Taps: 4 EIA standard.
   4. Axial Sensitivity: 91db minimum.
   5. Frequency Response: 90-15000 Hz @ 3db.
   6. Coil: 3/4-inch minimum.
   7. Magnet: 5-ounce.
   8. Dispersion: 100 degrees.

B. Speakers shall be mounted in steel backboxes, recessed mounted, in the ceiling or wall.

C. Provide steel grille with white baked enamel rust resistant finish.

D. Provide a wall-mounted adjustable attenuator on all office, tutor, science prep, and conference room speakers.

2.16 TERMINATION AND SURGE PROTECTION

A. All Intercom wiring and junctions shall be terminated on 66-M type punch down blocks. All termination and junctions shall be enclosed in metallic cabinets. The termination cabinet shall be located in the nearest accessible space adjacent to the Intercom Rack and equipment. All junctions shall be located in Electrical Equipment Rooms and mounted approximately five (5) feet from the floor.

B. All equipment installed shall be provided with surge protection devices on all power wiring and all signal lines at the systems Head-End and entrances to separate buildings. Protectors shall be mounted on 66-M type punch down blocks and grounded according to manufacturer's specifications.

C. All surge protection shall be Ditek or comparable product acceptable to the specifying engineer.
   1. Ditek DTK-3GTP for 120VAC.
   2. Ditek DTK-SL30B for paging, intercom and call in circuits. SL130A for analog phones. DTK-SL30B for digital phones.

2.17 CONDUCTORS AND CABLES

A. Wire shall be per manufacturer's recommendation. The shield shall not be used as a conductor and SHALL BE terminated to ground at the cabinet only.

B. Signal wiring shall be plenum rated unless noted otherwise and shall be of the following:
   1. Wire for speakers shall consist of twisted, shielded pair conductors, 18 to 22 AWG, stranded unless otherwise specified by the manufacturer.
   2. Wire for speakers and call-in phones shall consist of two twisted, shielded pair conductors, 18 to 22 AWG, stranded unless otherwise specified by the manufacturer.
   3. All wire shall be rated Cat. 3 or higher.
   4. Color shall be "off-white".

2.18 RACEWAYS

A. Intercom System Raceways and Boxes: Comply with requirements in Section 26 05 33 "Raceway and Boxes for Electrical Systems."

B. Educational Intercommunication and Program System Raceways and Boxes: EMT.

C. Outlet boxes shall be not less than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions of building installations to determine the typical requirements for new devices.

B. Plan installation of raceways prior to commencing work. Adjustments to the indicated device positions shall be indicated on the as-built drawings.

C. Verify that required utilities are available, in proper location, and ready to use.

D. Beginning of installation means installer accepts all specified conditions.

3.2 WIRING METHODS

A. Wiring Method: Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters. Conceal pathway and cables except in unfinished spaces.
1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
2. Install plenum cable in environmental air spaces, including plenum ceilings.

B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF RACEWAYS

A. Comply with requirements in Section 26 05 33 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements:
1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.

3. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
6. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used.

C. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
2. Suspend speaker cable not in a wireway or pathway a minimum of 8 inches above ceiling by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

3.5 INSTALLATION

A. General: Install all equipment and wiring in accordance with NFPA 70 and applicable EIA codes and standards, as well as manufacturer’s written instructions and procedures. All devices shall be provided as indicated on approved submittals.

B. Wiring: Wiring shall be routed above suspended, fully accessible, “lay-in” ceilings where possible. Route in cable trays where provided above suspended ceilings. Provide raceway for all exposed runs of wiring. Support all raceway as required by NFPA 70. Provide a recessed panel behind intercom rack to allow for demarcation of intercom cabling. Provide sleeves from recessed panel to above accessible ceiling space. Provide a single conduit from recessed panel demarcation to rack for cabling routing.

C. Impedance matching and level adjustment: Match all devices to signal line impedance requirements. Adjust level taps so that the ALL-CALL announcements are heard in all areas of each room.

D. Splices shall not be allowed in system wiring. Wiring shall only be terminated at field devices, the main equipment rack, and building junction cabinets.

E. Provide surge protection to all conductors at the main termination cabinet on 66-M type punch down blocks

F. All devices used on the outside of the building shall be approved for exterior use and shall be water and moisture resistant.

G. All final connections shall be made by factory trained technicians.

H. Provide additional expansion capacity and all components necessary, except handsets, for twenty (20) percent additional capacity.

I. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.

J. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.

K. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.6 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Provide “Earth” ground for all Intercom system cabinets, consoles and devices.

C. Provide grounding connections for shielded cables at the main termination cabinet. Cable shields shall be grounded individually. All shields shall be connected to ground at the main termination cabinet only.

3.7 SYSTEM PROGRAMMING

A. Programming: Fully brief Owner on available programming options. Record Owner's decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and final results.

3.8 FIELD QUALITY CONTROL

A. Manufacturer’s field services: Engage a factory-authorized service representative to supervise the field assembly and connection of components, testing and adjusting of the system.

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. Schedule tests with at least seven days' advance notice of test performance.
2. After installing intercom systems and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: Test originating station-to-station, all-call. Verify proper routing and volume levels and that system is free of noise and distortion. Test each available message path from each station on system.
4. Frequency Response Test: Determine frequency response of two transmission paths, including all-call and paging, by transmitting and recording audio tones. Minimum acceptable performance is within 3 dB from 150 to 2500 Hz.

5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 150, 200, 400, 1000, and 2500 Hz into each intercom, paging, and all-call amplifier. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 5 percent total harmonics.
6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each paging zone. Maximum permissible variation in level is plus or minus 3 dB; in levels between adjacent zones, plus or minus 5 dB.
7. Power Output Test: Measure electrical power output of each paging amplifier at normal gain settings of 150, 1000, and 2500 Hz. Maximum variation in power output at these frequencies is plus or minus 3 dB.
8. Signal Ground Test: Measure and report ground resistance at system signal ground. Comply with testing requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

D. Inspection: Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging and independent room speaker-line matching transformers.

E. Systems will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.9 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service and initial system programming.
1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
2. Complete installation and startup checks according to manufacturer's written instructions.

3.10 CLEANING AND PROTECTION

A. Provide protection throughout for all equipment to prevent scratches, paint, splatters, drywall mud, mortar, dust, etc. Equipment contaminated with such shall be replaced by the contractor.

B. Prior to final acceptance, clean system components and protect from damage and deterioration.

C. Cleaning: Remove dirt and debris, etc. Finish shall be as per original factory finish. Clean unit internally using methods and materials recommended by the manufacturer.

3.11 COMMISSIONING

A. Train owner’s operation and maintenance personnel in the procedures and schedules involved in operating, troubleshooting, and servicing of the system. Provide a minimum of eight hours of training to owner’s personnel. Schedule training with Architect, with at least seven days' advance notice.

B. Provide all materials necessary to program the system. This is to include any software, hardware, and cables.

C. Occupancy adjustments: When requested by Owner within two years of date of acceptance, provide on-site assistance in adjusting sound levels, resetting matching transformer taps, and adjusting controls to suit actual occupied conditions. Provide up to six visits in addition to warranty work, to the site for this purpose.

3.12 FACTORY IN RESIDENCE FORMAL TRAINING

A. Provide separate proposal to Owner for provision of factory training by system manufacturer for up to four Owner Electronics Technicians. This training shall include installation, modifications, programming and repairing all components of the Intercom System. Hotel and airfare accommodation shall be included if over 75 miles from Charlotte. This training should be available within six months from acceptance of the system by Owner.

END OF SECTION

This Master Specification Section summarizes Charlotte-Mecklenburg Schools' standards and requirements for the Work of this Section. Design Consultant shall edit this document to correspond to Project requirements. Obtain CMS approval for manufacturers and products not listed in this Section.

SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Requirements:
   1. Section 28 23 10 "Video Surveillance Cabling" for video surveillance cabling.
   2. Section 28 31 10 "Access Control Cabling" for access control cabling.
   3. Section 28 23 10.01 "Access Control Cabling – for renovations".

1.2 SUMMARY

A. Section Includes:
   1. RS-232 cabling.
   2. RS-485 cabling.
   3. Control-voltage cabling.
   4. Control-circuit conductors.
   5. Fire alarm wire and cable.
   6. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

D. Open Cabling: Passing low voltage cabling through open space (e.g., between the studs of a wall cavity).

E. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For cable, include the following specification data for each type used:
      a. Nominal OD.
      b. Minimum bending radius.
      c. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings, labeling ID, and printouts.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
1. Prior to installation, test each pair for open and shorts.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 BACKBOARDS

A. Backboards: Plywood, A/C ¾" fire-rated and install with "A" side facing out.

B.
RS-232 CABLE

C. Standard Cable: NFPA 70, Type CM.
1. Nine, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. PVC jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with UL 1581.

D. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Nine, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PE insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. Fluorinated ethylene propylene jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.3 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM or Type CMG.
1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.4 CONTROL-VOLTAGE CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Wire & Cable Inc.
2. Belden Inc.
3. General Cable Technologies Corporation.
4. Genesis Cable Products; Honeywell International, Inc.
5. Southwire Company.
6. Windy City.

B. Paired Cable: NFPA 70, Type CMG.
1. One pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

C. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
1. One pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.5 CONTROL-CIRCUIT CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Allied Wire & Cable Inc.
   2. General Cable Technologies Corporation.
   3. Southwire Company.

B. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in pathway.

C. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in pathway.

D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF in pathway.

2.6 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. Genesis Cable Products; Honeywell International, Inc.
   2. Rockbestos-Suprenant Cable Corp.
   3. West Penn Wire.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG size as recommended by system manufacturer.
   1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
   1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
   2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
   3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated.

2.7 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. HellermannTyton.
   3. Kroy LLC.
   4. Panduit Corp.

B. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to evaluate cables.

B. Cable will be considered defective if it does not pass tests and inspections. This includes kinks or damage to the jacket, supplemental to a "passed" test.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

3.2 WIRING METHOD

A. Install wiring in metal pathways and wireways where exposed or the possibility of being unsupported, unless otherwise noted on the plans.
1. Minimum conduit size shall be 1/2 inch. Control and data-transmission wiring shall not share conduits with other building wiring systems.
2. Comply with requirements in Section 26 05 36 "Cable Trays for Electrical Systems."
3. Comply with requirements in Section 27 05 36 "Cable Trays for Communications Systems."

B. Install cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring on Racks and within Enclosures:
1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM's "Cabling Termination Practices" chapter. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.
2. Install lacing bars and distribution spools.
3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
4. Install conductors parallel with or at right angles to sides and back of enclosure.
5. Connect conductors associated with intrusion system that are terminated, spliced, or interrupted in any enclosure onto terminal blocks.
6. Mark each terminal according to system's wiring diagrams.
7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1 and NFPA 70.

B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.

C. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

D. General Requirements for Cabling:

E.

1. Maintain minimum cable bending radius during installation and termination of cables.
2. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
3. Cold-Weather Installation: Do not install cabling when temperature is below 32 degrees Fahrenheit.
4. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions. Do not exceed manufacturer's rated cable-pulling tension.
5. Comply with Section 28 05 44 "Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling."

F. Separation from EMI Sources:

G.

1. Separation between open communication cables or cables in nonmetallic pathways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
2. Separation between communication cables in grounded metallic pathways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
3. Separation between cables in grounded metallic pathways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
4. Separation between Cables and Electrical Motors and Transformers, 5 kVA or hp and Larger: A minimum of 48 inches.
5. Separation between Cables and Light Fixtures: A minimum of 5 inches.
6. Avoid putting cables in areas susceptible to EMI.

3.4 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method:

1. Cables and pathways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of two-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is not permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or pathway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by 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.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color Coding: Color code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and another for supervisory circuits. Color code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red. See specification 281600 "Intrusion detection" for color coding requirements.

F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 POWER AND CONTROL-CIRCUIT CONDUCTORS

A. 120-V Power Wiring: Install according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:
1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.6 CONNECTIONS

A. Comply with requirements in Section 28 16 00 "Intrusion Detection" for connecting, terminating, and identifying wires and cables.

B. Comply with requirements in Section 28 31 11 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.7 FIRESTOPPING

A. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

B. Comply with TIA-569-C, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.8 GROUNDING

A. For communication wiring, comply with J-STD-607-A and with BICSI TDMM's "Grounding, Bonding, and Electrical Protection" chapter.

3.9 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide or transfer the data from the instrument to the computer, save as text files, print, and submit.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

SECTION 281300 – ACCESS CONTROL

PART 1 – GENERAL

1.1 SCOPE OF WORK:

A. It is the intent of this standard to provide a complete & properly operating Access Control System (ACS). Any component or item of equipment or hardware that may not be specifically shown on the drawings or specified herein, but necessary for proper system operation, shall be provided by the Contractor.

B. Provide all necessary labor, material, plant, and equipment, including materials and equipment not specifically mentioned but necessary to complete the work in a neat and workmanlike manner, to include:

1. ACS Intelligent Access Controllers.
2. ACS Wiring and Cable, including Fiber Optic Systems where specified.
3. Complete branch circuit wiring system for the ACS System including final connections to equipment.

C. Refer to Section 281310 – "Access Control Cabling" for additional information.

1.2 GENERAL REQUIREMENTS:

A. The following latest editions of the industry standards are the basis for the structured cabling system described in this document. The standards listed shall be adhered to in the same manner as if they were codes.

B. All current state & local codes

1. TIA – Telecommunications Industries Association
   a. Articles 526, 568, 569, 606, 607.
2. ANSI - American National Standards Institute.
3. BISCI – Building Industry Consulting Service International
   a. Telecommunications Distribution Methods Manual (TDMM), latest edition.
   b. Information Technology Systems Installation Methods Manual (ITSIMM), latest edition.
   c. Customer-Owned Outside Plant Design Reference Manual (OSPDRM), latest edition.
4. EIA – Electronic Industries Alliance
   a. RS232C – Interface between Data Terminal Equipment and Data Communications Equipment Employing Serial Binary Data Interchange
   b. RS485 – Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multi-Point Systems
5. ETL – Intertek Electrical Testing Laboratories.
6. UL – Underwriters Laboratories.
   a. UL294 – Access Control System Units.

7. NEMA – National Electrical Manufacturers Association.
8. OSHA – Occupational Safety and Health Administration standards.
1. NFPA – National Fire Protection Association.
    a. NFPA 70, National Electrical Code (NEC).
    b. NFPA 101, National Life Safety Code.
9. Americans With Disabilities Act of 1990 (ADA).
10. Division 26 Electrical Specifications.
11. Standard Industry Practices.

C. If there is a conflict between applicable regulatory industry standards, and then the more stringent requirements shall apply. The Contractor has the responsibility to determine and adhere to the latest editions when developing the proposal for installation.

D. All Electronic Equipment and materials are all to be UL standard testing, listing and labels shall be listed and labeled by UL or other agency that is acceptable to the AHJ and the State of North Carolina approved 3rd party testing agencies. This can be found on the state construction website.

1.3 CONTRACTOR QUALIFICATIONS:

A. The Prime Security Contractor (SC) shall be regularly engaged or partner with sub-contractors that are regularly engaged in providing security equipment and security related services and shall have been engaged in such work for a period of not less than three years prior to bid submittal.

B. The Prime Security Contractor or their sub-contractor performing the majority of the security system installation work shall, at the time of the bid, hold an Alarm Systems Business License issued by the State of North Carolina to perform security work within the state. Contractors who have security licenses or permits pending may not be considered acceptable for bidding on this project. All personnel employed by this contractor shall be registered with the appropriate North Carolina Licensing Board as provided for by current state statutes. Each Contractor submitting a bid for this project shall include a copy of his current Alarm System Business License.

C. The Security Contractor shall be prepared, upon award for the work to provide the Owner, Charlotte-Mecklenburg Schools (CMS) a criminal background check for each person employed to perform security work on this project. Each criminal background check shall cover all places of residence for the previous seven years and shall be performed within the previous six months. Criminal background checks may be performed by a state or local agency or by a private company specializing in such work.

D. The Security Contractor shall provide the name, location, and contact information for three similar projects in scope and size within the last 5 years.

E. Contractors performing the work in the supply, installation or programming of access control equipment shall be factory authorized dealers for the manufacturer of the equipment and systems provided. Contractor shall be authorized by Open Options as a reseller. Documentation of this authorization shall be provided at the time of bid.

F. The Security Contractor shall demonstrate the qualifications of the project manager assigned to this project

G. The Security Contractor or sub-contractor responsible for cabling shall have a Low Voltage

Wiring License issued by the NC Board of Examiners of Electrical Contractors and any other certifications as designated in the cabling specification.

H. Security Contractor will designate an overall project manager and a project manager for each specific site that will be the points of contact.

I. Only a North Carolina licensed locksmith shall install or work on locks, locking devices, egress control devices etc. or as permitted by North Carolina State Law. Refer to NC Code G.S. 74F-4.

1.4 WARRANTY:

A. The Contractor shall guarantee all equipment and wiring for this system to be free of defects in workmanship & material for a period of one (1) year from the date of substantial completion. Include one (1) 6-month preventative maintenance visit per section 3.4-A. A Requirement List, plus miscellaneous preventative maintenance as required during this one (1) year period.

B. The Contractor shall replace all portions that fail because of faulty materials or workmanship at no cost to CMS including material, labor, tax freight and freight. The contractor shall be notified of any defects and immediately repair them. Items repaired under this provision shall have an extended warranty period of (12) months beginning with the acceptance of the repair.

C. Warranty service by the contractor shall include eight (8) hour emergency response during normal weekends and holidays. Response time shall be measured from the time the contractor is notified to the time of arrival of service personnel at the affected site to initiate repairs. The contractor shall provide a method of making these repair requests. At the time of bid, the contractor will provide a description of how they propose to execute this provision.

D. During the warranty period, the contractor will maintain and guarantee that the adequate supply of parts is maintained at their nearest place of business.

E. Contractor/Manufacturer shall guarantee products repairable/direct replacement for a minimum of three (3) years.

F. Guaranteed replacement/service requirement: products used on this project must ship within 24 hours of the contractor order.

G. At a minimum provide a one (1) year comprehensive warranty exclusive of physical/lightning damage, including advanced replacement on all ACS intelligent access controllers for the three (3) year warranty.

H. All cabling shall have a one (1) year Contractor warranty and a 20-year manufacturer warranty.

1.5 SUBMITTALS:

A. Shop drawing submittals are required and shall include the following for review. Submittals not containing all of the information listed below will be rejected. Deliver all required submittals within ten (10) days of the Notice to Proceed date.

B. Before submitting a shop drawing or related material, the SC shall:

1. Review each submission for conformance with all SC's means, methods, techniques, sequences and operations of construction & safety precautions; and programs incidental thereto, all of which are the sole responsibility of the SC.

2. Review & coordinate each submission with other related or affected work.

3. Approve each submission before submitting same.

C. Submittals shall include the following:

1. Shop drawings, product data (including cut sheets & catalog information), samples required by the Contract Documents for the networked access control cabling system.
    a. Access Control Equipment.
    b. Intelligent Access Controllers
    c. Access Control Modules
    d. Integrated and Electronic/Electromechanical Locks
    e. Power Supplies
    f. Card Readers
    g. Sensors
    h. Switches & Buttons
    i. Media Converters
    j. Surge Protection
    k. Surface Mount Boxes
    l. Patch Cords

D. By submitting shop drawings, product data, and samples, the SC represents that he/she has carefully reviewed and verified materials, quantities, field measurements, and field construction criteria related thereto. It also represents that the SC has checked, coordinated and verified that information contained within shop drawings & product data conforms to the requirements of the work & of the Contract Documents.

E. The acceptance of shop drawings, product data and samples submitted by the SC shall not relieve the SC of responsibility for adhering to the requirements of the Contract Documents. Nor shall the acceptance relieve the SC of responsibility for errors or omissions in such shop drawings, product data or samples.

F. The review & acceptance, or other appropriate action upon shop drawings, product data is for the limited purpose of checking for conformance with information given & design concept illustration in the Contract Documents. Review of such submittals is not conducted for the purpose of determining accuracy & completeness of other details such as dimensions & quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the SC as required by the Contract Documents. The review shall not constitute approval of safety precautions or of construction means, methods, techniques, sequences or procedures.

G. For initial submission & for resubmission required for acceptance, submit electronic copies of each item. Combine all electronic files into one final submittal packaged electronic file.

H. Illegible submittals will not be checked.

I. If a submittal deviates from the drawings & project manual because of standard shop practice, substitutions (approved in accordance with General Conditions, amended) or any other reason, the Designer shall be advised in an attached separate written instrument. Deviations shall be acknowledged by Designer in writing. Unless acknowledged by the Designer in writing, the Contractor will not be relieved of the responsibility for executing the work in accordance with the Contract Documents.

J. Designer Action:

1. Designer will review all submittals & return comments promptly.

2. The Designer will issue a summary review indicting acceptance; indicate items not acceptable, or indicate action needed by the contractor.
3. Items "Rejected" are not permitted to be used at the project site or elsewhere where work is in progress.
4. Change and/or correct submittals as required by the Designer & resubmit until all items are accepted.

1.6 DRAWINGS AND SPECIFICATIONS:

A. It is understood that while drawings will be followed as closely as circumstances will permit, the SC is held responsible for the installation of the system according to the true intent and meaning of the drawings. Anything not completely clear in the Construction Documents will be explained upon request to the Designer. However, if conditions arise where, in the judgment of the SC, certain changes will be advisable; the SC will communicate through the proper channels & obtain review and approval of these changes before proceeding with the work.

B. The drawings are not to be scaled. The SC must refer to the architectural drawings for building construction, dimensions and material, finish and construction method of walls, floor and ceiling in order to insure proper installation of work.

C. Provide two copies of 11"x17" Campus/Facility drawings, indicating locations of doors, controllers, and the associated data rooms supporting the ACS equipment. The drawing shall list the Media Access Control (MAC) addresses of the ACS controllers, and a description of where the ACS controller is located. For example: D Controller #1 is located above the ceiling near Health Room #215 with a MAC address of 00-00F-E5-02-66-87 for Door #216A (Staff Parking) that connects to Data Room MC, patch panel port #45, switch port #35, card #2960-1. This shall be also supplied in PDF format and in Autodesk AutoCAD version 10 DWG format.

D. If there is a conflict between the Drawings and the Specifications, the most stringent requirement shall apply.

1.7 QUALITY ASSURANCE:

A. The SC shall employ qualified and certified technicians to this project that have experience with the installation of low voltage cabling infrastructures & security equipment and security related services; and provide appropriate supervision to all technicians on site.

B. The Architect / Engineer shall have the right to reject any proposed Security Contractor that, in the opinion of the Architect / Engineer, does not have the qualifications to perform the work to the satisfaction of the Architect / Engineer.

C. Security Contractor (SC) Qualifications:

1. The SC shall employ qualified & certified technicians on this project that have experience with the installation of low voltage cabling infrastructures & provide appropriate supervision to all technicians on site. Required qualifications and certifications are as follows:
    a. SC shall employ certified & qualified technicians to perform this scope of work.
    b. SC shall possess a current North Carolina Electrical Low Voltage License.
    c. SC shall possess a current North Carolina Security/Burglar Alarm License.
    d. SC shall have demonstrated physical security access control experience & completed two or more access control projects, similar in size & complexity, in North or South Carolina in the last three (3) years.
        1. Cabling Contractor certifications shall include:

a) See Specification Section 28 23 10 for additional information.

2. Access Control Security Contractor certifications shall include:

a) Technician certifications from the product manufacturer of the equipment.

b) Low Voltage Security/Burglar Alarm License.

c) Open Options equipment must be provided through a certified Open Options Dealer.

e. Document Submittal:

1. SC shall not be awarded the project without possessing the required certifications.

2. SC, upon being awarded the project, shall submit all required certifications, insurance certificates, project roster, and previous experience and reference documents. This shall be submitted within ten (10) days of award of contract.

a) If the Security Contractor does not possess the required certifications required to perform the project upon the initial submittal, the SC will have ten (10) days from the notice from the Architect / Designer of rejection of the qualification documents to resubmit the required certifications. If at that time the SC does not submit all certifications required, the SC will not be allowed to perform the work & must be replaced by the General Contractor.

3. SC shall submit the following copies of current certifications:

a) Open Options 'Essentials Training' Certificate (owned by Technician)

b) Company Certifications

c) Company North Carolina Electrical Low Voltage license

d) Company North Carolina Security/Burglar Alarm License.

e) List of physical access control project experience & completed two or more projects similar of size & complexity in North or South Carolina in the last three (3) years. Include reference contact information.

f) Project roster of technicians and staff assigned to the project

g) Insurance certificates.

D. Equipment and materials of the type for which there are independent standard testing requirements, listings and labels, shall be listed and labeled by the independent testing laboratory (i.e. UL).

E. Where equipment & materials have industry certification, labels or standards (i.e. NEMA) this equipment shall be labeled as certified or complying with standards.

F. Material & equipment shall be new, conform to grade, quality and standard specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout. Materials and equipment are to be installed per industry standards & manufacturer's recommendations.

G. The Designer retains the right of inspection of the work at any time. Any material or work which does not comply with the specifications or current industry standards will be subject to rejection. Any such rejected work or material shall be reworked and/or replaced & made to conform with said specifications at no additional cost to the Owner.

H. Any stoppage, delay, suspensions or forfeiture due to a rejection shall in no way invalidate any terms of the Contract, and no additional charges will be allowed by the SC.

I. The SC site superintendent shall submit a weekly report due each Monday detailing the previous week's accomplishments; and providing a two (2) week forecast of areas where work will be performed and expected accomplishments. This report will be copied to the Owner and the Designer.

J. The SC shall inspect all installation materials & workmanship, and ensure contract compliance for final acceptance.

K. The SC is responsible for all damages to persons or property that occurs as a result of his fault, omission or negligence in connection with the prosecution of the work. The SC is responsible for the proper care and protection of all work performed until completion and final acceptance, whether or not the same has been covered in whole or in part by payments made by Owner.

L. The SC must remove all debris and packaging resulting from the delivery and installation of equipment & materials. The SC must leave the premises in the same condition as found. The SC will leave all work areas clean & free of debris.

M. Any damage done to the premises by the SC, the SC's agents, vendors or employees, will be repaired at his own expense. If the SC fails to repair any such damages, then the Owner may affect such repairs at SC's expense & offset any payments made by the Owner relating to such repairs against amounts payable by the Owner to the SC.

N. Property of the Owner, as well as any other property disturbed in the process of work, will be restored to the original condition that existed prior to the beginning of work. Restoration shall be at the SC's expense.

1.8 RELATED DOCUMENTATION:

A. Division 08 – Architectural (CMS A&E Guide)

B. Division 13 – Special Construction (CMS A&E Guide).

C. Division 25 – Mechanical (CMS A&E Guide).

D. Division 26 – Electrical (CMS A&E Guide).

E. Division 27 - Communications

F. Division 28 – Electronic Safety and Security

1.9 COORDINATION:

A. All work under this Section shall be coordinated with other trades to insure proper location of outlets and equipment connections, and to minimize conflicts with structural members, duct work, piping, cabling, etc.

B. SC shall verify that the same locking equipment, card readers, and ACS panels are provided in similar application situations across all of the work sites (facilities) involved with this contact, minimizing the variety of access control equipment types installed, where-ever possible.

PART 2 - EQUIPMENT

2.1 MANUFACTURER:

A. The following equipment manufacturers produce equipment or components which are included in these specifications; or which are approved for use by CMS. Products and manufacturers for the following equipment shall be limited to the following unless specifically stated otherwise elsewhere:

1. Physical Security Access Control System (ACS)
    a. Security Contractor is responsible for the hardware configuration and processor/memory capabilities and recommending the proper Server Configuration based on ACS density, complexity, processor needs, and storage/memory needs.
2. Physical Security Access Controllers and Modules
    a. Mercury Security based intelligent access controllers and access modules re-branded and sold by Open Options.
3. Integrated Intelligent Locks
    a. NOT CURRENTLY AUTHORIZED FOR CMS INSTALLATIONS
4. Electronic/Electromechanical Locks
    a. Electric Strikes (Provided by certified Door Hardware contractor)
        1. HES 1006 Series electric strike in mortise and cylinder applications. Mount recessed.

            Use of the electric strike includes locations such as data (MDF) rooms, only, unless approved by CMS security manager.
    b. Exit Devices (Provided by certified Door Hardware Contractor)
        1. Sargent 80 Series Electronic Exit Device with ELR (56-), REX (55-) options and McKinney McK-EL-EPT Electrical Power Transfer
        2. Von Duprin QEL 98 RX Electronic Exit Device with Von Duprin EPT-10 Power Transfer Hinge
        3. Adams Rite 8000 Series Electronic Exit Device with M/REX, SE (silent electrification) options and McKinney McK-EL-EPT Electrical Power Transfer
5. Door Power Supplies (Provided by certified Door Hardware Contractor)
    a. Allegion/Schlage PS902-2RS-BBK power supply panel with enclosure and battery backup.
    b. Allegion/Schlage PS904-2RS-BBK power supply panel (multi-door locations) with enclosure and battery backup.
    c. Owner approved equal
6. Card Readers
    a. Aptiq MT15-485 card reader for traditional wall installations
    b. Aptiq MT11-485 mullion card reader (only for fixed mullion installations)
    c. Contractor must provide configuration card to adapt reader to current Mifare standards to keep readers compatible with latest cards provided.
7. Door Position Switch
    a. Allegion Schlage 679-05-HM Concealed Magnetic Switch for traditional door applications.
    b. Allegion Schlage 674-OH Floor Mount Magnetic Switch for overhead door applications.
8. Door Motion Exit Sensor
    a. Bosch DS-160.

2.2 ACCESS CONTROL SYSTEM DESCRIPTION:

A. The Physical Security Access Control System (ACS) shall be provided to support the portals (doors, access hatches, etc.) as indicated in the facility. The access control shall be provided through coordination with Open Options.

B. This section includes the requirements and operational characteristics for an Access Control System, which is an integral part of the Security Control System. Access Control Systems included are:

1. Intelligent Access Controllers
2. Access Control Modules
3. Integrated and Electronic/Electromechanical Locks
4. Power Supplies
5. Card Readers
6. Sensors
7. Switches & Buttons
8. Access Control Cards (where applicable).

C. 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 for a seamless control, programming and future flexibility.

2.3 INTELLIGENT ACCESS CONTROLLERS AND MODULES:

A. The access control hardware will be a distributed intelligence, open architecture platform capable of scalability.

B. Enclosed and assembled controllers shall be offered as a factory, pre-wired unit and must be a UL recognized assembly. If intended for mounting above the ceiling, the controller assembly shall utilize a plenum rated metal or poly carbonate enclosure.

C. The access control hardware shall work in a hierarchical structure, by which an intelligent controller is deployed and control downstream controller modules (i.e. Reader Interface Modules, Input/Output Modules).

D. The intelligent access controllers support the following communication protocols:

1. TCP/IP (as defined by the Internet Engineering Task Force)
2. RS485 (ANSI/TIA/EIA-485)

E. The access control hardware shall be manufactured by Mercury Security Products, headquartered in Long Beach, California, USA.

F. The access control hardware shall consist of the following part numbers:

1. Intelligent Access Controllers
    a. DController (Mercury EP-1501)

G. Unless otherwise noted, every access controlled door (i.e. with a card reader) shall have a dedicated DController supporting that door, and located near the door in an accessible space. Subcontrollers are not allowed unless specific approval given by CMS.

H. Locate Intelligent Access Controller in an accessible location six (6) inches above the ceiling within a 10” x 10” x 4” plenum rated metal enclosure with a hinged door and latch. Provide one (1) 3/4” conduit from controller enclosure to associated power supply enclosure located above

the ceiling. Refer to drawing of enclosure for layout and installation specifics.

I. Certified project Security Contractor to install a CAT 6 plenum rated cable (white in color) from Intelligent Access Controller to associated security patch panel in IT/Data Closet. Cabling to be tested per 282310 Specification requirements.

J. Provide a phenolic plate on the Intelligent Access Controller enclosure to indicate the following:

1. Number of device
2. Associated IT/Data Closet
3. Associated Power Circuit
4. MAC/IP Address of each device within the enclosure

K. Provide a white sticker label to indicate the following:

1. On the Intelligent Access Controller enclosure listing the MAC/IP Address of each device within the enclosure
2. On the ceiling near the location of the controller enclosure

L. The access control hardware must support credential readers that communicate via Weigand, RS-485, or clock and data communications formats.

M. The access control hardware shall support the Open Supervised Device Protocol (OSDP).

N. Each Intelligent Access Controller shall meet the following requirements:

1. A minimum of 16 card readers.
2. Unlimited card formats
3. Up to 255 time schedules
4. Up to 255 holidays
5. Unlimited personnel records
6. Unlimited number of operators
7. Unlimited number of client connections

2.4 INTEGRATED INTELLIGENT LOCKS:

A. Not currently authorized for cms installations.

2.5 ELECTRONIC / ELECTROMECHANICAL LOCKS:

A. Electronic Mortise Lock

1. Provided with the Door Assembly by the certified Door Hardware Contractor
2. Shall have request to exit option for contact interface with ACS
3. Shall also include electronic power transfer hinge for cabling interface with ACS (installed by certified Door Hardware Contractor)
4. Cabling to electronic power transfer hinge by Security Contractor. Provide 2-18AWG plenum rated cable to associated Intelligent Access Controller within 3/4" conduit
5. Coordinate with Division 08 Specifications
6. Security Contractor to coordinate all requirements with the Door Hardware Manufacturer prior to rough-in and bid to make sure all the parts are being provided for a complete and

operational system

B. Exit Devices ("Crash Bars", etc.)

1. Provided with the Door Assembly by the certified Door Hardware Contractor
2. Shall have quiet electric latch retraction operation (not solenoids)
3. Shall have request to exit option for contact interface with ACS
4. Shall also include electronic power transfer hinge for cabling interface with ACS (installed by certified Door Hardware Contractor)
5. Cabling to electronic power transfer hinge by Security Contractor. Provide two (2) 2-18AWG plenum rated cables to the associated Intelligent Access Controller within dedicated 3/4" conduit.
6. Coordinate with Division 08 Specifications
7. Security Contractor to coordinate all requirements with the Door Hardware Manufacturer prior to rough-in and bid to make sure all the parts are being provided for a complete and operational system

2.6 EXIT RIM HARDWARE POWER SUPPLIES (provided by door hardware contractor):

A. 12-24VDC Power Supply for local device and lock power needs

1. Shall be a UL294 certified power supply.
2. Power supply shall come with a metal enclosure, located within 20' of associated door/portal above accessible ceiling. Enclosure to have a metal partition to separate power cabling from low-voltage cabling.
3. Electrical contractor to provide a phenolic plate on the Intelligent Access Controller enclosure to indicate the following:
   a. Number of device
   b. Associated Power Circuit

2.7 CARD READERS (MULTI-TECHNOLOGY):

A. Physical credential card readers will be used to authorize users at doors/portals

1. Card Readers will support existing XceedID 35-bit credentials used by CMS.
2. Card Reader will have a visual indicator to identify is access granted or denied.
3. Card Readers will have integral tamper switches, which will be interfaced with the ACS to alarm when the card reader is disassembled.
4. Card Reader will be forward compatible to support newer smartcard technologies to support future needs.
5. Card Reader will be compatible with HID 'SIO' technology.
6. Mount Card Reader on a 2" x 4" weatherproof recessed junction box within wall at desired location of Card Reader. Mount 42" above finished floor (unless otherwise noted).
7. Provide 6-22AWG plenum rated cable from Card Reader to associated Intelligent Access Controller within 3/4" conduit.

2.8 DOOR POSITION SWITCH:

A. Surface Mount Magnetic Contact for Traditional Doors

1. Contact device shall be a sealed switch
2. Shall be capable of being installed in wood and metal doors
3. Cabling shall be completely (100%) run within the door frame and associated wall, with no cable/wires exposed.
4. Provide 2-22AWG plenum rated cable Belden or approved equal) from switch to associated Intelligent Access Controller within 3/4" conduit.

B. Surface Mount Magnetic Contact for Roll-Up Doors

1. Contact device shall be a sealed switch
2. Shall use an armored cable for connecting to security system equipment
3. Cabling shall be completely (100%) run within the door frame and associated wall, with no cable/wires exposed.
4. Provide 2-22AWG plenum rated cable Belden or approved equal) from switch to associated Intelligent Access Controller within 3/4" conduit.

2.9 DOOR EXIT MOTION SENSOR:

A. Passive Infrared (PIR) detection sensor will be mounted on the secured side of the door/portal above the portal to detect the approach of individuals and trigger the ACS to unlock the associated locking mechanism and allow for egress without additional operation actions within the ACS.

1. PIR shall be designed for commercial applications.
2. PIR shall have dynamic temperature compensation.
3. PIR shall have an integral tamper switch.
4. Install the PIR according to all manufacturer requirements
5. Cabling shall be completely (100%) run within the door frame and associated wall, with no cable/wires exposed.
6. Provide 4-18AWG plenum rated cable from sensor to associated Intelligent Access Controller within 3/4" conduit.
7. Test the PIR in the finished, final environment (including furniture, finish materials, etc.) and adjust prior to turnover.

Motion sensor use is only in conjunction with electric strike locations.

2.10 CABLING AND CONNECTORS:

A. See 28 13 10 Access Control Cabling and 28 05 13 conductors and cables for electronic safety and security specifications for cabling information. If there is a specification section 27 00 00 included in the bid package all parts and pieces supersede the 28 13 10 section for all equipment and cabling.

PART 3 - INSTALLATION

3.1 GENERAL:

A. Installation of system shall be performed under the supervision of ACS system technicians

certified in the installation, operation, testing, and servicing of the type of system being installed. The ACS and related equipment shall be installed in accordance with the manufacturer's installation instructions. Supervise the installation to appraise ongoing progress of other trades and contracts, make allowances for all ongoing work, and coordinate the requirements of the installation of ACS with the General Contractor and all other trades.

1. Access Control Tree/Directory: verify intelligent controller inputs, outputs, field devices, and cable numbers must match. Provide durable number labels on each access module, intelligent controller, and on each cable. Coordinate the Designer and Owner for exact equipment naming and numbering scheme prior to installation and configuration.
2. Cables: Refer to 28 23 10 for additional information.
3. Grounding: Ground new intelligent access controllers in strict accordance with the manufacturer's recommendations and per NEC requirements. Assure metal enclosures are securely grounded.
4. Voltage: The Security Contractor (SC) shall supply power to equipment at the voltage indicated on the drawings. The SC will be held responsible for coordinating the equipment voltages, the control equipment wiring and the location and type of disconnect required to comply with the equipment manufacturer's requirements, NEC, and applicable local building codes. If equipment is supplied at a voltage other than that provided, the SC will be held responsible for making any necessary adjustments to correct the conflict, at no cost to the Owner, to the satisfaction of the Electrical Engineer. 120V power to the system headend and to all field power supplies shall be on dedicated circuits.
5. Supports: All supports shall be installed to the satisfaction of the AHJ. Refer to 28 23 10 section for additional information.
6. Equipment: Installed components will be color compatible, and shall be installed in keeping with the manufacturer's recommendations. All components shall be installed as indicated in the design documents and result in the views indicated. Any conflicts noted during the installation process will be immediately brought to the attention of the CMS project manager and Engineer of record for immediate resolution.
7. CMS Information System Connection: Intelligent Controllers will be cabled to patch panels in the Telecommunications Room and patch cables provided, but not hooked up. The SC will coordinate with the CMS Information Systems Department in the actual connections to the network switches and assignments of the IP addresses.

B. General Contractor Information:

1. At the end of each work period where the space will be subsequently occupied by children, the space will be left clean and neat with all potential hazards removed.
2. It is the Security Contractor's responsibility to secure their construction materials, clean up their messes and dispose of their construction debris.
3. All work will be permitted and inspected as required by the local AHJ and all required components will be UL labeled or otherwise certified to their satisfaction.
4. This SC is responsible for all permit fees and permitting pickup, inspections, and permit closeout.

3.2 FIRESTOPPING:

A. Refer to Section 078413 for additional information. A fire stop system is comprised of the item or items penetrating the fire-rated structure, the opening in the structure and the materials & assembly of the materials used to seal the penetrated structure. Fire stop systems

comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.

B. All penetrations through fire-rated building structures (walls & floors) shall be sealed with an appropriate fire stop system. This requirement applies to through penetrations (complete penetrations) and membrane penetrations (through one side of a hollow fire-rated structure). Any penetrating item (i.e.–riser slots & sleeves, cables, conduit, cable tray & raceways) that are specifically designated for the data/video/voice infrastructure shall be properly fire stopped. The contracting discipline installing the sleeve or slot shall be responsible for sealing the area on the exterior of the sleeve or slot. The Telecommunications Contractor shall be responsible for fire stopping the interior annular area.

C. Verify that cabling & all other penetrating elements and supporting devices have been completely installed and temporary lines & cables have been removed before the installation of fire stop.

D. Perform all necessary coordination with trades constructing floors, walls or other partitions of building construction with respect to size & shape of each opening to be constructed and device system approved for use in each instance.

E. Coordinate each fire stop selection with adjacent work for dimensional or other interference & for feasibility. In areas accessible to public and other finished areas, fire stop systems work shall be selected, installed & finished to the quality of adjacent surfaces of building construction being penetrated.

F. If a Professional Engineer's UL design is not available, Telecommunications Contractor shall provide appropriate UL design for penetrations through rated walls properly fire stop penetrations. These documents shall be submitted to the General Contractor and to the UCPS Telecommunications Site Inspector.

G. Refer to 28 13 10 Access Control Cabling Specification for additional information.

H. Sample UL Penetration Details may be found below and on the drawings:

Construction	Wall Rating	UL Number
Single Cable thru Concrete Floor/Wall or Block Wall	2 hours	CAJ2028
Single Cable thru Concrete Floor/Wall or Block Wall	2 hours	CAJ3078
Multiple Cables thru Concrete Floor/Wall or Block Wall	2 hours	CAJ3089
Cables thru Gypsum Wall Assembly	2 hours	WL3059
Cables thru Gypsum Wall Assembly	2 hours	WL3058
Cables thru Gypsum Wall Assembly	2 hours	WL2033
Cable or Cable Bundle thru Gypsum Wall	2 hours	WL3047
Metal Pipe thru Gypsum Wall	2 hours	WL1054

3.3 GROUNDING AND BONDING:

A. Grounding shall conform to ANSI/TIA/EIA J-STD-607 Commercial Building Grounding and Bonding Requirements for Telecommunications; NFPA 70 Article 250 for types, sizes & quantities for equipment grounding conductors; unless specific types, larger sizes or more

conductors than required by NFPA 70 are indicated. Also coordinate with manufacturer's grounding requirements as minimum.

B. For insulated conductors & connections, comply with Division 26 05 26 Specifications, Grounding and Bonding.

C. Bond & ground equipment racks, housings, messenger cables, ladder racks, metallic raceways and armored fiber with a #6 AWG stranded green conductor. #12 AWG stranded green conductor shall be used to bond surface mounted metallic raceways. However, in plenum areas, the grounding conductor shall be a bare, solid conductor for all grounding applications. Coordinate with Electrical Contractor. Electrical Contractor to bond or ground all pathways provided by Electrical Contractor.

D. Route along shortest & straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact or may damage the ground.

E. Security systems/racks shall be grounded to the existing main telecommunications bus bar. If no bus is present the SC shall provide a new telecommunications bus bar and ground/bond all existing racks that are not properly grounded/bonded.

F. Refer to 28 13 10 Access Control Cabling Specification for additional information.

3.4 TESTING:

A. The Security Contractor will be responsible for testing and operating the system to the satisfaction of the Engineer and the Owner's representative. Testing shall be done in accordance with the equipment manufacturer's instructions and also as listed below by the owner. Tests shall include as a minimum a functional test of all equipment. The final test will be performed in the presence of the installation alarm technician. All deficiencies will be corrected until satisfactory results are obtained.

1. At the individual sites completion Supplier's Technical Representative, local school staff, CMS technical staff and CMS contracted technical personnel will review:

a. Quality of the installation/compliance with the specification.

b. Functionality of the system, including testing and verifying connections to equipment of other divisions such as life safety and elevators.

c. As-Built information provided to the designers and a mounted 30x42 framed copy of the updated site map posted at the head end equipment wall.

d. Overall system documentation provided to CMS Building Services.

e. Refer to 28 13 10 Access Control Cabling Specification for additional information.

B. Cabling installed by the Security Contractor shall be tested in accordance with Specification 270200 for appropriate cable type and testing methodology.

3.5 DOCUMENTATION AND COMPLETION OF WORK:

A. Provide completed "System Device Identification Log" thirty (30) days prior to the substantial completion date.

B. Operation and Maintenance Manual: Upon completion of the installation and testing, the Contractor shall provide the Owner with three (3) instruction manuals for the operation, installation, and maintenance of the system. Manuals shall be bound in hardback binders and shall include recommended spare parts lists and vendors, troubleshooting guides, and maintenance instructions and recommended servicing periods. A telephone number for the

service and repair organization for the system shall be included in the binder. It shall also include:

1. Operating instructions specific to the installation.
2. Device nomenclature.
3. Device placement.
4. Step-by Step directions for routine maintenance of the system.
5. Descriptions of all components.
6. Parts list by name/model/number/manufacturer/etc. and parts cut-sheets.
7. It shall also include service and maintenance manual for each component and troubleshooting guides.
8. A final list of all contractors and subcontractors involved in the specific installation including company names, foreman, address, and phone numbers.
9. Provide a chart, matching the CMS format shown, of all network connected devices that includes device number, model number, serial number, MAC address, and data drop including patch panel port numbers. Refer to Figure 281300-01.

C. The Contractor shall maintain at the site one record copy of all contract drawings, specifications, addenda, change orders and other modifications, in good order, and marked currently to record all changes made during the construction and shall maintain at the site copies of approved shop drawings, product data and operations and maintenance information.

D. Upon completion of work, the contractor in combination with the designer as required shall deliver two (2) copies of record drawings in paper format and one (1) electronic copy in PDF format to include contract and shop drawings. All record drawings shall be "as built" and reflect the work that was actually installed. They shall be in a format and contain sufficient details (like power supply and media converter locations and power sources with circuit numbers) to permit rapid and accurate troubleshooting by a skilled technician with no previous knowledge of the specific installation.

E. Record drawings and documents shall be provided in both printed and electronic formats. Electronic files will be submitted as both AutoCAD DWG (2012 or previous) and PDFs on media to be specified by CMS. Electronic files and the configuration files for the specific installation. In addition to the individual programs and setup files an image file of each specific installation will be provided to facilitate rapid reloading. Refer to 28 13 10 Cabling for additional requirements.

F. Labels: Provide label on each power supply, showing source of feed, i.e. PP123-CKT 14. Provide durable number label on each controller housing, visible from ground level, and on each cable. Provide corresponding number label for cable input.

G. As-Built Drawings: Provide as-built drawings showing name, card reader number, controller number, and location for all controlled doors and access control equipment. Drawing to include location of power supplies. Power supply feed to be labeled on drawing, i.e. PP123-CKT 14. Panelboard directory to be updated to indicate power supply fed. Drawing must be durably mounted next to cameras head-end rack.

H. Refer to 28 13 10 Access Control Cabling Specification for additional information.

I. Refer to 27 01 00 Communications Specification for warranty of, but not limited to, cabling and patch panel logs.

J. Other Close Out Documentation:

1. Contractor's Warranty.
2. Warranty Summary sheet and original Manufacturer's Warranty for specific items as listed in these specifications.

FIGURE 281300-01: Systems Device Listing, Security Example

Site Name: EXAMPLE

Contractor Responsibility					***** IP Address***	**CMS Responsibility**	
Device	***Device #***	***Device Location***	***Cable ID***	***MAC Address***	***** IP Address***	***Switch ID***	***Switch Port #***
Camera	Camera 10	Front Entry Door	TR1-R2-S10	00:00:00:00:00:00	000.000.000.000	TR1-Switch 3	10
PIM	PIM01	Side Entry in Corridor 200	TR2-R2-P01	00:00:00:00:00:00	000.000.000.000	TR2-Switch 2	45
Door Controller	DC02	Kitchen Entry	TR4-R1-C48	00:00:00:00:00:00	000.000.000.000	TR4-Switch 2	48
Helios	Helios	Front Entry Door	MC-R1-C40	00:00:00:00:00:00	000.000.000.000	MC-Switch 5	40
BAS 1	BAS	Boiler Room	TR3-R1-B32	00:00:00:00:00:00	000.000.000.000	TR3-Switch 2	38
BAS 2	BAS	Boiler Room	TR3-R1-B32	00:00:00:00:00:00	000.000.000.000	TR3-Switch 2	38
BAS 3	BAS	Boiler Room	TR3-R1-B32	00:00:00:00:00:00	000.000.000.000	TR3-Switch 2	38

***** IP Address Responsibility is dictated by System Processes Flowchart***

3.6 APPENDIX A REQUIREMENT LIST:

A. Planned Preventive Maintenance (P.M.) Requirements List for CMS access controlled equipment.

1. School Name
2. Contractor Name
3. Technician Name
4. Date
5. Room Name and Number
6. Door Number
7. Intelligent Access Controller Manufacturer
8. Intelligent Access Controller Model Number
9. Intelligent Access Controller Serial Number
10. Access Control Module Manufacturer
11. Access Control Module Model Number
12. Access Control Module Serial Number
13. General:
    a. Visually check complete head-end unit
    b. Visually check head-end room for trash, proper ventilation, lighting and overall disrepair. Report findings.
14. Intelligent Controllers and Access Modules
    a. Clean all enclosures (exterior and interior) per manufacturer (i.e. anti-static procedures)
    b. Verify tamper switch is fully operational.
    c. Visually inspect all cabling and terminations.

d. Visually inspect all lighting protection devices.

15. Card Readers

e. Clean all card readers per manufacturer (i.e. anti-static procedures)

f. Verify card reader internal tamper switch is operational

g. Visually inspect all readers for wear and tear, damage, replacement needs

h. Visually inspect all cabling and terminations.

16. Head-End:

a. Check all connectors on the system head-end for good connections

b. Check for overall operation of system. Confirm with Principal or Principal's designee.

c. Visually inspect all computer monitors, computer keyboards and computer mice

d. Visually inspect UPS system

e. Visually inspect all lightning protection devices

f. Visually check all controllers and doors/portals are included in the system and are fully operational.

g. Visually check all controllers and doors/portals are included on the graphic maps

17. Reports – provide a detailed report to the Alarm Supervisor describing the work performed and recommendations for corrective maintenance not covered by the planned maintenance service.

END OF SECTION

This Master Specification Section summarizes Charlotte-Mecklenburg Schools' standards and requirements for the Work of this Section. Design Consultant shall edit this document to correspond to Project requirements. Obtain CMS approval for manufacturers and products not listed in this Section.

SECTION 281310 – ACCESS CONTROL CABLING

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Section includes:

1. UTP Cabling.
2. Cabling connecting equipment.
3. Cable connectors.
4. Racking hardware.
5. Labeling requirements.
6. Testing requirements.
7. Warranty requirements.
8. Closeout documentation.

B. Provide all labor, materials, tools & equipment required for the complete installation of work called for in the Construction Documents.

C. All service shall commence in accordance with the master construction schedule. The Security Contractor will provide schedule information to assist in the development of the Master Schedule.

D. Federal, state, local codes, rules, regulations, ordinances and current industry standards governing the work are as fully part of these specifications as if herein repeated or hereto attached. If the Security Contractor should note items in the Construction Documents or Specifications, construction of which would be code violations or not adhere to current industry standards, then the Security Contractor shall promptly call the suspected violations or deviations to the attention of the Designer in writing.

E. Security Contractor (SC) Scope of Work:

1. The work covered under this section shall include furnishing & installing networked cabling infrastructure for the physical security Access Control System (ACS).
2. All cables & related terminations, cross-connects, equipment, materials, support, grounding hardware and all shall be furnished, installed, tested, labeled and documented by the Security Contractor.
3. The Security Contractor shall provide & install lightning protection devices on all cables exposed to lightning risks.

4. The Horizontal Cabling System for Security shall consist of 4 pair Unshielded Twisted Pair (UTP) Copper Cables to each Intelligent Access Controller location (i.e. Door/Portal) and other key locations as noted on the Construction Documents (drawings). These cables shall be installed from the Intelligent Access Controller location to the designated Security/Telecommunications Room Intermediate Distribution Frame (IDF) / Telecom Room IDF existing data racks or existing wall mounted data racks or enclosures. If adequate space is not available in the existing IDFs, Security Contractor to provide additional wall mounted rack(s)/enclosure(s).

5. Product specifications & installation requirements are provided under Division 28. The successful Security Contractor shall meet or exceed all requirements for the cable system described in this document.

6. The Construction Drawings are diagrammatic only. They are not intended to show every detail of the construction project, every item or material that is required. It is the responsibility of the contractor submitting proposals to provide the equipment necessary to provide a properly operating system. The intent of the Construction Documents/Drawings includes constructing complete and working system.

1.1 RELATED SECTIONS:

A. Drawings and general provisions of the contract, including General conditions and Division 01 Specification Sections apply to this section.

B. The requirements of Section 28 13 10 govern the work specified in this section.

C. Refer to the following sections for related work:

1. 27 01 00 – Telecommunications General Requirements - ACS Security Contractor must abide by all 27 01 00 thru 27 02 00. If there is a conflict between the two specifications the most stringent requirement shall apply.

2. 27 01 10 – Telecommunications Equipment Room Fittings - ACS Security Contractor SC must abide by all 27 01 00 thru 27 02 00. If there is a conflict between the two specifications the most stringent requirement shall apply.

3. 27 02 00 – Data/Voice Cabling - ACS Security Contractor must abide by all 27 01 00 thru 27 02 00. If there is a conflict between the two specifications the most stringent requirement shall apply.

4. Cabling (manufacturer) shall match the provided telecommunications cabling manufacturer and connectivity manufacturer for the respective project.

1.2 REGULATORY REQUIREMENTS:

A. The following latest editions of the industry standards are the basis for the structured cabling system described in this document. The standards listed shall be adhered to in the same manner as if they were codes.

B. All current state & local codes.

1. TIA – Telecommunications Industries Association.

a. Articles 526, 568, 569, 606, 607, TSP-149, TSB-140.

2. ANSI - American National Standards Institute.
3. BICSI – Building Industry Consulting Service International
    a. Telecommunications Distribution Methods Manual (TDMM), latest edition.
    b. Information Technology Systems Installation Methods Manual (ITSIMM), latest edition.
    c. Customer -Owned Outside Plant Design Reference Manual (OSPDRM), latest edition.
4. EIA – Electronic Industries Alliance
    a. RS232C – Interface between Data Terminal Equipment and Data Communications Equipment Employing Serial Binary Data Interchange
    b. RS485 – Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multi-Point Systems
5. ETL - Intertek Electrical Testing Laboratories.
6. UL – Underwriters Laboratories.
    a. UL294 – Access Control System Units.
7. NEMA – National Electrical Manufacturers Association.
8. OSHA – Occupational Safety and Health Administration standards.
9. NFPA – National Fire Protection Association.
    a. NFPA 70, National Electrical Code (NEC).
    b. NFPA 101, National Life Safety Code.
10. Americans With Disabilities Act of 1990 (ADA).
11. Division 26 Electrical Specifications.
12. Standard Industry Practices
13. All current and local codes.

C. If there is a conflict between applicable regulatory industry standards, then the more stringent requirements shall apply. The Contractor has the responsibility to determine and adhere to the latest editions when developing the proposal for installation.

D. All electronic equipment and materials are to be tested, listed and labeled by UL, ETL or other agency that is acceptable to the AHJ and the State of North Carolina approved 3rd party testing agencies. Acceptable agencies can be found on the state construction website.

1.3 DEFINITIONS:

A. BICSI – Building Industry Consulting Services International

B. EC – Electrical Contractor

C. EMI – Electromagnetic Interference

D. IDF – Intermediate Distribution Frame

E. MDF – Main Distribution Frame

F. NEC – National Electric Code

G. NEMA – National Electrical Manufacturers Association

H. SC – Security Contractor

I. TC – Telecommunications Contractor

J. UL – Underwriters Laboratory, Inc.

K. UTP – Unshielded Twisted Pair cable

L. IP – Internet Protocol

1.4 WORK NOT INCLUDED:

A. Providing 120 Volt (or greater) power wiring.

B. Providing networking equipment.

1.5 SUBMITTALS:

A. Shop drawing submittals are required and shall include the following for review. Submittals not containing all of the information listed below will be rejected.

B. Before submitting a shop drawing or related material, the Security Contractor (SC) shall:

1. Review each submission for conformance with all SC's means, methods, techniques, sequences and operations of construction & safety precautions; and programs incidental thereto, all of which are the sole responsibility of the SC.

2. Review & coordinate each submission with other related or affected work.

3. Approve each submission before submitting same.

C. Submittals shall include the following:

1. Shop drawings, product data (including cut sheets & catalog information), samples required by the Contract Documents for the ACS cabling system.

a. Cabling.

1. Manufacturer's data sheets for the telecommunications outlets, jacks, all cross connect equipment.

2. Horizontal cables.

3. Specialty cables.

4. Wire management.

5. Over voltage protection equipment.

6. Cabling supports.

7. Racks.

8. Patch cords.

D. By submitting shop drawings, product data, and samples, the SC represents that s/he has carefully reviewed and verified materials, quantities, field measurements, and field construction criteria related thereto. It also represents that the SC has checked, coordinated and verified that information contained within shop drawings & product data conforms to the requirements of the work & of the Contract Documents.

E. The acceptance of shop drawings, product data and samples submitted by the SC shall not relieve the SC of responsibility for adhering to the requirements of the Contract Documents. Nor shall the acceptance relieve the SC of responsibility for errors or omissions in such shop drawings, product data or samples.

F. The review & acceptance, or other appropriate action upon shop drawings, product data is for the limited purpose of checking for conformance with information given & design concept illustration in the Contract Documents. Review of such submittals is not conducted for the purpose of determining accuracy & completeness of other details such as dimensions & quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the SC as required by the Contract Documents. The review shall not constitute approval of safety precautions or of construction means, methods, techniques, sequences or procedures.

G. For initial submission & for resubmission required for acceptance, submit electronic copies of each item. Combine all electronic files into one final submittal packaged electronic file.

H. Illegible submittals will not be checked.

I. If a submittal deviates from the drawings & project manual because of standard shop practice, substitutions (approved in accordance with General Conditions, amended) or any other reason, the Designer shall be advised in an attached separate written instrument. Deviations shall be acknowledged by Designer in writing. Unless acknowledged by the Designer in writing, the Contractor will not be relieved of the responsibility for executing the work in accordance with the Contract Documents.

1.6 DRAWINGS AND SPECIFICATIONS:

A. It is understood that while drawings will be followed as closely as circumstances will permit, the SC is held responsible for the installation of the system according to the true intent and meaning of the drawings. Anything not completely clear in the Construction Documents will be explained upon request to the Designer. However, if conditions arise where, in the judgment of the SC, certain changes will be advisable; the SC will communicate through the proper channels & obtain review and approval of these changes before proceeding with the work.

B. The drawings are not to be scaled. The SC must refer to the architectural drawings for building construction, dimensions and material, finish and construction method of walls, floor and ceiling in order to insure proper installation of work.

C. If there is a conflict between the Drawings and the Specifications, the most stringent requirement shall apply.

1.7 QUALITY ASSURANCE:

A. The SC shall employ qualified and certified technicians to this project that have experience with the installation of low voltage cabling infrastructures & security equipment and security related services; and provide appropriate supervision to all technicians on site.

B. The Architect / Engineer shall have the right to reject any proposed Security Contractor that, in the opinion of the Architect / Engineer, does not have the qualifications to perform the work to the satisfaction of the Architect / Engineer.

C. Contractor Qualifications:

1. The SC shall employ qualified & certified technicians on this project that have experienced with the installation of low voltage cabling infrastructures & provide appropriate supervision to all technicians on site. Required qualifications and certifications are as follows:

a. SC shall employ certified & qualified technicians to perform this scope of work.

b. SC shall have an RCDD and a licensed individual who possess a North Carolina Security/Burglar Alarm license to oversee the project.

c. SC shall possess a current North Carolina Electrical Low Voltage License.

d. SC shall possess a current North Carolina Security/Burglar Alarm License.

e. Contractor shall have demonstrated physical security access control experience & completed two or more access control projects, similar in size & complexity, in North or South Carolina in the last three (3) years.

1. Cabling Contractor certifications shall include:

a. Technician certifications from the connectivity and cable manufacturers, to include manufacturer installed on the job. A minimum of 30% of technicians assigned to the project shall hold these certifications (for cabling only).

b. SC shall hold company certifications from the connectivity & cable manufacturers to include manufacturer installed on the project.

c. The lead technician assigned to the project shall have the following certifications:

1. BICSI certified installer at the technician level.

2. Technician certifications from the connectivity and cable, including manufacturer(s) installed on the project.

3. BICSI Technician shall be on site whenever work is being performed.

d. 30% of all Technicians on site at all times shall be BICSI certified installers.

e. Cabling Contractor shall not touch or install any video surveillance equipment unless they are also the hired installer of video surveillance equipment which holds the project low voltage security/burglar alarm license for the project.

f. Qualification Document Submittal:

1. Contractor shall not be awarded the project without possessing the required certifications.

2. Contractor, upon being awarded the project, shall submit all required certifications, insurance certificates, project roster, previous experience and reference documents. This shall be submitted within ten (10) days of award of contract.

   a. Contractors not possessing the required certifications required to perform the project upon the initial submittal, the Contractor will have ten (10) days from the notice from the Architect / Designer of rejection of the qualification documents to resubmit the required certifications. If at that time the Contractor does not submit all certifications required, the Contractor will not be allowed to perform the work & must be replaced by the General Contractor.

3. Contractor shall submit the following copies of current certifications:

   a. Technician certifications.

   b. Company Certifications.

   c. Company North Carolina Electrical Low Voltage license.

   d. Company North Carolina Security/burglar Alarm License.

   e. RCDD certificate(s).

   f. List of physical access control project experience & completed two or more projects similar of size & complexity in North or South Carolina in the last three (3) years. Include reference contact information.

   g. Project roster of technicians and staff assigned to the project.

   h. Insurance certificates.

D. Equipment and materials of the type for which there are independent standard testing requirements, listings and labels, shall be listed and labeled by the independent testing laboratory (i.e. UL).

E. Where equipment & materials have industry certification, labels or standards (i.e. NEMA) this equipment shall be labeled as certified or complying with standards.

F. Material & equipment shall be new, conform to grade, quality and standard specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout. Materials and equipment are to be installed per industry standards & manufacturer's recommendations.

G. The Designer retains the right of inspection of the work at any time. Any material or work which does not comply with the specifications or current industry standards, will be subject to rejection. Any such rejected work or material shall be reworked and/or replaced & made to conform with said specifications at no additional cost to the Owner.

H. Any stoppage, delay, suspensions or forfeiture due to a rejection shall in no way invalidate any terms of the Contract, and no additional charges will be allowed by the SC.

I. The SC site superintendent shall submit a weekly report due each Monday detailing the previous week's accomplishments; and providing a two (2) week forecast of areas where work will be performed and expected accomplishments. This report will be copied to the Owner and the Designer.

J. The SC shall inspect all installation materials & workmanship, and ensure contract compliance for final acceptance.

K. The SC is responsible for all damages to persons or property that occurs as a result of his fault, omission or negligence in connection with the prosecution of the work. The SC is responsible for the proper care and protection of all work performed until completion and final acceptance, whether or not the same has been covered in whole or in part by payments made by Owner.

L. The SC must remove all debris and packaging resulting from the delivery and installation of equipment & materials. The SC must leave the premises in the same condition as found. The SC will leave all work areas clean & free of debris.

M. Any damage done to the premises by the SC, the SC's agents, vendors or employees, will be repaired at his own expense. If the SC fails to repair any such damages, then the Owner may affect such repairs at SC's expense & offset any payments made by the Owner relating to such repairs against amounts payable by the Owner to the SC.

N. Property of the Owner, as well as any other property disturbed in the process of work, will be restored to the original condition that existed prior to the beginning of work. Restoration shall be at the SC's expense.

PART 2 - PRODUCTS

2.1 UNSHIELDED TWISTED PAIR CABLE:

A. UTP 4 pair Plenum-rated Cable for access control: Category 6 Cable, White colored jacket. Cable must meet or exceed TIA/EIA 568-C.2 standards.

1. Cable shall be rated to 400 MHz minimum.

2. All cable shall conform to the requirements for communications circuits defined by NFPA 262. Cable shall be listed to NEC Type CMP (NFPA 262) for plenum installations.

3. The cable shall meet or exceed the requirements as described in CENELEC EN 50288-6-1, TIA 568-C.2 Category 6, and ISO/IEC 11801 Class E.

4. The cable shall meet or exceed the requirements as described in CENELEC EN50173, ICEA S-102-700, TIA 568-C.2 Category 6, RoHS Compliant Directive 2002/95/EC and ISO/IEC 11801.

5. Third party performance verified.

6. RoHS Compliant Directive 2011/65/EU.
7. The cable shall have a flexible jacket that strips cleanly & resists kinking.
8. Products:
    a. CommScope – Ultra Media CS37P - #UN874046314/10
    b. Panduit - PUP6004
    c. Siemons - System 6, #9C6P4-E3-02-RXA (white)
    d. General Cable – GenSpeed 6000

B. UTP 4-pair Outside Plant Cable: Category 6.

1. Cable shall be rated to 250 MHz minimum.
2. Shall have water / moisture blocking components to protect the cable in potentially wet areas.
3. The cable shall meet or exceed the requirements as described in CENELEC EN 50288-6-1, TIA 568-C.2 Category 6, and ISO/IEC 11801 Class E.
4. The cable shall have a flexible jacket that strips cleanly & resists kinking.
5. RoHS Compliant Directive 2011/65/EU.
6. Solid conductors.
7. Jacket color: black.
8. Products –
    a. CommScope, Outdoor, CS34O BLK C6 - #UN884019984/30
    b. Siemon – OSP-#9C604-E1
    c. Or Approved Equal

2.2 CONNECTORS AND JACKS:

A. Copper Patch cords – Category 6 – White

1. 24 AWG conductors
2. Shall meet or exceed Category 6 / Class E requirements of ISO/IEC 11801, CENELEC EN50173-1 and TIA 568-C.2.
3. ETL listed.
4. Cables shall be factory manufactured & terminated.
5. Narrow boot with strain relief.

6. Provide patch cords at the station end and all the IDF end with 10% spare of each length required for Owner's future use. Submit patch cords for Owner's cross-connect activities two (2) weeks prior to project's end.
7. Provide additional lengths as required to adhere to site conditions.
8. Products:
    a. CommScope Uniprise:
        1. Security Room – Riser rated:
            a. 3' - #UC1BBB2-0MF003
            b. 5' - #UC1BBB2-0MF-005
            c. 7' - #UC1BBB2-0MF-007
        2. (plenum rated): 10' - #UC1BBC2-0MF010 (provide additional lengths as needed)
    b. Panduit - TX 6:
        1. Security Room – Riser rated:
            a. 3' - #UTPSP3YWH
            b. 5' - #UTPSP5YWH
            c. 7' - #UTPSP7YWH
        2. Field Device End: 10' - #UKPGR10WH/N (provide additional lengths as needed)

B. UTP Category 6 jacks - White
1. All products must meet or exceed TIA 568-C.2 Category 6 performance standards, ISO 11801 (class E), EN50173-1 (class E).
2. Meets requirements for IEEE 802.3af and IEEE 802.3at for PoE requirements.
3. UL 1863 approved.
4. Backwards compatible.
5. Modular jacks shall be unshielded, 4-pair, RJ-45.
6. Modular jacks shall terminate using 110-style pc board connectors, color-coded for T568B wiring.
7. Each modular jack shall be wired to T568B.
8. Products:
    a. CommScope Uniprise - UNJ600-WH, #760237788(white)
    b. Panduit – non keyed - #CJ688TGWH (white)

c. Siemon - #MX6-F02 (white)

2.3 FACEPLATE APPPLICATIONS:

A. Recessed Applications

1. Duplex style, single gang faceplate.
2. Shall be available in 1, 2, 3, 4 and 6 vertical outlet configurations.
3. Provide faceplate with 1 spare port to allow for growth.
4. Ivory in color.
5. Shall be provided with mounting screws, label covers and label cards.
6. Provide blank dust covers for all blank ports.
7. Products:

a. CommScope Uniprise (color for this manufacturer is listed as 'Misty /Cream')

1. 2 Port – M12LE-215 - #108333048

b. Panduit

1. 2 Port-#CFPE2IWY

c. Siemon

1. 2 Port-#MX-FP-S-02-02

B. Surface Mount Applications that equal Wiremold 700 or 2000 Applications

1. Duplex style, single gang faceplate.
2. Faceplates shall work seamless with the raceway to be installed.
3. Colors shall match the raceway to be installed.
4. All fittings, modules and bezels necessary shall be provided.
5. Faceplates shall accept the same manufacturer of jacks that are being installed on the project.
6. Shall be provided with mounting screws, label covers and labeling cards.
7. Provide blank dust covers for all blank ports.
8. Products:

a. Panduit - #CFPSE4IW,

b. Or Approved Equal

C. 106 Frames

1. Frames will mount behind standard 106 NEMA faceplates.

2. Frames will accept modules for STP and UTP, and audio/video.

3. Ability to snap in and out to allow for moves, adds and/or changes.

4. Products

a. CommScope

1) 2 Port-#M106FR2-262 - #106622251

b. Panduit:

1) 2-Port - #CF1062IWY

c. Siemon:

1) 2-Port-#MX-E2F-02

2.4 CONSOLIDATION POINT ENCLOSURES:

A. Consolidation point Enclosure Category 6:

1. Plenum rated adhering to UL 2043.

2. Meet or exceeds TIA 568-C category 6 standards.

3. 16 gauge aluminum.

4. Wall mount.

5. Accepts Category 6 cabling.

6. Removable cover that allows top & bottom access to cables.

7. All necessary accessories shall be provided including punch down bases, connecting blocks for the Category of cable being used.

8. Enclosure shall be clearly labeled according to TIA 606-A.

9. Shall accommodate two 100-pair 110 connect XC wiring blocks without legs.

10. Must be available in 24 port and 48 port capacities.

11. Products:

a. Panduit # WMCPE and Panduit # GPB24-X-24 pair punch down base

b. Or Approved Equal.

2.5 MEDIA CONVERTER RACK MOUNT:

A. IEEE 802.3 and IEEE 802.3u compliant.

B. UL listed and labeled.

C. Meets or exceeds the following standards.

D. FCC part 15 Class A.

E. CISPR Class A.

F. VCCI Class A.

G. CE mark.

H. Built-in twisted pair port 10/100/1000 switch.

I. Auto-negotiation RJ-45 connector with Auto-MDIX.

J. ST Connector port.

K. LEDs for functions, links and activity.

L. Link fault signaling for use with managed switches.

M. 1,024 MAC address capacity.

N. Store and forward architecture.

O. Full and half duplex operation.

P. Wall or chassis mountable (utilize chassis mount).

Q. Provide all accessories necessary for mounting.

R. Lifetime performance warranty.

S. 2 rack unit mounting chassis.

T. 120v power supply to chassis.

U. Overload protection with automatic recovery.

V. Chassis cooling two 42.5cfm side mounted fans plus one fan for each redundant power supply.

W. Product unit:

1. Signamax #065-1196SFPDR
2. Or Approved Equal

X. Product chassis with ac power:

1. Signamax #065-1185/1185FAN

2. Or Approved Equal

2.6 POE INJECTOR:

A. UL Listed and labeled and IEEE 902.3af compliant.

B. Input 24VAC.

C. 1 port for power over Ethernet to 1 cat5/cat6 cable min dist. 300’.

D. LED status light.

E. Provided with plug in transformer included.

F. Products:

1. Altronix - NetWay1 single port.

2. Or approved equal.

2.7 TIE-WRAPS:

A. All tie wraps must be red in color.

B. All tie wraps must be plenum rated.

C. UL Listed and labeled.

D. Products:

1. Thomas and Betts-#TY-25M-9, or Approved Equal:

2. Panduit:

a. 4” – #PLT1M-C702

b. 7.4” -#PLT2S-C702

c. 11.6” - #PLT3S-C702

2.8 RACKS AND WALL MOUNTED ENCLOSURES:

A. 84” High Foot Aluminum floor Mounted Data Rack, 45 rack units, 19" wide, Black:

1. High strength aluminum construction.

2. 1200 lb capacity.

3. Pre-punched base angles for floor mounting.

4. Top angles to allow J-bolt attachment without interfering with top rack-mount spaces.

5. EIA-310-D Standard Universal 5/8" - 5/8"-1/2" alternating hole pattern.

6. Six web channel holes per side to enable multiple racks to be mounted together side by side.

7. High strength roll-formed threaded mounting holes.

8. Rack-mount unit marks.
9. Thirty (30) pilot point #12-24 mounting screws with combination Phillips/Straight heads to reduce cross-threading.
10. UL listed.
11. Products:
    a. CPI 19" Universal Black rack - #46353-103
    b. Saunders/Cooper B-Line - #SB-556-084-XU
    c. Or Approved Equal

B. Wall Mounted Enclosures, 19” wide, Black:

1. Dual hinged
2. Fully welded, 16 gauge cold rolled steel construction
3. Heavy duty.
4. Load rating 200 lb
5. EIA/ECA-310-E compliant mounting rail system with #12-24 tapped rails.
6. UL listed to UL60950 standard-file number E235184.
7. Fan kit to be included
8. Plexiglass front door
9. Lock included
10. Width 24.7”
11. Depth 30”
12. Heights

a. 24” with 12 rack units
b. 36” with 19 rack units
c. 48” with 26 rack units

13. Products

a. Cooper-B-Line V-Line Dual Hinge Wall Mount Cabinets-#VLWM####
b. Chatsworth Products Cube-IT Plus Cabinet-#12419-7##
c. Or Approved Equal

C. Wall Mounted Telcom Rack-Swing (Install in data rooms only)

1. Flat black powder coat
2. Dual hinge
3. Steel frame with steel hinge pin in aluminum door
4. EIA/ECA-310-E compliant with universal mounting hole spacing.
5. Load rating 150 lb
6. UL listing E235184
7. Width to accept 19” rack mounted equipment
8. Depth 25”
9. Heights

a. 24” with 10 rack units
b. 30” with 13 rack units
c. 44” with 21 rack units
d. 54” with 27 rack units

10. Products

a. Cooper-Bline Swing Gate Wall Mounted Equipment Rack-#SB70819##25FB
b. Or Approved Equal

2.9 DATA RACK WIRE MANAGEMENT

A. 7 foot Vertical:

a. Provide 6" wide double-sided managers for outside end of data racks. Provide 10" wide double-sided managers for installation between two data racks.
b. 70” x 6” x 16.6” (6” wide), 70” x 10” x 17.5” (10” wide).
c. 38 rack units.
d. Steel mid panels and splice plates and plastic sides. Covers on 6” wide shall be plastic, the covers on 10” shall be steel with plastic hinges.
e. Four vertical sections with T-shaped cable guides spaced 1 ru apart.
f. Four mid panels with attachment points for cable management accessories.
g. Two splice plates used to assemble the top and bottom side sections.
h. Four half-height covers that snap onto the T-shaped cable guides.

i. Color shall be black.

j. 6” Wide Vertical Wire Manager

1. Products:

1. Chatsworth Velocity Double-Sided - #13912-703
2. Panduit –#PRV6
    a) Center mount Bracket Kit #WMPVCBE
3. Or Approved Equal

k. 10” Wide Vertical Wire Manager:

a. Products:

1) Chatsworth Velocity Double-Sided - #13914-703
2) Panduit-#PRV10
3) Or Approved Equal

B. Horizontal-19” width”:

a. 3.47"H x 19"W x 9.75"D.

b. Snap on rear cover.

c. Cable management for front and rear.

d. 2 rack units.

e. Plastic construction.

f. Front cover hinge shall open 180 degrees up or down.

g. Curved surfaces.

h. Pass-through holes for front to rear cabling.

i. Built in cable retainers.

j. Products:

1. Panduit - #NCMH2
2. Or Approved Equal

2.10 POWER STRIPS:

A. UL Listed.

B. 19” rack mounted.

C. 20 amps.

D. 120V, 1.9kW

E. 8 NEMA 5-20R rear outlets.

F. 15’ service tail with 5-20P

G. Breakered

H. Power switch

I. One rack unit

J. One 20a power strip to be installed at the bottom of each data rack or enclosure.

K. Products:

a. Geist-#VSSL084-152R20,

b. Or Approved Equal

2.11 GROUNDING:

1. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
2. Telecommunications Main Bus Bar shall be provided by the EC.
3. Rack mount ground bus bar provided by the SC as denoted on the plans.
4. Provide horizontal rack mounted ground bus bars on each telecommunications rack that the SC is providing.
5. Products:

a. CPI - #10610-019

b. Or Approved Equal

2.12 UNIVERSAL CABLE RUNWAY:

A. Ladder Rack and Accessories installed in telecom or security rooms):

1. 3/8" x 1-1/2" x.065" wall rectangular steel tubing.
2. Cross members welded at 12" intervals.
3. 12" and 18” width, unless otherwise noted.
4. To be supported every 3'.
5. Runway elevation kits shall be provided to enable securing to top of data racks.
6. Runway installed along perimeter of Telecom or Security Rooms shall be secured to walls utilizing triangular support brackets sized for the runway being installed.

7. All material parts are not listed or illustrated in the Contract Documents. Contractor responsible for acquiring all parts and materials required for a complete runway system.
8. Black in color.
9. Runway.
    a. Products:
        1. CPI 12" Wide Black Universal Ladder Rack - #10250-712,
        2. Or Approved Equal
        3. CPI 18” Wide Black Universal Ladder Rack - #10250-718,
        4. Or Approved Equal
10. Runway Support:
    a. Products:
        1. CPI 12” Wall Mount Triangular Support Brackets - #11746-712,
        2. Or Approved Equal
        3. CPI 18” Wall Mount Triangular Support Brackets - #11746-718,
        4. Or Approved Equal
11. Equipment rack to runway mounting plates:
    a. Products:
        1. CPI - #10595-712,
        2. Or Approved Equal
        3. CPI - #13730-718,
        4. Or Approved Equal
12. Runway over rack elevation kits 6”:
    a. Products:
        1. CPI - #10506-706,
        2. Or Approved Equal
13. Concrete mounting kit for equipment racks:
    a. Products:
        1. CPI - #40604-001,
        2. Or Approved Equal

2.13 BACKBOARDS:

A. Telecommunications/Security Rooms - Plywood, fire-retardant treated 3/4" x 48" x 96" A-C Grade, unpainted with A side facing outward. Comply with requirements for plywood backing panels specified in Architectural specifications.

PART 3 - EXECUTION

3.1 HORIZONTAL DISTRIBUTION CABLING:

A. Horizontal cabling is installed in a star topology.

B. Bridged taps and splices are not permitted as part of the horizontal cabling.

C. All connectivity products such as patch panels & data jacks shall be of the same manufacturer (see approved products list above).

D. All cables inside buildings shall be plenum rated. Cables routing to the exterior of buildings shall be rated for Outside Plant applications.

E. Contractor shall install all cabling according to latest industry standards, manufacturer's recommendations & best practices. Cabling shall be installed in an orderly & neat manner. Cables shall be installed parallel and perpendicular to building lines.

F. Horizontal cables shall terminate to the closest Telecommunications/Security Room IDF or designated cross connect area on the same floor as designated in the Construction Documents.

G. Horizontal copper cable links shall not exceed 275 feet. If the Security Contractor discovers any copper cable run exceeding this length, the Security Contractor shall contact the designer and coordinate the best course of action to reduce the length of cable.

H. UTP cable shall be installed so that there are not bends smaller than 4 times (4x) the cable's outside diameter at any point in the cabling run and the termination area. If cables are kinked or the cable jacket is damaged during construction project, the cable will be removed and replaced with new cable at no additional cost to the Owner.

1. Confirm all bend radius requirements with the manufacturer.

I. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a 4-pair UTP cable.

J. A pull cord (nylon; 1/8 inch minimum) shall be co-installed with all cable installed in any homerun conduit & conduits exceeding 1" in diameter

K. Cable raceways shall not be filled greater than the TIA/EIA 569 maximum fill for the particular raceway type or 40%.

L. Where transition points or consolidation points are required, they shall be located in accessible locations & housed in an enclosure intended and suitable for the purpose. Coordinate with the AHJ (authority having jurisdiction) on acceptable locations and further requirements in order for the installations to be accepted for required inspections.

M. Slack Required:

1. Telecommunications Room – 10-feet minimum

2. Field Equipment Locations – 20-feet minimum

N. Electrical contractor shall provide all raceways including conduit, outlet boxes, and sleeves, UON.

a. Contractor shall coordinate with electrical contractor to ensure all pathways intended for the SC are installed according to the contract documents and best aid the SC in his work.

b. Conduit sleeves shall align with cable tray when walls need to be penetrated to allow a continuous cabling pathway.

O. Cable trays are to be installed by the electrical contractor.

1. 18" cable trays with 1 divider are to be provided. The tray shall be divided in a 12" section and a 6" section.

2. SC to coordinate with EC and all other disciplines with their work in the location of the cable trays prior to its installation.

3. A minimum of 12" clearance above the tray and 36" clearance to access the tray from one side is required at all times.

a. Water piping is not allowed to route above the tray. If this is unavoidable due to the constraints of the ceiling space, a drip pan with installed drains must be installed under the piping in order to protect the cables from water damage.

1) This requirement will not be required where there are no joints in branch piping less than 2" in diameter that do not have any joints in the pipes 2' from the top of the cable tray dimensioning from each side of the tray.

b. The data, voice, wireless and catv cables shall occupy the larger section of the partitioned cable tray.

c. Intercom, video surveillance, access controls and security cables shall occupy the smaller section of the partitioned cable tray.

d. Mechanical controls cable shall not be installed in the cable tray, nor be supported by the cable tray or the cable tray supports.

e. Electrical conductors are not allowed to be routed in the tray or be supported by the cable tray. They shall not be routed parallel within 12" of the tray due to susceptibility of EMI.

f. Duct work and mechanical piping shall not obstruct the tray and must leave the tray accessible throughout its routing.

P. Non-continuous hangers and supports

1. Provide non-continuous hangers and supports from cabling exiting conduits to the cable trays.

2. Installation of hangers shall abide by current industry standards and manufacturer recommendations.

3. Install where cables, conductors, nor jackets will be damaged.

4. Do not bend cables, in handling or in installing to smaller radii than minimums recommended by the manufacturer.

5. Follow manufacturer's and industry standards for allowable fill capacity for each hanger or support.

6. Provide support 4'-5' on center.

7. Route parallel and perpendicular to building lines.

8. All hangers and supports shall be secured to structure and must be tied off at the bottom. If tying to existing ceiling grid, these support wires must be tagged or painted and must be distinguishable from the ceiling grids support wires.

9. Groom cables with in supports with tie-wraps.

10. No more than 12" of cable sag is allowed between supports.

Q. The ceiling cable support throughout most of the facility will be accomplished by utilizing open areas above ceilings & cable trays when available.

    1. If cable trays or sleeves are available, the Security Contractor (SC) must use the cable trays and sleeves as their pathway, if sleeves and open ceiling pathways are full the contractor is responsible for the addition of additional sleeves where required, unless the SC has received formal approval from the Designer.

    2. All penetrations through fire-rated walls or floors must be sleeved.

        a. Contractor to support cabling no greater than 2' prior to entering a sleeve and no greater than 2' after existing a sleeve.

    3. In areas where support structure is not available, cables will be supported with metallic J-brackets at regular intervals of 4' to 5'.

    4. Cables may only be supported by building structure when the cable spans do not exceed 5 foot intervals.

    5. Cables SHALL NOT be supported on top of walls, I-beams, or in areas where the cable is susceptible to damage or EMI.

    6. Cables shall not be attached to ceiling grid or light fixture wires. At no point shall cable(s) rest on acoustic ceiling grids or panels.

R. There shall be a minimum of 3 inches of clearance between the cable support system and the ceiling tile support grid.

S. No cables shall run exposed. In areas of no accessible ceiling & where a pathway is not being provided by others the Contractor shall provide the pathway. The pathway shall be EMT conduit in common areas; or wiremold metallic raceway in classroom/office areas. SC shall provide all necessary sleeving of walls & floors where sleeves or openings are not existing.

T. All equipment & materials installed in plenum environment shall be UL rated acceptable for plenum environments.

U. Horizontal distribution cables shall be bundled in groups of no more than forty (40) cables. Cable bundle quantities in excess of 40 cables may cause deformation of the bottom cables within the bundle & degrade cable performance. This includes cable bundles supported in J-hooks.

V. Cable shall be installed above fire-sprinkler systems & shall not be attached to the system or any ancillary equipment or hardware. The cable system & support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes or other control devices.

W. Contractor must ensure that TIA/EIA recommended minimum separation distances are maintained between the newly installed cabling & high-energy sources that may interfere with data transmission. Cables shall never come into contact with any ceiling grids, lighting sources, or any devices that emit EMI.

X. Firestopping.

1. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating items - i.e. riser slots & sleeves, cables, conduit, cable tray, raceways that are specifically designated for the security cabling infrastructure – shall be properly firestopped. The contracting discipline installing the sleeve or slot shall be responsible for sealing the area on the exterior of the sleeve or slot. The Contractor shall be responsible for firestopping the interior annular area.

    a. Provide temporary closure at termination of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15 psig hydrostatic pressure.

2. Firestop systems utilized shall be dictated by this project's Professional Electrical Engineer's UL design. If a PE UL design is not available, the Contractor shall provide appropriate UL design for penetrations through rated walls and properly firestop penetrations. These documents shall be submitted to the Designer.

Y. Cables routing under slab or outside shall be rated outside plant & provide water blockage. Upon entering the building & exiting the conduit, the outdoor cable shall be transitioned to a plenum rated cable. This will be accomplished by placing transition points within 50-feet of the cable's entry into the building.

Z. Provide over voltage protection on both ends of cabling exposed to lighting or accidental contact with power conductors.

3.2 SECURITY ROOM (SR) / CROSS CONNECT AREA – IDF:

A. Data Racks:

1. Contractor to utilize existing telecom racks when space is available. A minimum of 6U spaces shall remain open and unused for the owner's future equipment. Contractor to provide additional wall mounted racks / enclosures when necessary.

2. Data racks/enclosures contained within the SR and shown on the Construction Drawings are for the purpose of providing a base installation requirement in each cross connect area and for the Contractor to perform take offs for their cost estimating.

3. All additional racks to be provided by the Contractor shall be heavy duty EIA compliant, 19-inches wide. Rack height & location shall be coordinated with the Owner. Racks shall have a black finish. Side channels shall be drilled & tapped on both sides.

4. All new wall mounted racks shall be mounted on Contractor provided ¾" fire-rated plywood.

    a. New racks shall be anchored to type of wall being installed on with proper rack mount hardware from the rack manufacturer and approved for the rack installation environment.

5. Unused rack equipment mounting screws shall be bagged & attached to the racks upon completion of the project.

6. All new racks & enclosures shall have a horizontal grounding bus bar installed at the top of each rack. See section 3.2D, Grounding and Bonding, below.

7. All existing racks and enclosures shall be provided with a new grounding bus bar and grounding to building steel if existing racks do not have proper grounding. If the data/IDF room does not have a ground bus bar then the contractor shall provide a 6" pre-drilled ground bus bar with grounding to building steel.

8. Coordinate all placements of new racks with Owner.

B. Cable Management:

1. Horizontal Wire Management shall be provided and utilized by the Contractor. The system provided shall be comprised of equipment to manage cables on both the front & rear of the rack. The Wire Management shall protect network performance by controlling bend radius & providing cable strain relief.

2. All cable management channels shall have covers.

3. Horizontal Wire Managers shall be placed above & below each new patch panel.

4. D-Rings shall be metallic & used in areas of the Security Room or electrical room where cables are not supported by cable runway or cable tray. The D-Rings shall be minimum size of 4-inches. The Contractor shall be responsible for determining quantity and placement of D-Rings at strategic points throughout these areas.

C. Plywood Backboards:

1. If additional wall mounted racks are required & there is no existing fire-rated plywood at the proposed rack location, Contractor shall provide new 3/4" fire retardant plywood with fire-rated stamped band on plywood facing outwards. Plywood is to remain unpainted.

2. 3/4" fire retardant plywood shall be installed vertically for the ability to mount the rack/enclosure on the plywood.

D. Grounding and Bonding:

1. Grounding shall be installed per NEC, J-STD-607-A and manufacturer's grounding requirements as minimum

2. If there is no existing ground bus bar in the room where new racks/enclosures are to be installed, Contractor shall provide a new 6" ground bus bar.

    a. Provide conductor to bond the ground bus bar to building steel. Size conductor per TIA guidelines.

3. Bond and ground equipment racks with a #6 AWG stranded green insulated conductor. #12 AWG stranded insulated green conductor shall be used to bond surface mounted metallic raceways. However, in plenum areas, the grounding conductor shall be a bare, solid conductor for all grounding applications.

4. Provide horizontal rack busbar at the top of each new rack / enclosure. Connect rack bus bars to wall mounted bus bar via home-run stranded #6 AWG stranded green insulated conductor.

E. UTP Cable Termination Hardware:

1. Each horizontal cabling run will be terminated using appropriate connectors or connecting blocks depending upon the cable type.

2. Horizontal networked cables will be terminated on new modular patch panels installed in the rack / enclosure which are specifically designated for security.

3. Cables shall be dressed & terminated in accordance with recommendations made in the TIA/EIA 568-B standard, manufacturer's recommendations & industry standards.

4. Pair untwist at the termination shall not exceed .5"

5. Bend radius shall not exceed 4 times (4x) the outside diameter of cable.

6. Splitting the pairs prior to termination is not acceptable.

7. Cables shall be neatly bundled & dressed into their respective panels. Each panel shall be fed by an individual bundle separated & dressed back to the point of cable entrance into the rack or frame.

8. The cable jack shall be maintained as close as possible to the termination point.

9. Each cable will be clearly labeled on the cable jacket behind the patch panel. Labels shall be machine printed & clearly visible within the bundle.

10. 4-pair Category 6 UTP cabling shall be terminated onto a 4-pair Category 6 module. All modules shall be terminated using the T568B (B) wiring scheme. The eight position module shall exceed the connector requirements of the proposed TIA/EIA Category 6 standard.

11. Modular Patch Panels shall be of the manufacturer & part number as listed in these specifications. The patch panels shall accept the Category 6 jacks specified. Mount patch panels in the data racks. Cables shall be neatly groomed with Velcro Integral cable ties. Port & panels shall be easy to identify with write-on areas. Patch panels shall be completely populated with jacks.

    a. Modular patch panels shall be the angled type.

12. Copper patch cords.

a. Provide and install patch cords for connection from ceiling mounted outlet box to ceiling mounted security equipment cross connect.

1. Contractor to plug the correct length of patch cord into the patch panel only. The other end will be left unconnected for Owner to provide the final connections to the Owner network electronics.

2. Patch cords shall be onsite no later than two (2) weeks prior to when IP connectivity is needed to occur.

3. Provide 10% spare patch cords of each needed length for Owner's future use. Turn these over to the Owner prior to close out.

b. Provide patch cords for connections from patch panels to Owner provided switches. Do NOT install. Submit patch cords to Owner two (2) weeks prior to project completion.

c. Provide 10% spare patch cords of each needed length for Owner's future use.

13. See labeling section of these specifications for labeling requirements.

14. Refer to Risers for locations of Patch Panels.

15. Security equipment shall not use the last 6 free rack units in the data racks. If no more than 6 rack units of free space is not available in the data racks, then the Security Contractor shall provide additional racks. Locations of additional racks will be coordinated on site with the Owner and Owner's IT department prior to installation.

3.3 WORK AREA OUTLETS:

A. Cables slack shall be coiled in the near the access control panel or IP device neatly coiled and properly supported via j-hooks in areas of accessible ceilings. In areas where there is no ceiling and the area is open to structure, contractor shall coil the slack in junction boxes. In either case, the cable coil shall not exceed the bend radius or be secured where the cable is kinked, or the cable jacket is deformed in any way.

B. Copper cables pair untwist at the termination shall not exceed .5".

C. Bend radius limitations shall be observed at each termination point.

D. The cable jacket shall be maintained to as close as possible to the termination point.

E. Copper UTP cables shall be terminated on a white RJ45 jacks. All RJ45 jacks shall meet or exceed the TIA/EIA-568-B.2-1 standard for Category 6.

3.4 IDENTIFICATION AND LABELING:

A. All cables, patch panels, ports, grounding conductors & junction boxes shall be labeled with self-adhesive printed labels. Cables shall be labeled on each end. Refer to TIA/EIA 606 and Owner requirements to coordinate labeling schemes. Font size on labels shall be consistent throughout the facility. Label placement on face plates shall be consistent throughout facility. Font size shall be as large as possible yet still functional for the item being labeled.

B. All labels shall be black lettering on white labels.

C. Labels shall be placed 6" from the termination point on each end of the cables. Labels shall be clearly visible during construction & after construction is completed.

D. The label for the security field equipment cabling shall be as follows:

1. CR#-TR#(IC#)-S-##-A-12 where "CR# school courier number, "TR#" or "IC#" designates the Telecom Room (telecom, electrical room, etc); "S##" designates security equipment number; "A" designates the patch panel; "12" designates the port number on the patch panel (match telecommunications labeling for patch panel and port numbers.

E. The label for the patch panel will be located on the face of the patch panel and will be tagged for 'Security' and alphabetical in order from top to bottom, "Security A", "Security B", etc. The security patch panel port will also be labeled with the MAC address of the associated IP device.

F. The label for the rack will be TR or TR-1, TR-2, etc., indicating "TR" or "IC" telecommunications room, "1", "2", etc indicates the number of the security room cross connect area.

3.5 TESTING:

A. The Owner reserves the right to test all delivered goods, and to use a portion of any goods before the results of the tests are delivered, without prejudice to any final adjustments, rejecting the unused portion of the delivery, and making payment on an adjusted basis for the used portion. The cost of inspections & tests of any item, which fails to meet the advertised specifications, shall be borne by the contractor.

B. All cables and termination hardware shall be 100% tested for defects to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA 568-B and 526-14A. The field test equipment shall meet the requirements of ANSI/TIA/EIA 568-B.

C. Test each copper pair & shield of each cable for opens, shorts, grounds and pair reversal. Correct grounded and reversed pairs. Examine open & shorted pairs to determine if problem is caused by improper termination.

D. Testing equipment shall be calibrated prior to testing. (Calibration results from the manufacturer are required in the Close Out Document submittal for each tester used on the project.)

E. Test results shall be submitted within ten (10) days of the completion of each testing phase.

F. When repairs & re-tests are performed, the problem found & corrective action taken shall be noted, and both the failed and passed test data shall be documented and included in the final close-out documents.

G. The Designer and/or Owner may request that at 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Test shall be a repeat of those defined above. If findings contradict the documentation submitted by the Contractor, additional testing can be requested to the extent determined necessary by the Designer and/or Owner, including a 100% re-test by outside agency. This re-test shall be at no additional cost to the Owner.

H. Copper Permanent Link Testing

1. Perform testing of copper cables with tester meeting ANSI/TIA/EIA 568 requirements.
2. If horizontal cables contain bad conductors or shield, remove & replace cable. "*Pass" results will not be accepted.
3. Continuity – Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs.
    a. Shielded / screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturer's recommended procedures, and referenced to the appropriate cable identification number & circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
4. Length – Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA 568-B standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. This documentation shall be in a sequential format. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.
5. Category 6 Performance:
    a. Follow the Standards requirements established in ANSI/TIA/EIA 568-B-1.
    b. A level III test unit is required to verify category 6 performance.
    c. Required tests:
        1. Wire Map.
        2. Insertion Loss.
        3. Length.
        4. NEXT loss, pair to pair, measured from local end.
        5. NEXT loss, pair to pair, measured from far end.
        6. NEXT loss, power sum, measured from local end.
        7. NEXT loss, power sum, measured from far end.
        8. Return Loss, measured from local end.
        9. Return Loss, measured from far end.
        10. ELFEXT, pair to pair.
        11. ELFEXT, power sum.
        12. Propagation Delay.
        13. Delay skew.

14. ACR.

15. Power Sum (PSACR).

I. Horizontal testing results are to be presented in electronic format.

J. Tests are to be performed utilizing the graphic chart option on the cable tester. Test results will not be accepted without graph representation.

3.6 SYSTEM DOCUMENTATION AND OWNER ACCEPTANCE:

A. The Contractor shall maintain at the site, one (1) record copy of all Contract Documents in good order & marked currently to record all changes made during construction; and shall also maintain at the site copies of approved shop drawings, product data operation and maintenance.

B. The final inspection by the Designer and/or Owner shall be the closure of all previously listed punch list items.

C. The Completion Date of Project is defined as the date that all documentation obligations have been met under the Construction Documents and these specifications.

D. The final inspection by Building Standards shall be the closure of required Electrical Permits.

E. Upon completion of the installation, the Contractor shall provide electronic files of all Close Out Document materials.

F. Close-Out Document Submittal:

1. Electronic files.

a. The test results shall include a record of test frequencies, cable type, conductor pair and identified in the same format required in the "Identification and labeling" section of this specification, measurement direction, reference setup, and crew member name(s). Results shall have all cables sequentially listed. The test documents shall detail the test method used & the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

1. Copper Test Results (Permanent Link).

2. Copper Test Summary (Single Line).

3. Copper Test Detail for each cable.

4. Patch panel logs in editable electronic format.

2. Draft (marked up) as-built drawing submitted may be requested by the Owner within 30 days of the Completion Date of Project.

3. Calibration Sheets in PDF format – Include test equipment name, manufacturer, model number, serial number, software version and last calibration date. Submit sheets for each tester being used for the project.

4. Patch Panel Log in PDF and Excel format – Labeling shall be consistent with the "Identification and Labeling" section of this specification.

5. Electrical Permit Inspection Detail – PDF format.

6. Final As-Built Drawings:

    a. Submitted drawings shall be neat, clear and professionally produced. Do not place text over objects where the label indicator cannot be deciphered. Use care to keep the test size consistent throughout the drawings. Do not use colored ink to distinguish between symbols or lines. Provide another symbol or line type designation to represent different components. Any final as-built drawing will be subject to rejection if the Designer and/or Owner find the information on the drawings unclear.

    b. Final drawings shall indicate all horizontal cable routes. They will also indicate final outlet locations labeled according to the "Identification and Labeling' section of this specification. Indicate final pathway locations and final locations of all equipment. Use a different line-type for each type of cable installed.

    c. Include a legend on the first sheet indicating line-type of each cable, and any additional symbols the Contractor has added.

    d. Format shall be PDF and .dwg.

7. Provide facility assignment records which include patch panel logs and as-built C size (11"x22") in a laminated protective cover at each Security Room location that is specific to the facilities terminated therein.

8. Warranty Information:

    a. The Contractor shall guarantee all equipment, wiring and software for this system to be free of defects in workmanship & material for a period of one (1) year from the date of acceptance by the Owner.

    b. The Contractor shall provide a minimum period of twenty (20) years manufacturer's warranty on materials & equipment. Any manufacturer's warranty that may exceed a twenty (20) year period shall also be provided through the Contractor.

    c. Warranty service by the Contractor shall include eight (8) hour emergency response service during normal contractor working hours; and twelve (12) hour emergency response service after normal contractor working hours, on weekends and on holidays. Response time shall be measured from the time of Contractor notification to the arrival of service personnel at the affected site to initiate repairs. The Contractor shall provide a method of requesting emergency service after normal working hours, on weekends, and on holidays appropriate to the required response time.

    d. The Owner shall be presented with the horizontal cable materials warranties no later than ninety (90) days after project completion.

3.7 SITE CLEAN UP:

A. All areas where work is conducted, shall be cleaned up on a daily basis.

3.8 SECURITY/IT/TELECOM ROOM CLEAN UP:

A. All room locations must be broom and/or vacuum swept. This includes the space between the racks & the trough between the base footprint of the rack.

B. All data racks and enclosures shall be wiped clean.

C. All cabinet locations must be broom and/or vacuum swept. This includes the bottom space of the cabinet.

END OF SECTION

SECTION 281600 - INTRUSION DETECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Intrusion detection with communication links to perform monitoring, alarm, and control functions.
   2. Integration of other electronic and electrical systems and equipment.

1.3 DEFINITIONS

A. PIR: Passive infrared.

B. RFI: Radio-frequency interference.

C. UPS: Uninterruptible power supply.

D. Control Unit: System component that monitors inputs and controls outputs through various circuits.

E. Master Control Unit: System component that accepts inputs from other control units and may also perform control-unit functions. The unit has limited capacity for the number of protected zones and is installed at an unattended location or at a location where it is not the attendant's primary function to monitor the security system.

F. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.

G. Protected Zone: A protected premises or an area within a protected premise that is provided with means to prevent an unwanted event.

H. Standard Intruder: A person who weighs 100 lb or less and whose height is 60 inches or less; dressed in a long-sleeved shirt, slacks, and shoes.

I. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.

J. Systems Integration: The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.

K. Zone. A defined area within a protected premise. It is a space or area for which an intrusion must be detected and uniquely identified. The sensor or group of sensors must then be assigned to perform the detection, and any interface equipment between sensors and communication must link to master control unit.

1.4 ACTION SUBMITTALS

A. Product Data: Components for sensing, detecting, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.
   1. Raceway Riser Diagrams: Detail raceway runs required for intrusion detection. Include designation of devices connected by raceway, raceway type and size, and type and size of wire and cable fill for each raceway run.
   2. UPS: Sizing calculations.
   3. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables inside and outside the building. Include room layout for master control-unit console, terminal cabinet, racks, and UPS.
   4. Master Control-Unit Console Layout: Show required artwork and device identification.
   5. Device Address List: Coordinate with final system programming.
   6. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
   7. Details of surge-protection devices and their installation.
   8. Sensor detection patterns and adjustment ranges.

C. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
   1. Data for each type of product, including features and operating sequences, both automatic and manual.
   2. Master control-unit hardware and software data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association and Manufacturer.
2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
3. Certified Bosch Commercial Intrusion Certification and G Series Certification.

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. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with SIA CP-01.

D. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
1. Altitude: Sea level to 4000 feet.
2. Master Control Unit: Rated for continuous operation in an ambient of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
3. Interior, Controlled Environment: System components, except master control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambients of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
4. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambients of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
5. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambients of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Comply with UL 294 and UL 639 for outdoor-use equipment. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 24 inches thick.
6. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings shall be rated, listed, and installed according to NFPA 70.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENT REQUIREMENTS

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.
   1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits." Based on Ditek DTK-3GTP or equal.
   2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731. Based on Ditek DTK-2MHLP series or equal.

B. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.

C. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.

D. Tamper Protection: Tamper switches on detection devices, control units, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Master control-unit alarm display shall identify tamper alarms and indicate locations.

E. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to master control unit.

F. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to master control unit as an alarm signal.

G. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to master control unit.

H. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at master control unit for calibration, sensitivity, and alarm condition.

2.2 ENCLOSURES

A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.

B. Interior Electronics: NEMA 250, Type 12.

C. Exterior Electronics: NEMA 250, Type 4X, fiberglass.

D. Corrosion Resistant: NEMA 250, Type 4X, PVC.

E. Screw Covers: Where enclosures are readily accessible, secure with security fasteners of type appropriate for enclosure.

2.3 SECURE AND ACCESS DEVICES

A. Basis of Design Products: Subject to compliance with requirements, provide the following or a comparable product approved by Architect prior to bid:
1. Bosch Security Systems, Inc., with individual components as follows:
a. Control Panel: Bosch B9512G.
b. POPEX Module: Bosch B299.
c. POPEX Module: B600.
d. POPIT Module: Bosch 9127U (one per point).
e. POPIT Cabinet: Bosch D8103.
f. Interface output relay: B308
g. B444 Conettix Plug-in Cellular Communicator
h. B444 V Plug-in cell module, Verizon LTE

B. Power Supply: Provide the following:
1. Power Charger: Altronix AL600ULXB.
2. Cabinet.
3. 7AH backup battery.
4. Radionics D101 lock.
5. Power supply and 3-wire line cord with three-prong plug to connect to receptacle.

C. Keypad and Display Module: Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data. Basis of design is Bosch B942 key pad, recess mounted. This is the minimum level of quality required.

2.4 DOOR AND WINDOW SWITCHES

A. Basis of Design Products: Subject to compliance with requirements, provide the following or a comparable product approved by Architect prior to bid:
1. Glass Break Detector: Bosch Detection Systems, Inc. ModelDS-1103i, DS-1102i;DS-1101i; all devices shall be the same type throughout the project.
2. Door Contacts: Interlogix/United Techologies 2505a, surface mounted, wide gap, armored.

B. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of three encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.

C. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.

D. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounted magnet and floor-mounted switch unit.

2.5 PIR SENSORS

A. Basis of Design Products: Subject to compliance with requirements, provide the following or a comparable product approved by Architect prior to bid:
   1. Wall Mounted:
      a. Short Range Applications: Bosch Detection Systems, Inc. Model ISC-CDL1-W15G, wall mounted, broad coverage 50 by 50 feet. 8’ to 9’ AFF recommended installation height.

2.6 Long Range Applications: Bosch Detection Systems, Inc. Model DS778, wall mounted, long range coverage, 200 by 15 feet. 8’ AFF recommended

2.7 PIR SENSORS

A. Basis of Design Products: Subject to compliance with requirements, provide the following or a comparable product approved by Architect prior to bid:
   1. Wall Mounted:
      a. Short Range Cone coverage Applications: Bosch Detection Systems, Inc. Model ISC-CDL1-W15G, wall mounted, broad coverage 50 by 50 feet. 8’ AFF recommended installation height.
      b. Long Range Cone coverage Applications: Bosch Detection Systems, Inc. Model DS778, wall mounted, long range coverage, 200 by 15 feet. 8’ AFF recommended installation height.
   2. Ceiling Mounted:
      a. Full Room Applications: Bosch Detection Systems, Inc., 360° PIR Motion DS 939 , 360 degree, 46’ diameter coverage. Mounting height from 9’ to 20’.
      b. Short Range Cone coverage Applications: ISC CDL1-W15G with universal ceiling bracket. Mount in ceiling tile, not higher than 9 feet above finished floor.
      c. Long Range Cone coverage Applications: DS778 with universal ceiling bracket. Mount in ceiling tile, not higher than 9 feet above finished floor.

B. Listed and labeled by a qualified testing agency for compliance with SIA PIR-01.

C. Description: Sensors detect intrusion by monitoring infrared wavelengths which have been broken by a mobile object or body moving within the protected zone and by being sensitive to changing wavelength variations.

D. Device Performance:
   1. Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps across two adjacent segments of detector's field of view.
   2. Test Indicator: LED test indicator that is not visible during normal operation. When visible, indicator shall light when sensor detects an intruder. Locate test enabling switch under sensor housing cover.

2.8 MASTER CONTROL UNIT

A. Basis of Design Products: Subject to compliance with requirements, provide the following or a comparable product approved by Architect prior to bid:
   1. Bosch Security Systems, Inc.

B. Description: Supervise sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.
   1. 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.
   2. Include a real-time clock for time annotation of events on the event recorder and printer.
   3. Addressable initiation devices that communicate device identity and status.
   4. Control circuits for operation of mechanical equipment in response to an alarm.

C. Comply with UL 1076.

D. Console Controls and Displays: Arranged for interface between human operator at master 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: LCD, one line of 16 characters, minimum.
   2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
   3. Control-Unit Network: Automatic communication of alarm, status changes, commands, and other communications required for system operation. Communication shall return to normal after partial or total network interruption such as power loss or transient event. Total or partial signaling network failures shall identify the failure and record the failure at the annunciator display and at the system printer.
   4. Field Device Network: Communicate between the control unit and field devices of the system. Communications shall consist of alarm, network status, and status and control of field-mounted processors. Each field-mounted device shall be interrogated during each interrogation cycle.
   5. Operator Controls: Manual switches and push-to-test buttons that do not require a key to operate. Prevent resetting of alarm, supervisory, or trouble signals while alarm or trouble condition persists. Include the following:
      a. Acknowledge alarm.
      b. Silence alarm.
      c. System reset.
      d. LED test.
   6. Timing Unit: Solid state, programmable, 365 days.
   7. Confirmation: Relays, contactors, and other control devices shall have auxiliary contacts that provide confirmation signals to system for their on or off status. Software shall interpret such signals, display equipment status, and initiate failure signals.
   8. Alarm Indication: Audible signal sounds and an LED lights at master control unit identifying the protected zone originating the alarm.
   9. Alarm activation sounds an exit or entry tone at keypad to only tell operator when to exit after arming system or disarm upon entry.
   10. Upon alarm activation, system shall be programmed for a one-minute delay egress before system is set.
   11. System shall have an output to BAS that is used for lighting control. See BAS specification for sequence of operations.
   12. Provide an undercounter push button "panic button" to transmit a supervisory alarm indicating distress requiring local law enforcement.

E. Protected Zones: Quantity of alarm and supervisory zones as indicated, with capacity for expanding number of protected zones by a minimum of 25 percent.

F. Power Supply Circuits: Master control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.

G. System shall be provided with a 12V battery back-up feature.

H. Cabinet: Lockable, steel enclosure arranged so operations required for testing, normal operation, and maintenance are performed from front of enclosure. If more than a single cabinet is required to form a complete control unit, provide exactly matching modular enclosures. Accommodate all components and allow ample gutter space for field wiring. Identify each enclosure by an engraved, laminated, phenolic-resin nameplate. Lettering on enclosure nameplate shall not be less than 1 inch high. Identify, with permanent labels, individual components and modules within cabinets.

I. Transmission to Monitoring Station: A communications device to automatically transmit alarm, supervisory, and trouble signals to the monitoring station, operating over a standard voice grade telephone leased line. Comply with UL 1635.

J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

K. Cellular dialer option.

2.9 SECURITY FASTENERS

A. Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.

B. Drive System Types: Pinned Torx-Plus; pinned Torx; or pinned hex (Allen).

C. Socket Flat Countersunk Head Fasteners:
1. Heat-treated alloy steel, ASTM F 835.
2. Stainless steel, ASTM F 879, Group 1 CW.

D. Socket Button Head Fasteners:
1. Heat-treated alloy steel, ASTM F 835.
2. Stainless steel, ASTM F 879, Group 1 CW.

E. Socket Head Cap Fasteners:
1. Heat-treated alloy steel, ASTM A 574.
2. Stainless steel, ASTM F 837, Group 1 CW.

F. Protective Coatings for Heat-Treated Alloy Steel:

1. Zinc chromate, ASTM F 1135, Grade 3 or Grade 4, for exterior applications and interior applications where indicated.
2. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

2.10 CABLE

A. Place wire marker number placed at each termination point.

B. Two conductor, 18AWG stranded, non-shielded, twisted (with a minimum of 6 twists per foot) cable with a mid capacitance (35 Pico-farads per 100 foot), CL3, CM cable. Overall jacket color will be oyster white. Plenum if required.
1. Wire colors green and yellow.
2. Green and white conductors are for loop side wiring only.

C. Two conductor, 18AWG stranded, non-shielded, twisted (with a minimum of 6 twists per foot) cable with a mid capacitance (35 Pico-farads per 100 foot), CL3, CM cable. Overall jacket color will be oyster white. Plenum if required.
1. Wire colors red and black.
2. Red and black conductors are for power wiring only.

D. Four conductor, 18AWG stranded, non-shielded, twisted (with a minimum of 6 twists per foot) cable with a mid capacitance (35 Pico-farads per 100 foot), CL3, CM cable. Overall jacket color will be oyster white. Plenum if required.
1. Wire colors will be red, black, green and white.
2. See color coding above.

E. Underground cable: Four-conductor, 18AWG stranded, non-shielded, and twisted cable, rated for direct burial.

2.11 PANIC BUTTON

A. Basis of design: HUB series DPDT latching actuator or approved equal.

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 intrusion detection.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.

D. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.
1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.

2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.

E. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SYSTEM INSTALLATION

A. Comply with UL 681 and NFPA 731.

B. Equipment Mounting: Install master control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
1. Comply with requirements for seismic-restraint devices specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
1. Comply with requirements for seismic-restraint devices specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

D. Connecting to Existing Equipment: Verify that existing perimeter security system is operational before making changes or connections.
1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the Supervising Station.
3. Expand, modify, and supplement existing monitoring equipment as necessary to extend existing monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

3.3 WIRING INSTALLATION

A. Wiring Method: Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters. Conceal pathway and cables except in unfinished spaces.
1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
2. Install plenum cable in environmental air spaces, including plenum ceilings.
3. Comply with requirements for pathways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

B. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible. Device wiring shall be homeruns from each respective device. Daisy chaining of devices are only permitted for door contacts grouped on a double door..

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Wires and Cables:
   1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.
   2. 120-V Power Wiring: Install according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
   3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable unless otherwise indicated or if manufacturer recommends shielded cable, according to Section 28 05 13 "Conductors and Cables for Electronic Safety and Security."

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

G. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with identification requirements in Section 26 05 53 "Identification for Electrical Systems."

3.5 GROUNDING

A. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.

B. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

C. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5-ohm ground. Measure, record, and report ground resistance.

D. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Section 28 05 26 "Grounding and Bonding for Electronic Safety and Security."

3.6 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
   1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."
   1. Inspection: Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.
   2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."

E. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."

F. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.7 ADJUSTING

A. 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 visits to Project during other-than-normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the intrusion detection system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training."

END OF SECTION

SECTION 282300 – IP-BASED VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: IP-based video surveillance system including the following components:

1. NVS Cameras with Lens, Housings, and Mounts.
2. Network Video System.
3. System Keyboard Controller.
4. NVS Wiring and Cable, including Fiber Optic Systems where specified.
5. Complete branch circuit wiring system for the NVS System including receptacles, outlets and final connections to equipment.
6. Remote viewing and control from CMS security center and any SRO/Principals office via internet access.
7. Integration of other electronic and electrical systems and equipment.

B. Related Requirements:

1. Section 282310 "Video Surveillance Cabling."

1.3 PRECONSTRUCTION CONFERENCES

A. Preconstruction Conference: Scheduled with Owner's Representative to coordinate with CMS Electrical Department for additional information on camera and Genetec Software programming. Provide additional programming including changes to the specified settings as a result of this conference, which are to be considered part of the requirement of this Section.

1.4 ACTION SUBMITTALS

A. Product Data: For all products, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes, at a minimum but not all inclusive:

1. Genetec Server.
2. Hardware, and recording space calculations required (must show all calculations and state which software you used for the calculations).

B. Camera Information:

a. Number and type of each camera.

b. Low and High Resolution of each camera.

c. Megapixel of each camera.

d. Frame rate of each camera.

e. Key Frame interval.

f. Image quality settings of each camera.

g. MBPS Recording Stream (x) number of cameras.

2. Camera Mounts.

3. Detailed description of programming and settings.

C. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

1. Raceway Riser Diagrams: Detail raceway runs required for the video surveillance system. Include designation of devices connected by raceway, raceway type and size, and type and size of wire and cable fill for each raceway run.

2. UPS: Sizing calculations.

3. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables inside and outside the building. Include room layout for master control-unit console, terminal cabinet, racks, and UPS.

4. Master Control-Unit Console Layout: Show required artwork and device identification.

5. Device Address List: Coordinate with final system programming.

6. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.

7. Details of surge-protection devices and their installation.

8. Video unit detection patterns and adjustment ranges.

D. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.

E. Samples for Initial Selection: For units with factory-applied color finishes.

F. Samples for Verification: For each type of exposed finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1. Technician certifications

2. Company Certifications

a. Security Center 5.x Omnicast™ (video) technical certification SC-OTC-001

b. Security Center 5.x AutoVu fixed technical certification SC-AFC-00

c. Security Center 5.x Enterprise (advanced) technical certification SC-ETC-001

3. Company North Carolina Electrical Low Voltage license

4. Company North Carolina Security/Burglar Alarm License.

5. List of public-school experience & completed two or more public schools similar of size & complexity in North or South Carolina in the last three (3) years. Include reference contact information.

6. Project roster of technicians and staff assigned to the project

7. Insurance certificates.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For video surveillance system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Data for each type of product, including features and operating sequences, both automatic and manual.

2. Master control-unit hardware and software data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. The Prime Contractor shall be regularly engaged or partner with sub-contractors that are regularly engaged in providing security equipment and security related services and shall have been engaged in such work for a period of not less than three years prior to bid submittal.

2. The Prime Contractor or their sub-contractor performing the majority of the security system installation work shall, at the time of the bid, hold an Alarm Systems Business License issued by the State of North Carolina Department of Justice to perform security

work within the state. Contractors who have security licenses or permits pending may not be considered acceptable for bidding on this project. All personnel employed by this contractor shall be registered with the appropriate North Carolina Licensing Board as provided for by current state statutes. Each Contractor submitting a bid for this project shall include a copy of his current Alarm System Business License.

3. The contractor shall be prepared, upon award for the work to provide CMS a criminal background check for each person employed to perform security work on this project. Each criminal background check shall cover all places of residence for the previous seven years and shall be performed within the previous six months. Criminal background checks may be performed by a state or local agency or by a private company specializing in such work.

4. The Contractor shall provide the name, location, and contact information for three similar projects in scope and size within the last 5 years.

5. Contractors performing the work in the supply, installation or programming of video equipment shall be factory authorized dealers for the manufacturer of the equipment and systems provided. Documentation of this authorization shall be provided at the time of bid.

6. The Contractor shall demonstrate the qualifications of the project manager assigned to this project.

7. The Contractor or sub-contractor responsible for cabling shall have a Low Voltage Wiring License issued by the NC Board of Examiners of Electrical Contractors and any other certifications as designated in the cabling specification.

8. Contractor will designate an overall project manager and a project manager for each specific site that will be the points of contact.

9. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.

10. Genetec equipment must be a certified Genetec dealer/installer.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Altitude: Sea level to 4000 feet.

2. Master Control Unit: Rated for continuous operation in an ambient of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.

3. Interior, Controlled Environment: System components, except master control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambients of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.

4. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambients of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.

5. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambients of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Comply with UL 294 and UL 639 for outdoor-use equipment. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 24 inches thick.

6. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings shall be rated, listed, and installed according to NFPA 70.

1.9 WARRANTY

A. System Warranty: Installer's standard form in which Installer agree to repair or replace components of video surveillance devices and equipment that fail in materials or workmanship or installation labor within specified warranty period.

1. System Warranty Period: Two years from date of Substantial Completion.

a. Include one: six-month preventative maintenance visit plus miscellaneous preventive maintenance as required during this two-year period.

b. Items repaired under this provision shall have an extended warranty period of 12 months beginning with the acceptance of the repair. The Contractor shall replace all portions that fail because of faulty materials or workmanship at no cost to CMS including material, labor, tax freight and freight. The contractor shall be notified of any defects and immediately repair them.

2. Equipment manufacturers shall guarantee products repairable/direct replacement for a minimum of five years.

3. VMS Software Provider shall include 5 years' software support and maintenance with 24-hour, 36- day onsite and offsite support for the VMS solution. 5-year licensing. 5-year licensing needs to be applied from point of installment to April 2029.

4. Camera Warranty: Three-year comprehensive warranty exclusive of physical/lightning damage to include advanced replacement on all cameras.

5. Warranty service by the contractor shall include eight-hour emergency response during normal weekends and holidays. Response time shall be measured from the time the contractor is notified to the time of arrival of service personnel at the affected site to initiate repairs. The contractor shall provide a method of making these repair requests. At the time of bid, the contractor will provide a description of how the propose to execute this provision.

6. 24-hour 365-day maintenance no charge Technical Support for the cameras. With a 90 day no charge, return policy.

1.10 COORDINATION

1. All work under this Section shall be coordinated with other trades to ensure proper location of outlets and equipment connections, and to minimize conflicts with structural members, duct work, piping, etc.

2. Coordinate with the CMS Electrical Division for the proper contractor that holds the maintenance service contract for the CMSPD Enterprise Federation System. This contractor shall coordinate all requirements to the Enterprise Federation Contractor to make a fully functional and complete operational federation system for offsite monitoring. Any offsite monitoring issues shall be worked out between the two contractors at no additional cost to the owner.

PART 2 - PRODUCTS

2.1 FUNCTIONAL DESCRIPTION OF SYSTEM

A. The Campus VNS shall provide the following minimum operational features:

1. Reception Building 6600- 27-inch LED 1080P TV 240hz, table top mounted with dual power outlet behind monitor.

2. From the keyboard, the user can control camera/monitor switching, and multiplex screen functions, and presets and preset recalls. Initial system set-up shall be 4x4 viewing on each monitor. Viewing monitor will be connected to a new MCS provided workstation (mounted on back of the monitor) with Windows 10 software.

3. NVS Equipment Rack(s) with 1: 17-inch playback monitor, utilizing an open application programming interface (API) software development kit (SDK) supporting seamless integration with third-party applications.

4. Multi-server video surveillance solution: Recording of video from up to five servers, each with up to 64 IP cameras, and selected digital video recorders (DVRs). ONVIF S: Supports ONVIF S- compliant cameras and devices.

5. Outdoor Type Stationary Cameras (see floor plans for number): This fully compliant implementation of H.264 (MPEG 4, Part 10) providing full megapixel resolution at full video frame rates.

   a. The dome camera line provides an all-in-one solution with remote focus, remote zoom, and true mechanical day/night cut filter and IP66 and IK-10 vandal resistant dome enclosure. With the features of ONVIF S compliance, privacy masking, extended motion detection and flexible cropping, a high sensitivity, PoE (IEEE 802.3af) compliant camera with optional IR LEDs. Cameras to include all connectors, transmitters, receivers, power supplies, heaters, mounts, etc. necessary for a complete and operable system.

6. Indoor Stationary Cameras (see floor plans for number): Recessed ceiling or wall mounted housing with WDR (Wide Dynamic Range) network camera fully compliant implementation of H.264 (MPEG-4, Part 10) providing full megapixel resolution at full video frame rates as specified.

a. The dome camera line provides an all-in-one indoor ball shape solution with integrated WDR full HD camera, 3~9mm or 9~22mm IR corrected lens options true mechanical day/night cut filter and tamper resistant housing. With the features of ONVIF S conformance, privacy masking, extended motion detection and flexible cropping, a high sensitivity, PoE (IEEE 802.3af) compliant, day/night light gray dome camera. Cameras to include all connectors, transmitters, receivers, power supplies, heaters, mounts, etc. necessary for a complete and operable system.

b.

2.2 MANUFACTURER

A. All systems and components shall be provided with the availability of a toll free 24-hour technical assistance program (TAP) from the manufacturer. The TAP shall allow immediate technical assistance for both the equipment Supplier/Contractor and the end user at no charge.

B. The following equipment manufacturers produce equipment or components which are included in these specifications; or which are approved for use by CMS. Products and manufacturers for the following equipment shall be limited to the following unless specifically stated otherwise elsewhere:

1. Video Surveillance Head End Equipment

a. Video Management Solution (VMS/NVS) – Genetec server purchased from Genetec and preloaded with Genetec software version must be the same version as the Federation(verify Security Release upon purchase and Federation compatibility) Head End Equipment shall be sized based on camera quantity and future projected expansion. Camera types listed below must be compatible with listed version and software release.

6600 Building –

1. Directory Server - (1) SV-2011E-R6S-D480-236 Streamvault 2011E Appliance series Rackmount 1U (1) Xeon E-2236 16 (2) 1GbE RJ45 (0) - (2) 480GB 2.5 hot-plug SSD (2) 350W PSU, Windows Server IoT Standard 2019, no RAID, 5YR NBD KYH

2. Server – (1) SV-2011E-R14-120T-12-210 Streamvault 2011E series - 2U 14 Bay Streamvault Appliance 120TB (1) Xeon Silver 4210 16GB RAM (2) 240GB M.2 SSD (10) 12TB SATA Archivers

6635 and 6623 building (each) –

1. Directory Server – none.

2. Server – (1) SV-2011E-R4-48T-12-236 Streamvault 2000E Appliance - 1U 4-Bay Streamvault Appliance 48TB (1) Xeon E-2236 16GB RAM (2) 240GB M.2 SSD (4) 12TB SATA HDD Servers

C. The NVS software shall run on a Genetec certified/provided server and communicating over Ethernet network using the TCP/IP network protocol. The proposed solution shall not require proprietary computer hardware.

2.3 PERFORMANCE REQUIREMENTS

A. Statutory and Reference Standard Compliance: The following latest editions of the industry standards are the basis for the structured cabling system described in this document. The standards listed shall be adhered to in the same manner as if they were codes.

1. Requirements of authorities having jurisdiction.

2. TIA – Telecommunications Industries Association.

a. Articles 526, 568, 569, 606, 607, TSP-149.

3. BICSI – Building Industry Consulting Service International.

a. Telecommunications Distribution Methods Manual.

b. Cabling Installation manual.

c. Customer-Owned Outside Plant Design manual.

4. NFPA – National Fire Protection Association.

1) NFPA 70, National Electrical Code (NEC).

2) National Life Safety Code.

5. American with Disabilities Act and accessibility requirements of authorities having jurisdiction.

6. ETL - Electrical Testing Laboratories.

7. UL – Underwriters Laboratories.

8. NEMA – National Electrical Manufacturers Association.

9. Division 26 / Electrical Specifications.

10. Standard Industry Practices.

B. If there is a conflict between applicable regulatory industry standards, and then the more stringent requirements shall apply. The Contractor has the responsibility to determine and adhere to the latest editions when developing the proposal for installation.

C. All Electronic Equipment and materials are all to be UL standard testing, listing and labels shall be listed and labeled by UL or other agency that is acceptable to the AHJ and the State of North Carolina approved 3rd party testing agencies. This can be found on state constructions website.

D. Provide server configuration and upon hardware and recording calculations based on camera type, megapixel type, frames per second, and recording space for 30 days. Base system configuration must meet or exceed following minimum requirements to properly size each server per school site.

E. Camera Information:

1. Number and type of each camera.

2. Low and High Resolution of each camera.

3. Megapixel of each camera.

4. Frame rate of each camera.

5. Key Frame interval.

6. Image quality settings of each camera.

7. MBPS Recording Stream (x) number of cameras.

F. Remote streaming out MBPS (x) number of cameras:

1. Minimum of 30-day recording space.

2. Broadband consideration: Coordinate broadband usage with CMS IT Department.

G. System Recording Stream Requirements:

1. All cameras to record 24/7, 15 fps per camera, with 30 days of storage.

H. Provide alarm event management.

I. The NVS shall provide a Windows based GUI (Graphical User Interface). The NVS shall provide operation on multiple VGA monitors connected to a single PC using standard hardware and software.

J. The NVS shall automatically restart and resume recording in response to recovery from a power failure or other unexpected shutdowns.

K. 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.

L. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with SIA CP-01.

M. Comply with NFPA 70.

N. All video surveillance cameras and devices shall be ONVIF S™ compliant.

2.4 SYSTEM COMPONENT REQUIREMENTS

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits."

2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.

2.5 NETWORK VIDEO SYSTEM DESCRIPTION

A. This section includes the requirements and operational characteristics for a Network Video System, which is an integral part of the Security Control System.

1. Network Video System Servers.

2. Video Storage equipment.

3. Client Computers.

4. Computer provided by the Video Surveillance contractor, for the reception security monitor.

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 for a seamless control, programming and future flexibility. Provide programming and settings listed below:

1. Integration of the NVS with the GUI system to allow GUI operators to provide manual camera call up, automatic camera call-up and display of live video in a designated area on the GUI monitors.

2. Digital video recording of all the cameras in the CCTV system.

3. Configuration, viewing of recorded images, and ability to record incidents to DVD-R disc and export to external drive.

4. Provide Genetec Mapping Programming.

5. Provision of client computers loaded with the NVS 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.

i. Execution of system macros.

2.6 CLIENT COMPUTER INTERFACE

A. General: NVS Client Computers are existing CMS-owned computers running current Windows OSProvide 5 8 client software packages for Owner's designated computers. Coordinate with the Owner for the functionality or user access for each workstation and the workstation location. The keyboard and monitor located in the server rack (surveillance head-end) shall be directly connected to the server and shall provide administrative/maintenance functions. Designated client computers shall provide the administrative user interface for the system, enabling the definition and configuration of various system aspects.

~~1.~~ Contractor will need to set up GENETEC client logins to associate with CMS's Active Directory if acclimatable at time of installation.

2.7 GENETEC

A. User accounts of the 5 for Middle schools and Elementary schools 8 for High school's client packages:

1. Genetec Directory Server 5 total client users for CMSPD, CMS admin, 3 surveillance contractors.

2. (8) user accounts

3. SRO and camera Associates Office monitor set up (Provided by the Video Surveillance Contractor see plans for location.

B. List of Genetec user accounts CMS Admin, CMSFED, Contractor1, Contractor2, Contractor3, School admin user, Front monitor, SRO, and Camera AssociateNVS Client Software

1. Each CMS owned computer shall be fitted with the most recent up to date Genetec Security Center software and shall match the Genetec server software.

2. Security Center limited feature access:

a. The NVS 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 NVS 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, 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 NVS client applications shall provide an authentication mechanism, which verifies the validity of the user.

d. The Client Monitor application shall allow for live monitoring/playback of video ONLY SRO CAN EXPORT VIDEO THIS FEATURE MUST BE SET TO DENY FOR ALL OTHER STAFF USER ACCOUNTS.

e. The NVS Monitor application shall allow operators to view an instant replay of any camera.

f. The NVS 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.

g. The NVS Monitor application shall display all camera sequences created in the system. The NVS Monitor application shall allow for unlimited cameras sequences, which can be run independently of each other on either digital VGA monitor tiles or analog CCTV monitors.

h. The NVS 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.

i. The NVS Monitor application shall display all cameras, sequences, and analog monitors in a logical tree. The NVS 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 NVS 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.

j. In addition to the typical tree structure the NVS monitoring application will be provided with a mapping structure whereby a sites layout will be imported graphically as a.dwg,.pdf,.jpg etc.

k. The NVS 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.

l. The NVS Monitor application shall support digital zoom on a fixed camera's live video streams.

C. Genetec Mapping requirements:

a. Camera symbols and associated links to be superimposed on in such the clicking on or hovering over a camera symbol will immediately cause display of the live video from that camera and direct access to recorded video.

b. Convert the AutoCAD file to the bitmap/pdf format with the camera locations placed over the top of the designer's cameras. When placing cameras try to cover up as much of the camera possible from the designers or if you have AutoCAD place the cameras then freeze the designer cameras before you create the final bitmap/pdf to avoid concern over the cameras overlapping.

c. Each camera shall have the hovering feature that when you click on the camera a camera view with the description shall become available.

d. Camera view.

e. Camera description: Carrier #/Camera #/Room description.

f. Status online/offline.

g. Type fixed if there is an option of 180/360.

h. The camera shall be white in color in active mode but if there is an error with the camera the symbols shall default to red.

i. The mapping screen shall be to the right with the camera tree to the left of the screen simultaneously. If you click on the tree camera list, the active mapping camera should highlight as if you were clicking the camera on the mapping.

j. Associated intrusion devices/zone for each camera. Integration with Intrusion detection system. Intrusion panels should be connected to the network and added to Genetec software. For example: all exit doors should have the first motion detection unit closest to the door associated with the nearest 4 cameras. Contact CMS Surveillance Project Manager for clarification.

k. Designer responsibility:

1) Provide AutoCAD drawings with everything stripped out except for cameras and for any text that would be required to identify what the camera is focusing on i.e.: exterior camera should state (bus parking lot) (front door) (etc.).

2) This plan should have everything else taken off of it for the contractor to use for their bitmap/pdf.

3) Provide a true north arrow on each sheet so it is visible on the document.

D. Genetec License

a. Genetec Federation License contractor to provide: GSC-1SCFED with system ID: GSC-141002-368384.

2.8 HIGH RESOLUTION COLOR MONITORS

A. Contractor will provide:

a. Front Office 6600 – (3) 17-inch table top monitors and mounts.

B. Provide 1: 17-inch rack mount console monitor with keyboard and mouse. Provide with KVM cable kit to allow for PS/2 computer or KVM switch connection. Provide a PS/2 to USB adapter. Provide with front and back mounting kit for additional slide out support (for Head End Server Display).

1. Tripplite B021-000-17.

2. Emerson LCD17.

3. Approved Equal.

2.9 VANDAL-RESISTANT NETWORK DOME CAMERA

A. Equipment Manufacturer List: The following equipment manufacturer product equipment or components which are included in these specifications; or which are approved for use by CMS, Products & manufacturers for the following equipment shall be limited to the following unless specifically stated otherwise elsewhere.

1. Interior/Exterior Fixed: Preferred and or latest version compatible with the latest version of Genetec

a. Axis M3265-LVE indoor/outdoor fixed (4MP)

b. Hanwha Techwin – QNV-8080R Series Indoor/outdoor fixed (5MP).

c. Pelco Sarix Enhanced Domes 3 Series

2. Interior/Exterior PTZ (verify with CMS project manager for use with existing site):

~~a.~~ Hanwha SNP-5321

b. Axis – P5655-E PTZ indoor/outdoor.

c. Pelco - Spectra Professional IR 4K 20x Series

3. Interior (4) channel 360 2MP minimum multi-sensor/image flexible positioning:

a. Axis P3727-PLE.

b. Hanwha Techwin PNM-9002VQ

4. Exterior (4) channel 360 2MP minimum multi-sensor/image flexible positioning:

a. Axis P3727-PLE

b. Hanwha Techwin PNM-9084RQZ1

5. Exterior (4) channel 360 multi-sensor/image flexible positioning.

a. Axis 3719 PLE. Preferred for exterior locations.

b. Hanwha Techwin PNM-9085RQZ1

B. Cameras must work with the CMS provided Cisco switches used for the PoE supply of the cameras that utilizes Cisco Discovery Protocol. Any camera listed above must meet the criteria or be provided with a software update prior to bidding the project. Any software update not available will result in the camera not being approved and the contractor will be forced to use one of the listed alternative camera manufacturers at the contractor's expense. The only approved external injector is the Altronix Netway16. External PoE must be approved by the CMS construction team and will not be allowed in conjunction with a non-approved camera. This is a non-manageable unit.

C. TYPE 1 - Camera Specifications for Indoor 3MP – Minimum Performance:

1. 3-5 Megapixel effective CMOS image sensor.
2. Progressive scan.
3. Resolution: 2048X1536.
4. Minimum illumination Color: .065 lux
5. Video frame rate up to 30fps @ 2048x1536.
6. Compression type H.264 (MPEG, Part 10), Motion JPEG.
7. 10/100Base-TX
8. Power over Ethernet (PoE): PoE 802.3af
9. Easy 3-axis adjustments.
10. Tinted Dome.
11. True Wide Dynamic Range.
12. Must be compatible with Genetec Video System software.
13. Camera must have remote focus option.
14. Camera must have embedded analytics.

D. TYPE 2 - Camera Specifications for Outdoor 3MP – Minimum Performance:

1. 3-5 Megapixel effective CMOS image sensor.
2. Progressive scan.
3. Resolution: 2048X1536.
4. Minimum illumination Color: 0.065lux.
5. Video frame rate 30fps @ 2048x1536.
6. Compression type H.264 (MPEG, Part 10), Motion JPEG.
7. 10/100Base-TX
8. Power over Ethernet (PoE): PoE 802.3at for camera.
9. Die-cast aluminum chassis with 4” polycarbonate dome bubble, IK-10 rated.
10. Tinted Dome.
11. True Wide Dynamic Range.
12. Must be compatible with Genetec Video System software.

13. Easy 3-axis adjustments.

14. Rated IP66 for water and dust protection, operating temperature -20^{0}C (-4^{0}F) to +60^{0}C (140^{0}F), Humidity 0% to 90% (non-condensing).

15. Camera must have remote focus option.

E. TYPE 3 - Camera Specifications for Interior 360 (4)-2MP at 30 fps per channel or 4-2MP/5MP muti-sensor multi-directional camera,.

1. 360-four channel camera with varifocal camera heads.

2. 4X1080p capture mode.

3. Compression type H.264 (MPEG, Part 10), Motion JPEG

4. Camera must have remote focus option.

5. Power over Ethernet (PoE): PoE 802.3at for camera.

6. Must be compatible with Genetec Video System software.

7. Easy 3-axis adjustments.

8. Tinted Dome.

9. True Wide Dynamic Range.

10. 30fps.

11. 10/100Base-TX

F. TYPE 4 — Camera Specifications for outdoor PTZ – (Must be CMS project manager approved.)

1. The indoor/outdoor network positioning dome system shall be a discreet camera dome system consisting of a dome drive with a variable speed/high speed pan/tilt drive unit with continuous 360 rotation; 1/4-inch-high resolution color, monochrome, or color/black-white CCD camera; motorized zoom lens with optical and digital zoom; auto focus.

G. 2. The indoor/outdoor network positioning dome system shall provide Auto Tracking to detect and track movement in the camera's field of view. When the Auto Tracking behavior is configured, the system will automatically pan and tilt to follow the moving object until object stops or disappears from the monitored area.

H. 3. IP66 rated.

I. 4. Camera Must have Remote Focus Option.

J. 5. PTZ camera must be compatible with viewing saving, ptz motion settings, presets and manual controls with Genetec viewing software.

K. TYPE 5 - Camera Specifications for Exterior 360 (4)-2MP at 30 fps per channel or 4-2MP/5MP muti-sensor multi-directional camera.

1. 360-four channel camera with varifocal camera heads.
2. Rated IP66 for water and dust protection, operating temperature -20^{0}C (-4^{0}F) to +60^{0}C (140^{0}F), Humidity 0% to 90% (non-condensing).
3. Camera must have remote focus option.
4. Must be compatible with Genetec Video System software.
5. 4X1080p capture mode.
6. Compression type H.264 (MPEG, Part 10), Motion JPEG.
7. Power over Ethernet (PoE): PoE 802.3at for camera.
8. Easy 3-axis adjustments.
9. Tinted Dome.
10. True Wide Dynamic Range.
11. 30fps.
12. 10/100Base-TX.

L. TYPE 6 - Camera Specifications for Exterior 360 15MP, Degree Panoramic View (Basis of design).

1. 360-four channel camera with varifocal camera heads.
2. Rated IP66 for water and dust protection, operating temperature -20^{0}C (-4^{0}F) to +60^{0}C (140^{0}F), Humidity 0% to 90% (non-condensing).
3. Camera must have remote focus option.
4. Must be compatible with Genetec Video System software.
5. 4X1080p capture mode.
6. Compression type H.264 (MPEG, Part 10), Motion JPEG
7. Power over Ethernet (PoE): PoE 802.3at for camera.
8. Easy 3-axis adjustments.
9. Tinted Dome.
10. True Wide Dynamic Range.

11. 30fps.

12. 10/100Base-TX.

M. All cameras that come equipped with pre terminated patch cables are to be plenum rated. Non plenum pre-terminated connections will not be accepted, no exceptions.

N. All cameras are to be provided with plenum rated back box if the camera itself is not rated for plenum.

O. All cameras shall come with the latest firmware/software upgrade to date. Provide firmware upgrades from camera ordering to end of warranty.

P. All exterior fiber supplied cameras shall have POE injectors and not use the POE from switch. Mount POE injectors near switch located in respective data room. All exterior cameras located at stadium and parking lot areas shall have POE injectors at camera location that are fiber supplied.

2.10 CAMERA INTERFACE PROGRAMMING

A. See cameras above for additional Camera Resolution settings sections.

B. Under the 2nd round of baseline recording settings, establish camera type and different location setting to determine the optimal start and stop recording of each camera device. All final settings are to be recorded on a printout and turned over to CMS electrical department for final review and acceptance.

C. A pre-construction meeting must be scheduled with CMS Electrical Department for additional information on camera and Genetec Software programming. Once this pre-construction meeting is completed. Contractor shall include all programming in their bid price. Additional programming costs will not be accepted.

2.11 CABLING AND CONNECTORS

A. See 28 23 10 Video Surveillance Cabling Specifications for cabling information. If there is a specification section 27 00 00 included in the bid package all parts and pieces supersede the 28 23 10 section for all equipment and cabling.

B. All accessory components under Section 28 23 00 are part of the requirements of this Section.

2.12 MOUNTING BRACKETS

A. All mounting brackets are based on Pelco brand; see Manufacturer’s section for approved equivalents.

B. Exterior dome wall mounted devices shall utilize PP450 bracket.

C. Exterior dome (fixed and PTZ’s) corner mounted devices shall utilize CM400 bracket along with IMW-GY arm to extend 14” from corner of wall.

D. Interior dome shall be ceiling mounted devices shall utilize IS50-FK bracket.

E. Interior dome wall mounted devices shall utilize SWM-SR series brackets.

F. Interior dome pendant mounted devices shall utilize IS50-P. When using this device provide transition from 1-1/2" opening to conduit size stated on the drawings.

G. Interior dome surface mounted pendant device shall utilize C10-UM and/or EM1000U. When using this device provide the proper back box at the ceiling for proper and secure mounting.

H. All 180-degree cameras must have a minimum of 20deg. Angle bracket to eliminate ceilings if the camera is wall mount type only. (See Samsung 180-degree wall mounting bracket.)

I. All exterior brackets are to have proper weatherproof requirements, seals and gaskets provided to make a completely sealed system not to allow water into the camera thru the bracket/conduit entry.

2.13 MISCELLANEOUS EQUIPMENT

A. Camera Surge Protection: Provide SPD protection for all power, data and control lines for camera mounted external to the building. These devices are to be mounted 10' away from the camera unit. Units to be installed per the manufacturer's recommendations.

1. All SPD's will be assured to be properly connected to a true earth ground.

2. If the building does not have a true earth ground a new ground rod shall be installed directly below the camera with 1/2 inch IMC conduit to below earth for ground connection.

3. Each exterior camera shall have a ground terminal above the ceiling next to the surge device and shall have a minimum of #10gnd. From the surge to the bar and from the bar to the ground rod then also shall have #12 from camera to ground bar.

4. If the interior building does not have steel framing to ground to or near a water pipe, then the provide a ground wire all the way back to the rack or provide an exterior ground rod on the outside of the building.

5. Provide all surge devices that are not above 120v . All devices above 120v are specified under Division 26; coordinate with electrical Installer.

6. Cameras mounted on wooden poles will be provided with a 10'x/3/4" copper ground rod driven near its base. A section of pipe will be strategically driven adjacent to the ground rod to protect it from lawn mowers.

7. For the Power at exterior cameras (pole mounts) if required will require a Ditek #DTK-TSS4D or approved equivalent.

8. Refer to 28 23 10 Video Surveillance Cabling Specification for additional information.

9. Power Protection (for 120v security circuits):

10. DTK-TSS4D (provide for receptacle circuit that feeds the rack power/equipment) provide 1 for each 120v circuit. Mount on wall directly behind the rack next to receptacle.

11. DTK-TSS4D (provide for power at exterior power poles for media converter 120v power protection.)

12.

B. Outdoor Poles:

1. Certain outdoor cameras such as for certain mobile classrooms may be designated as being pole mounted.

2. As part of their scope of work the integrator will supply these poles unless existing poles may be utilized.

3. Unless otherwise noted on the contract documents the poles are to be 30’ wooden telephone poles.

   a. Pressure Treated Southern Pine Pole.

   b. All Wood Poles shall meet the requirements of ANSI Specifications for Wood Poles 05.1.

   c. The Penta preservative used in treatment shall conform to the requirements of AWPA Standard P8.

   d. All Poles shall be pressure treated in accordance with the requirements of AWPA C1 and C4. Minimum final retention of Penta shall be 0.45 lb. /cu. ft. by assay.

   e. All poles shall be inspected at the manufacturing plant by an independent inspection company.

   f. Framing to be RUS M-20.

   g. CCA Treated Wood Poles are approved as an equal.

4. 130 MPH wind code to be reflected for lighting components only, and not applicable to wooden poles.

5. All poles will be direct bury type and the earth shall be compacted to manufacturer’s specifications and tested; submit test results.

6. A locator service will be required to mark the site where the pole is to be buried. Damage to any existing underground services will be at this Installer's expense to repair back to a new state and fully operational. Methods of repair must be acceptable to Owner.

C. UPS

1. APC SMX1500RM2UCNC or comparable. Must have rack mounted power strip in server rack. All head end equipment must be plugged into UPS and then into wall outlet.

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 video surveillance.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of video surveillance connections before video surveillance installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.

D. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.

2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.

E. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SYSTEM INSTALLATION

A. Installation of system shall be performed under the supervision of NVS system technicians experienced in the installation, operation, testing, and servicing of the type of system being installed.

B. Camera Directory: camera number and cable number, input number must match. Provide durable number labels on each camera housing, visible from ground level, and on each cable. Camera name & number must be programmed to NVR/Server starting with School courier number-camera number. Contractor must coordinate with Principal on naming of cameras. Camera number and common name (as determined during installation) shall be present on all display(s) interfaces within the system. Coordinate the owner for exact camera naming and numbering scheme prior to installation and configuration.

C. Cables: Refer to 28 23 10 Video Surveillance System section for additional information.

D. Grounding: Ground new NVR equipment in strict accordance with the manufacturer’s recommendations and per NEC requirements. Assure metal camera housings and outside camera mounting structures are securely grounded.

E. Voltage: Supply power to equipment at the voltage indicated on the drawings. Coordinate the equipment voltages, the control equipment wiring and the location and type of disconnect required to comply with the equipment manufacturer’s requirements, NEC, and applicable local building codes. If equipment is supplied at a voltage other than that provided, make any necessary adjustments to correct the conflict, at no cost to the Owner, to the satisfaction of

the Electrical Engineer. 120V power to the video system headend and to all camera power supplies shall be on dedicated circuits.

F. Rack and Equipment: Rack to be located in a manner that allows easy access to rear connections for service. All cabling must be dressed neat for CMS Project Manager approval PC VGA and large monitors to be located such that they can all be viewed by system operator.

G. Supports: All supports shall be installed to the satisfaction of the AHJ. Refer to 28 23 10 section for additional information.

H. Equipment: Installed components will be color compatible and shall be installed in keeping with the manufacturer's recommendations. All components shall be installed as indicated in the design documents and result in the views indicated. Any conflicts noted during the installation process will be immediately brought to the attention of the CMS project manager and Engineer of record for immediate resolution.

I. Views: Acceptable views will be confirmed during the testing/quality assurance phase. Costs required to achieve the final acceptable views prior to final camera view selection and then again during resetting after bandwidth information is furnished by CMS.

J. CMS Information System Connection: As stated elsewhere, cameras will be cabled to patch panels in the data closets and patch cables provided, but not hooked up. Coordinate with the CMS Information Systems Department in the actual connections to the network switches and assignments of the IP addresses.

K. While working in existing school conditions. All work must be done between the time of issuance of the integrator's contract and this opening of schools in such a manner as to not interfere with the schools' daily operations. Refer to Section 003113 for more information.

3.3 WIRING INSTALLATION

A. Wiring Method: Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters. Conceal pathway and cables except in unfinished spaces.

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

2. Install plenum cable in environmental air spaces, including plenum ceilings.

3. Comply with requirements for pathways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

B. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Firestopping: Refer to requirements of Section 078413 "Penetration Firestopping."

E. Wires and Cables:

1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.

2. 120-V Power Wiring: Install according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable unless otherwise indicated or if manufacturer recommends shielded cable, according to Section 28 05 13 "Conductors and Cables for Electronic Safety and Security."

4. Data and Television Signal Transmission Cables: Install according to Section 282310 "Video Surveillance Cabling."

F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

G. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

H. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 GROUNDING AND BONDING:

A. Grounding shall conform to ANSI/TIA/EIA J-STD-607 Commercial Building Grounding and Bonding Requirements for Telecommunications; NFPA 70 Article 250 for types, sizes & quantities for equipment grounding conductors; unless specific types, larger sizes or more conductors than required by NFPA 70 are indicated. Also coordinate with manufacturer's grounding requirements as minimum.

B. For insulated conductors & connections, comply with Division 26 05 26 Specifications, Grounding and Bonding.

C. Bond & ground equipment racks, housings, messenger cables, ladder racks, metallic raceways and armored fiber with a #6 AWG stranded green conductor. #12 AWG stranded green conductor shall be used to bond surface mounted metallic raceways. However, in plenum areas, the grounding conductor shall be a bare, solid conductor for all grounding applications. Coordinate with Electrical Installer. Electrical Installer will bond or ground all pathways provided by Electrical Installer.

D. Route along shortest & straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact or may damage the ground.

E. Security systems/racks shall be grounded to the existing main telecommunications bus bar. If no bus is present, provide a new telecommunications bus bar and ground/bond all existing racks that are not properly grounded/bonded.

F. Refer to 28 23 10 Video Surveillance Cabling Specification for additional information.

G.

3.5 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."

1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

2. Test Methods: Video surveillance systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."

E. Testing shall be done in accordance with the equipment manufacturer’s instructions and also as listed below by the owner. Tests shall include as a minimum a functional test of all equipment. The final test will be performed in the presence of the installation alarm technician.

F. At the individual sites completion Supplier’s Technical Representative, local school staff, CMS technical staff and CMS contracted technical personnel will review:

G. Quality of the installation/compliance with the specification.

H. The aim and focus of all cameras and assure the desired views have been obtained.

I. Functionality of the system.

J. Designated local users are trained and their monitoring systems setup to their satisfaction.

K. All remote functions are fully operational such as fail-over; viewing and operation by CMSPD and maintenance, password rights administration, camera and server failure reporting etc. are functional.

L. Local documentation provided.

M. As-Built information provided to the designers and a mounted 30x42 framed copy of the updated site map posted at the head end equipment wall.

N. Overall system documentation provided to CMS Building Services.

O. Refer to 28 23 10 Video Surveillance Cabling Specification for additional information.

P. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."

Q. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

R.

3.6 SYSTEM PROGRAMMING/OWNER TRAINING

A. Provide the development, loading and checking of the software and databases for the complete and proper operation of the systems involved. Provide most current type and revision of required software. When licensing of the software is required, the license shall be assigned to CMS, unless specifically prohibited by the software manufacturer. Licenses will not be tied to the camera's MAC address such that there shall be no additional licensing requirements for replacement of a failing camera. Provide a copy of the software on electronic media to CMS prior to system acceptance.

B. Prior to performing the programming, coordinate with CMS and shall obtain CMS' specific programming requirements and/or assist in the determination of setting those requirements.

C. System software development shall include (but not limited to) all items necessary to provide proper system operation and shall include (but not be limited) to the following:

1. Assignment of new devices to the system.

2. Assignment of new inputs and outputs to the system.

3. Necessary time and day interval programming.

4. Motion detection configuration for each camera at the camera and not on the server.

5. Recording frame rates for each camera.

6. Alarm message generation programming.

7. Camera naming, viewing tree, viewing arrays, and viewing GUI setup.

8. Any view client programming.

9. Password/security structure setup:

Set up for Genetec workstations, front monitor, and security desk user accounts.
Front monitor is to be provided by the contractor and have latest version of Security Desk (compatible with Federation's version) installed on it. Out of the box the mini pc should be set up with two Genetec windows logins so that CMS Surveillance Project Manager and staff can access computers until CMS IT images them the way they need to.
Windows temporary logins should be as followed…

Username=admin
Password admin
Username=monitor (tape info on back of wireless keyboard)
Password=monitor

If more complexed logins are needed, then relay the information to the clients and to John Medellin
Sro Genetec workstations to be provided by the contractor also have temporary windows logins and are as followed…

Username=SRO
Password=Security1!

Security associates Genetec workstations to be provided by the contractor also have temporary windows logins and are as followed…

Username=Security
Password=Security1!

10. Let CMS Surveillance Project Manager know when you are complete with front monitor workstation and Genetec workstations so they can be schedule for IT image.

D. Owners Training shall include but not limited to:

1. At each site program training for operating personnel shall be a minimum of 3 hours.

2. All designated users at each site will be trained in the operation of their system and a training log provided to the CMS project management team. This will include viewing of cameras, settings up of custom viewing arrays, video search and playback procedures video, mapping, LPR License Plate Recognition cameras and restarting the system in the event of a shutdown.

3. In addition to the training level provide to local staff, CMS central staff will receive additional training in:

   a. Maintenance and care of the complete system.

   b. Setup and programming of all user adjustable feature of the complete system.

   c. Overall advice and the limitations on system issues like bandwidth, video storage capabilities, etc.

   d. Genetec Mapping program training regarding Security desk.

3.7 DOCUMENTATION AND COMPLETION OF WORK

A. Operation and Maintenance Manual: Upon completion of the installation and testing, provide the Owner with three (3) instruction manuals for the operation, installation, and maintenance of the system. Manuals shall be bound in hardback binders and shall include recommended

spare parts lists and vendors, troubleshooting guides, and maintenance instructions and recommended servicing periods. A telephone number for the service and repair organization for the system shall be included in the binder. It shall also include:

1. Operating instructions specific to the installation.

2. Device nomenclature.

3. Device placement.

4. Step-by Step directions for routine maintenance of the system.

5. Descriptions of all components.

6. Parts list by name/model/number/manufacturer/etc. and parts cut-sheets.

7. It shall also include service and maintenance manual for each component and troubleshooting guides.

8. A final list of all Installers involved in the specific installation including company names, foreman, address, and phone numbers.

9. Provide a chart of all network connected devices that includes device number, model number, serial number, address including IP, gateway, subnet and data drop including rack, switch and port numbers.

B. Maintain at the site one record copy of all contract drawings, specifications, addenda, change orders and other modifications, in good order, and marked currently to record all changes made during the construction and shall maintain at the site copies of approved shop drawings, product data and operations and maintenance information.

C. Upon completion of work, deliver three (3) copies of record drawings to include contract and shop drawings. All record drawings shall be "as built" and reflect the work that was actually installed. They shall be in a format and contain sufficient details (like power supply and media converter locations and power sources with circuit numbers) to permit rapid and accurate troubleshooting by a skilled technician with no previous knowledge of the specific installation.

D. Record drawings and documents shall be provided in both printed and electronic formats. Electronic files will be submitted as both AutoCAD DWG (2012 or previous) and PDFs on media to be specified by CMS. Electronic files and the configuration files for the specific installation. In addition to the individual programs and setup files an image file of each specific installation will be provided to facilitate rapid reloading. Refer to 28 23 10 Cabling for additional requirements. In addition to as-built design drawings, the contractor will provide an overall as-built campus camera plan in .dwg and .pdf format; this shall include all camera locations, camera identification, viewing direction, rack locations, etc.

E. Labels: Provide label on each power supply, showing source of feed, i.e. PP123-CKT 14. Provide durable number label on each camera housing, visible from ground level, and on each cable. Provide corresponding number label for cable input.

F. As-Build Drawings: Provide as-built drawings showing name, camera number and location for all cameras. Drawing to include location of power supplies. Power supply feed to be labeled

on drawing, i.e. PP123-CKT 14. Panelboard directory to be updated to indicate power supply fed. Drawing must be durably mounted next to cameras head-end rack.

G. Refer to 28 23 10 Video Surveillance Cabling Specification for additional information.

3.8 ADJUSTING

A. 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 visits to Project during other-than-normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the video surveillance system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training."

3.10 APPENDIX A REQUIREMENT LIST

A. Planned P.M. Requirements List for CMS security monitoring cameras.

1. School name
2. Installer name
3. Technician name
4. Date
5. Recorder manufacturer
6. Recorder model number
7. Camera manufacturer
8. Camera Model number
9. General:
    a. Visually check complete head-end unit
    b. Visually check head-end room for trash, proper ventilation, lighting and overall disrepair. Report findings.
10. Cameras (Interior and Exterior)
    a. Clean all domes and enclosure acrylic
    b. Adjust cameras and lenses for appropriate field of view and angle
    c. Adjust lens for clarity of picture

d. Check all cameras for broken/damage lens and enclosures. Report findings.

e. Check all camera mounting hardware. Report any damage

f. Visually inspect all lighting protection devices.

B. Head-End:

a. Service all NVRs including the cleaning of filter pads

b. Check all connectors on the system head-end for good connections

c. Check all digital recorder functions

d. Check camera controls

e. Check for overall operation of system. Confirm with Principal or Principal's designee.

f. Visually inspect all monitors, keyboards and joysticks

g. Visually inspect UPS system

h. Visually inspect all lightning protection devices

i. Visually check all camera pictures to insure a good picture

j. Check the "Search" capability to insure proper recording of events.

C. Reports – provide a detailed report to the Alarm Supervisor describing the work performed and recommendations for corrective maintenance not covered by the planned maintenance service.

END OF SECTION

This Master Specification Section summarizes Charlotte-Mecklenburg Schools' standards and requirements for the Work of this Section. Design Consultant shall edit this document to correspond to Project requirements. Obtain CMS approval for manufacturers and products not listed in this Section.

SECTION 282310 – VIDEO SURVEILLANCE CABLING

PART 1 - GENERAL

1.1 SCOPE:

Section includes:

1. UTP Cabling.
2. Optical fiber cabling.
3. Cabling connecting equipment.
4. Cable connectors.
5. Racking hardware.
6. Labeling requirements.
7. Testing requirements.
8. Warranty requirements.
9. Closeout documentation.

Provide all labor, materials, tools & equipment required for the complete installation of work called for in the Construction Documents.

All service shall commence in accordance with the master construction schedule. The Security Contractor will provide schedule information to assist in the development of the Master Schedule.

Federal, state, local codes, rules, regulations, ordinances and current industry standards governing the work are as fully part of these specifications as if herein repeated or hereto attached. If the Security Contractor should note items in the Construction Documents or Specifications, construction of which would be code violations or not adhere to current industry standards, then the Security Contractor shall promptly call the suspected violations or deviations to the attention of the Designer in writing.

Scope of Work:

1. The work covered under this section shall include furnishing & installing networked cabling infrastructure for the IP security camera system.
2. All cables & related terminations, cross-connects, equipment, materials, support, grounding hardware and all shall be furnished, installed, tested, labeled and documented by the Contractor.
3. The Security Contractor shall provide & install lightning protection devices on all cables exposed to lightning risks.
4. The Horizontal Cabling System for Security shall consist of 4 pair Unshielded Twisted Pair (UTP) Copper Cables and/or 2 strand Optical Fiber Cables to each camera location as noted on the Construction Documents (drawings). These cables shall be installed from the camera location to the designated Security/Telecommunications Room Intermediate Distribution Frame (IDF) / Telecom Room IDF existing data racks or existing wall mounted data racks or enclosures. If adequate space is not available in the existing IDFs Contractor to provide additional wall mounted rack(s)/enclosure(s).
5. Product specifications & installation requirements are provided under Division 28. The successful Contractor shall meet or exceed all requirements for the cable system described in this document.

6. The Construction Drawings are diagrammatic only. They are not intended to show every detail of the construction project, every item or material that is required. It is the responsibility of the contractor submitting proposals to provide the equipment necessary to provide a properly operating system. The intent of the Construction Documents/Drawings includes constructing complete and working system.

1.2 RELATED SECTIONS:

A. Drawings and general provisions of the contract, including General conditions and Division 01 Specification Sections apply to this section.

1.3 REGULATORY REQUIREMENTS:

A. The following latest editions of the industry standards are the basis for the structured cabling system described in this document. The standards listed shall be adhered to in the same manner as if they were codes.

1. TIA – Telecommunications Industries Association.
   a. Articles 526, 568, 569, 606, 607, TSP-149, TSB-140.
2. ANSI - American National Standards Institute.
3. BISCI – Building Industry Consulting Service International.
   a. Telecommunications Distribution Methods Manual.
   b. Cabling Installation manual.
   c. Customer-Owned Outside Plant Design manual.
4. ETL - Electrical Testing Laboratories.
5. UL – Underwriters Laboratories.
6. NEMA – National Electrical Manufacturers Association.
7. OSHA – Occupational Safety and Health Standards.
8. NFPA – National Fire Protection Association.
   a. NFPA 70, national Electrical Code (NEC).
9. Division 26 / Electrical Specifications.
10. All electronic equipment and materials are to be tested, listed and labeled by UL or other agency that is acceptable to the AHJ and the State of North Carolina approved 3rd party testing agencies. Acceptable agencies can be found on the state construction website.

B. All current state and local codes.
C. If there is a conflict between applicable regulatory industry standards, then the more stringent requirements shall apply. The Contractor has the responsibility to determine and adhere to the latest editions when developing the proposal for installation.

1.4 DEFINITIONS:

A. BICSI – Building Industry Consulting Services International

B. EC – Electrical Contractor

C. EMI – Electromagnetic Interference

D. IDF – Intermediate Distribution Frame

E. MDF – Main Distribution Frame

F. NEC – National Electric Code

G. NEMA – National Electrical Manufacturers Association

H. SC – Security Contractor

I. TC – Telecommunications Contractor

J. UL – Underwriters Laboratory, Inc.

K. UTP – Unshielded Twisted Pair cable

L. IP – Internet Protocol.
M. MM - Multimode Fiber.
N. SM - Singlemode Fiber

1.5 WORK NOT INCLUDED:

A. Providing 120v wiring, unless otherwise indicated.

B. Providing networked electronics.

1.6 SUBMITTALS:

A. Before submitting a shop drawing or related material, the SC shall:
1. Review each submission for conformance with all SC's means, methods, techniques, sequences and operations of construction & safety precautions; and programs incidental thereto, all of which are the sole responsibility of the SC.
2. Review & coordinate each submission with other related or affected work.
3. Approve each submission before submitting same.
4. Match cabling and connectivity manufacturer provided by submitting telecommunications contractor.

B. Submittals shall include the following:
    1. Shop drawings, product data (including cut sheets & catalog information), samples required by the Contract Documents for the networked IP camera cabling system.
        a. Cabling.
            1. Manufacturer's data sheets for the telecommunications outlets, jacks, all cross connect equipment.
            2. Horizontal cables.
            3. Wire management.
            4. Over voltage protection equipment.
            5. Cabling supports.
            6. Racks.
            7. Patch cords.
            8. All Documentation listed in this specification section and "Contractor Qualifications".

C. By submitting shop drawings, product data, and samples, the SC represents that s/he has carefully reviewed and verified materials, quantities, field measurements, and field construction criteria related thereto. It also represents that the SC has checked, coordinated and verified that

information contained within shop drawings & product data conforms to the requirements of the work & of the Contract Documents.

D. The acceptance of shop drawings, product data and samples submitted by the SC shall not relieve the SC of responsibility for adhering to the requirements of the Contract Documents. Nor shall the acceptance relieve the SC of responsibility for errors or omissions in such shop drawings, product data or samples.

E. The review & acceptance, or other appropriate action upon shop drawings, product data is for the limited purpose of checking for conformance with information given & design concept illustration in the Contract Documents. Review of such submittals is not conducted for the purpose of determining accuracy & completeness of other details such as dimensions & quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the SC as required by the Contract Documents. The review shall not constitute approval of safety precautions or of construction means, methods, techniques, sequences or procedures.

F. For initial submission & for resubmission required for acceptance, submit electronic copies of each item. Combine all electronic files into one final submittal packaged electronic file.

G. Illegible submittals will not be checked.

H. If a submittal deviates from the drawings & project manual because of standard shop practice, substitutions (approved in accordance with General Conditions, amended) or any other reason, the Designer shall be advised in an attached separate written instrument. Deviations shall be acknowledged by Designer in writing. Unless acknowledged by the Designer in writing, the Contractor will not be relieved of the responsibility for executing the work in accordance with the Contract Documents.

1.7 DRAWINGS AND SPECIFICATIONS:

A. It is understood that while drawings will be followed as closely as circumstances will permit, the SC is held responsible for the installation of the system according to the true intent and meaning of the drawings. Anything not completely clear in the Construction Documents will be explained upon request to the Designer. However, if conditions arise where, in the judgment of the SC, certain changes will be advisable; the SC will communicate through the proper channels & obtain review and approval of these changes before proceeding with the work.

B. The drawings are not to be scaled. The SC must refer to the architectural drawings for building construction, dimensions and material, finish and construction method of walls, floor and ceiling in order to insure proper installation of work.

C. If there is a conflict between the Drawings and the Specifications, the most stringent requirement shall apply.

1.8 QUALITY ASSURANCE:

A. The SC shall employ qualified and certified technicians to this project that have experience with the installation of low voltage cabling infrastructures & security equipment and security related services; and provide appropriate supervision to all technicians on site.

B. The Architect / Engineer shall have the right to reject any proposed Security Contractor that, in the opinion of the Architect / Engineer, does not have the qualifications to perform the work to the satisfaction of the Architect / Engineer.

C. Contractor Qualifications:
   1. The SC shall employ qualified & certified technicians on this project that have experienced with the installation of low voltage cabling infrastructures & provide appropriate supervision to all technicians on site. Required qualifications and certifications are as follows:
      a. SC shall employ certified & qualified technicians to perform this scope of work.
      b. SC shall have an RCDD and a licensed individual who possess a North Carolina Security/Burglar Alarm License to oversee the project.
      c. SC shall possess a current North Carolina Electrical Low Voltage License.
      d. SC shall possess a current North Carolina Security/burglar Alarm License.
      e. Contractor shall have demonstrated public school experience & completed two or more public school projects, similar in size & complexity, in North or South Carolina in the last three (5) years.
         1. Cabling Contractor certifications shall include:
            a. Technician certifications from the connectivity and cable manufacturers, to include manufacturer installed on the job. 30% of technicians assigned to the project shall hold these certifications (for cabling only).
            b. SC shall hold company certifications from the connectivity & cable manufacturers to include manufacturer installed on the project.
            c. The lead technician assigned to the project shall have the following certifications:
               a. BICSI certified installer at the technician level.
               b. Technician certifications from the connectivity and cable, including fiber, manufacturer(s) installed on the project.
               c. BICSI Technician shall be on site whenever work is being performed.
            d. 30% of all Technicians on site at all times shall be BICSI certified installers.
            e. Cabling Contractor shall not touch or install any video surveillance equipment unless they are also the hired installer of video surveillance equipment which holds the project low voltage security/burglar alarm license for the project.

f. Qualification Document Submittal:
   1. Contractor shall not be awarded the project without possessing the required certifications.
   2. Contractor, upon being awarded the project, shall submit all required certifications, project roster, previous experience and reference documents.
   3. Contractor shall submit the following copies of current certifications:
      a. Technician certifications.
         1. Copper Manufacturer Certifications for Technicians
         2. Fiber Manufacturer Certifications for Technicians
         3. Connectivity Manufacturer Certifications for Technicians
         4. BICSI Technicians Certifications
         5. BICSI Level 1 or 2 Certifications
      b. Company Certifications.
         1. Company Copper Manufacturer Certificates
         2. Company Fiber Manufacturer Certificates
         3. Company Connectivity Certificates

      c. Company North Carolina Electrical Low Voltage license.

d. Company North Carolina Security/Burglar Alarm License.
e. RCDD certificate(s).
f. List of public school experience & completed two or more public schools similar of size & complexity in North or South Carolina in the last five (5) years. Include reference contact information.
g. Project roster of technicians and staff assigned to the project. Be sure to list your BICSI technicians as lead technician on the project.

D. Equipment and materials of the type for which there are independent standard testing requirements, listings and labels, shall be listed and labeled by the independent testing laboratory (i.e. UL).

E. Where equipment & materials have industry certification, labels or standards (i.e. NEMA) this equipment shall be labeled as certified or complying with standards.

F. Material & equipment shall be new, conform to grade, quality and standard specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout. Materials and equipment are to be installed per industry standards & manufacturer's recommendations.

G. The Designer retains the right of inspection of the work at any time. Any material or work which does not comply with the specifications or current industry standards, will be subject to rejection. Any such rejected work or material shall be reworked and/or replaced & made to conform with said specifications at no additional cost to the Owner.

H. Any stoppage, delay, suspensions or forfeiture due to a rejection shall in no way invalidate any terms of the Contract, and no additional charges will be allowed by the SC.

I. The SC site superintendent shall submit a weekly report due each Monday detailing the previous week's accomplishments; and providing a two (2) week forecast of areas where work will be performed and expected accomplishments. This report will be copied to the Owner and the Designer.

J. The SC shall inspect all installation materials & workmanship, and ensure contract compliance for final acceptance.

K. The SC is responsible for all damages to persons or property that occurs as a result of his fault, omission or negligence in connection with the prosecution of the work. The SC is responsible for the proper care and protection of all work performed until completion and final acceptance, whether or not the same has been covered in whole or in part by payments made by Owner.

L. The SC must remove all debris and packaging resulting from the delivery and installation of equipment & materials. The SC must leave the premises in the same condition as found. The SC will leave all work areas clean & free of debris.

M. Any damage done to the premises by the SC, the SC's agents, vendors or employees, will be repaired at his own expense. If the SC fails to repair any such damages, then the Owner may affect such repairs at SC's expense & offset any payments made by the Owner relating to such repairs against amounts payable by the Owner to the SC.

N. Property of the Owner, as well as any other property disturbed in the process of work, will be restored to the original condition that existed prior to the beginning of work. Restoration shall be at the SC's expense.

PART 2 - PRODUCTS

2.1 UNSHIELDED TWISTED PAIR CABLE:

A. UTP 4 pair Plenum-rated Cable for video surveillance: Category 6 Cable, Green colored jacket. Cable must meet or exceed TIA/EIA 568-C.2 standards.
   1. Cable shall be rated to 400 MHz minimum.
   2. All cable shall conform to the requirements for communications circuits defined by NFPA 262. Cable shall be listed to NEC Type CMP (NFPA 262) for plenum installations.
   3. The cable shall meet or exceed the requirements as described in CENELEC EN 50288-6-1, TIA 568-C.2 Category 6, and ISO/IEC 11801 Class E.
   4. Third party performance verified.
   5. RoHS Compliant Directive 2011/65/EU.
   6. The cable shall have a flexible jacket that strips cleanly & resists kinking.
   7. Products:
      a. CommScope – Ultra Media CS37P - #UN874046314/10
      b. Panduit - #PUP6004
      c. Siemons - #System 6 9C6P4-E3-07-RXA
      d. GenSpeed 6000

B. UTP 4-pair Outside Plant Cable: Category 6.
   1. Cable shall be rated to 250 MHz minimum.
   2. Shall have water / moisture blocking components to protect the cable in potentially wet areas.
   3. The cable shall meet or exceed the requirements as described in CENELEC EN 50288-6-1, TIA 568-C.2 Category 6, and ISO/IEC 11801 Class E.
   4. The cable shall have a flexible jacket that strips cleanly & resists kinking.
   5. RoHS Compliant Directive 2011/65/EU.
   6. Solid conductors.
   7. Jacket color: black.
   8. Products –
      a. CommScope, Outdoor, CS34O BLK C6 - #UN884019984/30
      b. Siemon – OSP-#9C604-E1
      c. Or Approved Equal

2.2 OPTICAL FIBER CABLE:

A. Optical Fiber Cable for distances up to 300 meters
   1. Plenum-rated Tight-Buffered Cable, 2-strand, Multi-Mode, 10G, 50/125 um, jacket constructed with aluminum interlocking armor, NEC/CEC compliant (OFCP listed)
      a. Shall conform to the requirements as described by the NEC. Cable shall be listed to NEC article 800-154 (A) for plenum installations.
      b. The cable shall meet or exceed the requirements as described in TIA 568-C.3
      c. Fibers to be grouped into jacketed subunits & surrounded by a dielectric central member.
      d. The core to be protected by a flexible, spirally wrapped, aluminum interlocking armor that offers easy, one-step installation provides crush protection.
      e. Flame retardant outer jacket
      f. Products:

1) CommScope - #P-002-DZ-5L-FSUAQ #760127647
2) Corning - #002T88-33180-A3
3) Or approved equal

2. Optical Outdoor Fiber Cable, 10G, 50/125 um, Loose Tube.
   a. Shall conform to the requirements for the requirements for communications circuits as defined by the National Electrical Code.
   b. The cable shall meet or exceed the requirements as described in TIA 568-C.3, ANSI/ICEA S-87-640-2006 and EN 187105.
   c. The cable shall be provide gel-free water blocking and be non-armored and stranded loose tube.
   d. Products
      1) CommScope–D-0##-LN-5L-F12NS- #760054171 with interlocking armor
      2) Corning - #0##SSF-T4180DA1 with interlocking armor
      3) Or approved equal
3. Optical Indoor / Outdoor Plenum-rated Armored Cable, 2-strand, 10G, 50/125 um, Aqua
   a. Shall conform to the requirements for the requirements for communications circuits as defined by the NEC. Cable shall be listed to NEC article 800-154(A) for plenum installations.
   b. The cable shall meet or exceed the requirements as described in TIA 568-C.3, ANSI/ICEA S-104-696-2001 and EN 187105
   c. Cable shall be tight buffered, armored and provide gel-free water blocking.
   d. Products:
   1) CommScope - #P-002-LZ-5L-F12BK #760162883 with interlocking armor and P-002-LN-5L-F12BK without interlocking armor (inner duct will be used in lieu)
   2) Corning - #002T8P-31180-A3 with interlocking armor.
   3) Or approved equal

4. Optical Indoor/Outdoor Plenum Armored Cable, Single-Mode, Yellow/Black-for distances beyond 900'.
   a. Shall conform to the requirements for the requirements for communications circuits as defined by the National Electrical Code. Cable shall be listed to NEC Article 800-154 (A) for plenum installations.
   b. The cable shall meet or exceed the requirements as described in TIA 568-C.3, ANSI/ICEA S-104-696-2001 and EN 187105.
   c. Cable shall be tight buffered, armored and provide gel-free water blocking.
   d. Products
      1) CommScope-P-0##-LZ-8W-F12BK, with interlocking armor, or equal.
      2) Corning-#0##E8P-31131-A3 with interlocking armor.

2.3 CONNECTORS AND JACKS:

A. Copper Patch cords – Category 6 – Green
   1. 24 AWG conductors
   2. Shall meet or exceed Category 6 / Class E requirements of ISO/IEC 11801, CENELEC EN50173-1 and TIA 568-C.2.
   3. ETL listed.
   4. Cables shall be factory manufactured & terminated.
   5. Narrow boot with strain relief.
   6. Provide patch cords at the station end and all the IDF end with 10% spare of each length required for Owner's future use. Submit patch cords for Owner's cross-connect activities two (2) weeks prior to project's end.

7. Provide additional lengths as required to adhere to site conditions.
8. Products:
    a. CommScope Uniprise or equal
        1. Security Room – Riser rated:
            a. 3′ - #UC1BBB2-0MF003
            b. 5′ - #UC1BBB2-0MF-005
            c. 7′ - #UC1BBB2-0MF-007
        2. Camera End(plenum rated): 10′ - UC1BBC2-0MF010 (provide additional lengths as needed)
    b. Panduit – TX 6:
        1. Security Room – Riser rated:
            a. 3′ - #UTPSP3YGR
            b. 5′ - #UTPSP5YGR
            c. 7′ - #UTPSP7YGR
        2. Camera End(plenum rated): 10′ - #UKPGR10GR/N (provide additional lengths as needed).

B. Fiber Patch Cords
    1. Shall meet or exceed TIA-568-C.3.
    2. Shall meet or exceed the IEEE 802.3 10 Gigabit Ethernet Standard as wel as IEC-60793-2-10 and TIA-492AAAC and TIA-492AAAD for laser bandwidth Differential Mode Delay.
    3. Shall meet or exceed all ANSI/TIA and ISO/IEC insertion loss and return loss requirements.
    4. ETL tested and approved for component compliance for each respective Standard.
    5. Factory manufactured and terminated and tested.
    6. Products
        a. LC-LC MM Duplex 50 Micron 3 meter
            1. CommScope Uniprise - #FEXLCLC42-MXM003
            2. Corning - #050502Q5120003M
            3. Siemon - #FJ2-LCLC5MM-03
        b. ST-LC MM Duplex 50 Micron 3 meter
            1. CommScope Uniprise - #FEWLCST52JXM003
            2. Corning - #055002Q5120003M
            3. Siemon - #FJ2-LCSA5MM-03
        c. LC-LC MM Duplex 62.5 Micron 3 meter
            1. CommScope Uniprise - #FEMLCLC42
            2. Corning - #050502K5120003M
            3. Siemon - #FJ2-LCSA6MM-03
        d. ST-LC MM Duplex 62.5 Micron 3 meter
            1. CommScope Uniprise - #FEMLCST42
            2. Corning - #055002K5120003M
            3. Siemon - #FJ2-LCA6MM-03
        e. ST-LC SM Duplex 3 meter
            1. CommScope Uniprise - #FEXSCSC42-MXM003
            2. Corning - #046102R5Z20003M
            3. Siemon - #FJ2-LCUSAUL-03

C. UTP Category 6 jacks below ceiling-White color
    1. All products must meet or exceed TIA 568-C.2 Category 6 performance standards, ISO 11801 (class E), EN50173-1 (class E).
    2. Meets requirements for IEEE 802.3af and IEEE 802.3at for PoE requirements.
    3. UL 1863 approved.

4. Backwards compatible.
5. Modular jacks shall be unshielded, 4-pair, RJ-45.
6. Modular jacks shall terminate using 110-style pc board connectors, color-coded for T568B wiring.
7. Each modular jack shall be wired to T568B.
8. Products:
   a. CommScope Uniprise - #UNJ600-WH - #760237788
   b. Panduit – non keyed - #CJ688TGWH
   c. Siemon - #MX6-F02

D. UTP Category 6 jacks above ceiling-White color
1. All products must meet or exceed TIA 568-C.2 Category 6 performance standards, ISO 11801 (class E), EN50173-1 (class E).
2. Meets requirements for IEEE 802.3af and IEEE 802.3at for PoE requirements.
3. UL 1863 approved.
4. Backwards compatible.
5. Modular jacks shall be unshielded, 4-pair, RJ-45.
6. Modular jacks shall terminate using 110-style pc board connectors, color-coded for T568B wiring.
7. Each modular jack shall be wired to T568B.
8. Products:
   a. CommScope Uniprise - #UNJ600-WH - #760237788
   b. Or approved equal for plenum rated.

E. Optical Fiber Connectors
1. Optical Fiber Multi-mode 50 Micron ST connectors
a. UniCam Connector
b. Laser optimized 50 um Multi-mode
c. Ceramic ferrule
d. 0.1/0.5 dB typical maximum insertion loss
e. Black housing color
f. Aqua boot color
g. Products
1) CommScope Uniprise-#MFC-STF-09-5X, #760118034
2) Corning- #95-050-51-X
3) Or Approved Equal
2. Optical Fiber Multi-mode 62.5/125 Micron ST Connectors
a. Unicam Connector
b. Ceramic ferrule
c. .01/.05 typical maximum insertion loss
d. Amber housing color
e. Beige boot color
b. Products
1) CommScope Uniprise-#MFC-STF-09-6X, #760118026
2) Corning-#95-000-51
3) Or Approved Equal
3. Optical Fiber Single-mode ST connectors
a. UniCam Connector
b. Factory pre-polished
c. Ceramic ferrule
d. Insertion loss .2dB/.5dB; typical
e. Products

1) CommScope Uniprise-#MFC-STF-09-5X, #760118034
2) Corning-#95-200-52
3) Or Approved Equal

2.4 FIBER ENCLOSURES-RACK MOUNT

A. Fiber Optic Enclosures: Security Contractor is responsible for providing and installing all necessary coupling panels, couplings, connectors, and all other devices needed per manufacturers' recommendations.

B. 19 Inch Rack Mounted Enclosure & Closet Splice Housing

1. CommScope Uniprise –RFE-SLC-IS-EMT-BK/1U-PNL, or equal

a. 24 port Enclosure Adapter Panel Shelf- (accepts 3 PNL 6 packs) - #760147439

1. ST Connector 6-Pack, Shuttered
   a. 50/125 micron - #PNL-BK-006-MFA-ST06-AQ
   b. 62.5/125 micron - #PNL-BK-006-MFA-ST06-BG
   c. Single-mode - #PNL-BK-006-SFA-ST06-BL

2) 6-Pack Blank – #PNL-BK-BLANK-6-PACK

2. Corning

a. Enclosure

1) 24 port - #CCH-01U

b. ST Connector 6 pack - #CCH-CP-06-H3

c. ST Connector 12 pack - #CCH-CP-12-H3

d. Blank panels included with enclosures

2.5 PATCH PANELS - Modular

A. Modular patch panels:

a. Accepts Category 6 jacks specified.
b. Mounts to standard TIA 19 inch rack.
c. Stainless steel construction.
d. Angled front panel.
e. Area for labels & icons.
f. Products:
   a. 24 port – One rack unit:
      1) CommScope Uniprise- #CPPA-UDDM-M-1U-24 - #760207290
      2) Siemon - #MX-PNLA-24
      3) Panduit-#CPA24BLY
   b. 48 port – Two rack units:
   a. CommScope Uniprise - #CPPA-UDDM-M-2U-48 - #760207308
   b. Siemon - #MX-PNLA-48
   c. Panduit-#CPA48BLY

2.6 SURFACE MOUNTED OUTLET (BISCUIT JACKS) BOXES, PLENUM RATED:

A. UL rated

B. 2 port

C. White

D. Supports RJ-45 connectors

E. Cable entrances through the base and/or sides

F. Mount to solid surfaces

G. Easy front access to outlets, adaptors & couplers

H. Outfitted with dust covers, cable ties, labels / label holders, screws for mounting

I. Plastic-white

J. When terminating fiber, provide ST couplers

K. Products
1. CommScope M202 Plenum SMB-262 - #760067207
2. Or Approved Equal

2.7 FACEPLATE APPPLICATIONS:

A. Recessed Applications
1. Duplex style, single gang faceplate.
2. Shall be available in 1, 2, 3, 4 and 6 vertical outlet configurations.
3. Provide faceplate with 1 spare port to allow for growth.
4. Ivory in color.
5. Shall be provided with mounting screws, label covers and label cards.
6. Provide blank dust covers for all blank ports.
7. Products:

a. CommScope Uniprise (color for this manufacturer is listed as 'Misty /Cream')
2. 2 Port – M12LE-215 - #108333048

b. Panduit
1) 2 Port-#CFPE2IWY

c. Siemon
i. 2 Port-#MX-FP-S-02-02

B. Surface Mount Applications that equal Wiremold 700 or 2000 Applications
1. Duplex style, single gang faceplate.
2. Faceplates shall work seamless with the raceway to be installed.
3. Colors shall match the raceway to be installed.
4. All fittings, modules and bezels necessary shall be provided.
5. Faceplates shall accept the same manufacturer of jacks that are being installed on the project.
6. Shall be provided with mounting screws, label covers and labeling cards.
7. Provide blank dust covers for all blank ports.
8. Products:
a. Panduit - #CFPSE4IW,
b. Or Approved Equal

C. 106 Frames

1. Frames will mount behind standard 106 NEMA faceplates.
2. Frames will accept modules for STP and UTP, fiber optic and audio/video.
3. Ability to snap in and out to allow for moves, adds and/or changes.
4. Products

a. CommScope
1) 2 Port-#M106FR2-262 - #106622251
b. Panduit:
1) 2-Port - #CF1062IWY
c. Siemon:
1) 2-Port-#MX-E2F-02

2.8 CONSOLIDATION POINT ENCLOSURES:

A. Consolidation point Enclosure Category 6:
1. Plenum rated adhering to UL 2043.
2. Meet or exceeds TIA 568-C category 6 standards.
3. 16 gauge aluminum.
4. Wall mount.
5. Accepts Category 6 cabling.
6. Removable cover that allows top & bottom access to cables.
7. All necessary accessories shall be provided including punch down bases, connecting blocks for the Category of cable being used.
8. Enclosure shall be clearly labeled according to TIA 606-A.
9. Shall accommodate two 100-pair 110 connect XC wiring blocks without legs.
10. Must be available in 24 port and 48 port capacities.
11. Products:
a. Panduit # WMCPE and Panduit # GPB24-X-24 pair punch down base
b. Or Approved Equal.

2.9 MEDIA CONVERTER RACK MOUNT:

A. IEEE 802.3 and IEEE 802.3u compliant.

B. UL listed and labeled.

C. Meets or exceeds the following standards.

D. FCC part 15 Class A.

E. CISPR Class A.

F. VCCI Class A.

G. CE mark.

H. Built-in twisted pair port 10/100/1000 switch.

I. Auto-negotiation RJ-45 connector with Auto-MDIX.

J. ST Connector port.

K. LEDs for functions, links and activity.

L. Link fault signaling for use with managed switches.

M. 1,024 MAC address capacity.

N. Store and forward architecture.

O. Full and half duplex operation.

P. Wall or chassis mountable (utilize chassis mount).

Q. Provide all accessories necessary for mounting.

R. Lifetime performance warranty.

S. 2 rack unit mounting chassis.

T. 120v power supply to chassis.

U. Overload protection with automatic recovery.

V. Chassis cooling two 42.5cfm side mounted fans plus one fan for each redundant power supply.

W. Product unit:
    1. Signamax #065-1196SFPDR
    2. Or Approved Equal

X. Product chassis with ac power:
    1. Signamax #065-1185/1185FAN
    2. Or Approved Equal

2.10 BUILDING ENTRANCE TERMINAL/PROTECTORS FOR DATA APPLICATIONS:

A. See Specifications 28 23 00 Part 2 2.15 for 120v protection.

B. UL Listed and labeled.

C. The Cabling contractor shall provide and install all surge devices that are not 120v or above. All devices above 120v are to be provided and installed by the electrical contractor.

D. Products:
    1. Rack Mounted Protection RJ-45(for exterior cameras only):
        a. Ditek #DTK-RM12NETS

b.or Approved Equal

2. Outdoor Camera Protection RJ-45(for exterior cameras only):
   a. Ditek #DTK-MRJPOES
   b. or Approved Equal

2.11 POE INJECTOR:

A. UL Listed and labeled and IEEE 902.3af compliant.

B. Input 24VAC.

C. 1 port for power over Ethernet to 1 cat5/cat6 cable min dist. 300’.

D. LED status light.

E. Provided with plug in transformer included.

F. Products:
   1.Altronix - #netway1P single port.
   2.Or approved equal.

2.12 TIE-WRAPS:

A. All tie wraps must be red in color.

B. All tie wraps must be plenum rated.

C. UL Listed and labeled.

D. Products:
1. Thomas and Betts-#TY-25M-9, or Approved Equal:
2. Panduit:
   a. 4” – #PLT1M-C702
   b. 7.4” -#PLT2S-C702
   c. 11.6” - #PLT3S-C702

2.13 RACKS AND WALL MOUNTED ENCLOSURES:

A. 84” High Foot Aluminum floor Mounted Data Rack, 45 rack units, 19" wide, Black:
1. High strength aluminum construction.
2. 1200 lb capacity.
3. Pre-punched base angles for floor mounting.
4. Top angles to allow J-bolt attachment without interfering with top rack-mount spaces.
5. EIA-310-D Standard Universal 5/8" - 5/8"-1/2" alternating hole pattern.
6. Six web channel holes per side to enable multiple racks to be mounted together side by side.
7. High strength roll-formed threaded mounting holes.
8. Rack-mount unit marks.
9. Thirty (30) pilot point #12-24 mounting screws with combination Phillips/Straight heads to reduce cross-threading.
10. UL listed.
11. Products:

a. CPI 19" Universal Black rack - #46353-103 (OWNER PREFERRED)
b. Saunders/Cooper B-Line - #SB-556-084-XU
c. Or Approved Equal

B. Wall Mounted Enclosures, 19” wide, Black:

1. Dual hinged
2. Fully welded, 16 gauge cold rolled steel construction
3. Heavy duty.
4. Load rating 200 lb
5. EIA/ECA-310-E compliant mounting rail system with #12-24 tapped rails.
6. UL listed to UL60950 standard-file number E235184.
7. Fan kit to be included
8. Plexiglass front door
9. Lock included
10. Width 24.7”
11. Depth 30”
12. Heights
a. 24” with 12 rack units
b. 36” with 19 rack units
c. 48” with 26 rack units
13. Products
a. Cooper-B-Line V-Line Dual Hinge Wall Mount Cabinets-#VLWM####
b. Chatsworth Products Cube-IT Plus Cabinet-#12419-7##
c. Or Approved Equal

C. Wall Mounted Telcom Rack-Swing (Install in data rooms only)

1. Flat black powder coat
2. Dual hinge
3. Steel frame with steel hinge pin in aluminum door
4. EIA/ECA-310-E compliant with universal mounting hole spacing.
5. Load rating 150 lb
6. UL listing E235184
7. Width to accept 19” rack mounted equipment
8. Depth 25”
9. Heights
    a. 24” with 10 rack units
    b. 30” with 13 rack units
    c. 44” with 21 rack units
    d. 54” with 27 rack units
10. Products
    a. Cooper-Bline Swing Gate Wall Mounted Equipment Rack-#SB70819##25FB
    b. Or Approved Equal

2.14 DATA RACK WIRE MANAGEMENT:

1. 7 foot Vertical:

a. Provide 6" wide double-sided managers for outside end of data racks. Provide 10" wide double-sided managers for installation between two data racks.
b. 70” x 6” x 16.6” (6” wide), 70” x 10” x 17.5” (10” wide).
c. 38 rack units.
d. Steel mid panels and splice plates and plastic sides. Covers on 6” wide shall be plastic, the covers on 10” shall be steel with plastic hinges.
e. Four vertical sections with T-shaped cable guides spaced 1 ru apart.

f. Four mid panels with attachment points for cable management accessories.
g. Two splice plates used to assemble the top and bottom side sections.
h. Four half-height covers that snap onto the T-shaped cable guides.
i. Color shall be black.
j. 6" Wide Vertical Wire Manager
a. Products:
1. Chatsworth Velocity Double-Sided - #13912-703
2. Panduit
a. Center mount Bracket Kit #WMPVCBE
3. Or Approved Equal
k. 10" Wide Vertical Wire Manager:
a. Products:
1. Chatsworth Velocity Double-Sided - #13914-701
2. Panduit #PRV10
3. Or Approved Equal
2. Horizontal-19" width":
a. 3.47"H x 19"W x 9.75"D.
b. Snap on rear cover.
c. Cable management for front and rear.
d. 2 rack units.
e. Plastic construction.
f. Front cover hinge shall open 180 degrees up or down.
g. Curved surfaces.
h. Pass-through holes for front to rear cabling.
i. Built in cable retainers.
j. Products:
1. Panduit - #NCMH2,
2. Or Approved Equal

2.15 POWER STRIP

1. UL Listed.
2. 19" rack mounted.
3. 20 amps.
4. 120V, 1.9KW
5. 8 NEMA 5-20R rear outlets.
6. 15' service tail with 5-20P.
7. Breakered
8. Power switch
9. One rack unit
10. One 20a power strip to be installed at the bottom of each data rack or enclosure.
11. Products:
    a. Geist-#VSSL084-152R20,
    b. Or Approved Equal

D. Grounding:

1. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
2. Telecommunications Main Bus Bar shall be provided by the EC.
3. Rack mount ground bus bar provided by the SC as denoted on the plans.
4. Provide horizontal rack mounted ground bus bars on each telecommunications rack that the SC is providing.
5. Products:
a. CPI - #10610-019,

b. Or Approved Equal

2.16 UNIVERSAL CABLE RUNWAY:

A. Ladder Rack and Accessories: (installed in telcom or security rooms):

1. 3/8" x 1-1/2" x.065" wall rectangular steel tubing.
2. Cross members welded at 12" intervals.
3. 12" and 18″ width, unless otherwise noted.
4. To be supported every 3'.
5. Runway elevation kits shall be provided to enable securing to top of data racks.
6. Runway installed along perimeter of Telecom or Security Rooms shall be secured to walls utilizing triangular support brackets sized for the runway being installed.
7. All material parts are not listed or illustrated in the Contract Documents. Contractor responsible for acquiring all parts and materials required for a complete runway system.
8. Black in color.
9. Runway.
   a. Products:
      1. CPI 12" Wide Black Universal Ladder Rack - #10250-712,
      2. Or Approved Equal
      3. CPI 18″ Wide Black Universal Ladder Rack - #10250-718,
      4. Or Approved Equal
10. Runway Support:
    a. Products:
       1. CPI 12″ Wall Mount Triangular Support Brackets - #11746-712,
       2. Or Approved Equal
       3. CPI 18″ Wall Mount Triangular Support Brackets - #11746-718,
       4. Or Approved Equal
11. Equipment rack to runway mounting plates:
    a. Products:
       1. CPI - #10595-712,
       2. Or Approved Equal
       3. CPI - #13730-718,
       4. Or Approved Equal
12. Runway over rack elevation kits:
    a. Products:
       1. CPI - #10506-706,
       2. Or Approved Equal
13. Concrete mounting kit for equipment racks:
    a. Products:
       1. CPI - #40604-001,
       2. Or Approved Equal

2.17 BACKBOARDS:

A. Telecommunications/Security Rooms - Plywood, fire-retardant treated 3/4" x 48" x 96" A-C Grade, unpainted with A side facing outward. Comply with requirements for plywood backing panels specified in Architectural specifications.

2.18 UPS DEVICE:

A. Provide 19" racking frame for the UPS device. (if required)

B. The device the rack/frame must hold are: Digital Recorder Surge Protector with Battery Back-up.

C. Provide complete AC power, network data, and video protection for digital recorder. Digital recorder to be backed up by a rack mount 1500 VA UPS device.

D. TriSerial connection to be provided between UPS and DVR to facilitate automatic controlled shutdown in the event of an extended power outage.

E. UPS device must be UL listed and Labeled or 3rd party tested by an approved agency that the state of North Carolina approves. This list can be found on the North Carolina state construction website.

F. Products:
1. SMX1500RM2UCNC.
2. No equals, owner requested.

PART 3 - EXECUTION

3.1 HORIZONTAL DISTRIBUTION CABLING:

A. Horizontal cabling is installed in a star topology.

B. Bridged taps and splices are not permitted as part of the horizontal cabling.

C. All connectivity products such as patch panels & data jacks shall be of the same manufacturer (see approved products list above).

D. All cables inside buildings shall be plenum rated. Cables routing to the exterior of buildings shall be rated for Outside Plant applications.

E. Contractor shall install all cabling according to latest industry standards, manufacturer's recommendations & best practices. Cabling shall be installed in an orderly & neat manner. Cables shall be installed parallel and perpendicular to building lines.

F. Horizontal cables shall terminate to the closest Telecommunications/Security Room IDF cross-connect area on the same floor as designated in the Construction Documents.

G. Horizontal copper cable links shall not exceed 275 feet. If the Security Contractor discovers any copper cable run exceeding this length, the Security Contractor shall contact the designer and coordinate the best course of action to reduce the length of cable, or transition the cable to fiber.

H. UTP cable shall be installed so that there are not bends smaller than 4 times (4x) the cable's outside diameter at any point in the cabling run and the termination area. If cables are kinked or the cable jacket is damaged during construction project, the cable will be removed and replaced with new cable at no additional cost to the Owner.

1. Confirm all bend radius requirements with the manufacturer.
2. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a 4-pair UTP cable.

I. Fiber optic cable bend radius shall not exceed:
   1. Nonconductive fiber cables' minimum bend radius is 10 times the cables' outer diameter when under no load, and then 15 times the cable's outer diameter when being pulled.
   2. Conductive fiber cables' minimum bend radius is 10 times the cables' outer diameter when under no load and then 20 times the cable's outer diameter when being pulled.
   3. Confirm all bend radius requirements with the manufacturer.
   4. Pulling tension on optical fiber cable shall not exceed 300-lbf for a 2-strand cable

J. A pull cord (nylon; 1/8 inch minimum) shall be co-installed with all cable installed in any homerun conduit & conduits exceeding 1" in diameter

K. Cable raceways shall not be filled greater than the TIA/EIA 569 maximum fill for the particular raceway type or 40%.

L. Where transition points or consolidation points are required, they shall be located in accessible locations & housed in an enclosure intended and suitable for the purpose. Coordinate with the AHJ (authority having jurisdiction) on acceptable locations and further requirements in order for the installations to be accepted for required inspections.

M. Slack Required:
1. Telecommunications Room – 10-feet minimum
2. Camera Locations – 20-feet minimum

N. Electrical contractor shall provide all raceways including conduit, outlet boxes, and sleeves, UON.
   1. Contractor shall coordinate with electrical contractor to ensure all pathways intended for the SC are installed according to the contract documents and best aid the SC in his work.
   2. Conduit sleeves shall align with cable tray when walls need to be penetrated to allow a continuous cabling pathway.

O. Cable trays are to be installed by the electrical contractor.

1. 18" cable trays with 1 divider are to be provided. The tray shall be divided in a 12" section and a 6" section.
2. SC to coordinate with EC and all other disciplines with their work in the location of the cable trays prior to its installation.
3. A minimum of 12" clearance above the tray and 36" clearance to access the tray from one side is required at all times.

a. Water piping is not allowed to route above the tray. If this is unavoidable due to the constraints of the ceiling space, a drip pan with installed drains must be installed under the piping in order to protect the cables from water damage.

1) This requirement will not be required where there are no joints in branch piping less than 2" in diameter that do not have any joints in the pipes 2' from the top of the cable tray dimensioning from each side of the tray.

b. The data, voice, wireless and catv cables shall occupy the larger section of the partitioned cable tray.

c. Intercom, video surveillance, access controls and security cables shall occupy the smaller section of the partitioned cable tray.
d. Mechanical controls cable shall not be installed in the cable tray, nor be supported by the cable tray or the cable tray supports.
e. Electrical conductors are not allowed to be routed in the tray or be supported by the cable tray. They shall not be routed parallel within 12" of the tray due to susceptibility of EMI.
f. Duct work and mechanical piping shall not obstruct the tray and must leave the tray accessible throughout its routing.

P. The ceiling cable support throughout most of the facility will be accomplished by utilizing open areas above ceilings and cable trays when available.

1. If cable trays or sleeves are available, the SC must use the cable trays and sleeves as their pathway, unless the SC has received formal approval from the Designer.
2. All penetrations through fire-rated walls or floors must be sleeved.
a. Contractor to support cabling no greater than 2' prior to entering a sleeve and no greater than 2' after exiting a sleeve.
3. In areas where support structure is not available, cables will be supported with metallic J-brackets at regular 4-5 foot intervals.
4. Cables may only be supported by building structure when the cable spans do not exceed 5 foot intervals.
5. Cables SHALL NOT be supported on top of walls or I-beams or in areas where the cable is susceptible to damage or EMI.
6. Cables shall not be attached to ceiling grid or lighting fixture wires. At no point shall cable(s) rest on acoustic ceiling grids or panels.

Q. Non-continuous hangers and supports

1. Provide non-continuous hangers and supports from cabling exiting conduits to the cable trays.
2. Installation of hangers shall abide by current industry standards and manufacturer recommendations.
3. Install where cables, conductors, nor jackets will be damaged.
4. Do not bend cables, in handling or in installing to smaller radii than minimums recommended by the manufacturer.
5. Follow manufacturer's and industry standards for allowable fill capacity for each hanger or support.
6. Provide support 4'-5' on center.
7. Route parallel and perpendicular to building lines.
8. All hangers and supports shall be secured to structure and must be tied off at the bottom. If tying to existing ceiling grid, these support wires must be tagged or painted and must be distinguishable from the ceiling grids support wires.
9. Groom cables with in supports with tie-wraps.
10. No more than 12" of cable sag is allowed between supports.

R. The ceiling cable support throughout most of the facility will be accomplished by utilizing open areas above ceilings & cable trays when available.
   1. If cable trays or sleeves are available, the Security Contractor (SC) must use the cable trays and sleeves as their pathway, if sleeves and open ceiling pathways are full the contractor is responsible for the addition of additional sleeves where required, unless the SC has received formal approval from the Designer.
   2. All penetrations through fire-rated walls or floors must be sleeved.

a. Contractor to support cabling no greater than 2' prior to entering a sleeve and no greater than 2' after existing a sleeve.

3. In areas where support structure is not available, cables will be supported with metallic J-brackets at regular intervals of 4' to 5'.
4. Cables may only be supported by building structure when the cable spans do not exceed 5 foot intervals.
5. Cables SHALL NOT be supported on top of walls, I-beams, or in areas where the cable is susceptible to damage or EMI.
6. Cables shall not be attached to ceiling grid or light fixture wires. At no point shall cable(s) rest on acoustic ceiling grids or panels.

S. There shall be a minimum of 3 inches of clearance between the cable support system and the ceiling tile support grid.

T. No cables shall run exposed. In areas of no accessible ceiling & where a pathway is not being provided by others the Contractor shall provide the pathway. The pathway shall be EMT conduit in common areas; or wiremold metallic raceway in classroom/office areas. SC shall provide all necessary sleeving of walls & floors where sleeves or openings are not existing.

U. All equipment & materials installed in plenum environment shall be UL rated acceptable for plenum environments.

V. Horizontal distribution cables shall be bundled in groups of no more than forty (40) cables. Cable bundle quantities in excess of 40 cables may cause deformation of the bottom cables within the bundle & degrade cable performance. This includes cable bundles supported in J-hooks.

W. Cable shall be installed above fire-sprinkler systems & shall not be attached to the system or any ancillary equipment or hardware. The cable system & support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes or other control devices.

X. Contractor must ensure that TIA/EIA recommended minimum separation distances are maintained between the newly installed cabling & high-energy sources that may interfere with data transmission. Cables shall never come into contact with any ceiling grids, lighting sources, or any devices that emit EMI.

Y. Firestopping.

1. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating items - i.e. riser slots & sleeves, cables, conduit, cable tray, raceways that are specifically designated for the security camera cabling infrastructure – shall be properly firestopped. The contracting discipline installing the sleeve or slot shall be responsible for sealing the area on the exterior of the sleeve or slot. The Contractor shall be responsible for firestopping the interior annular area.
    a. Provide temporary closure at termination of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15 psig hydrostatic pressure.

2. Firestop systems utilized shall be dictated by this project's Professional Electrical Engineer's UL design. If a PE UL design is not available, the Contractor shall provide appropriate UL

design for penetrations through rated walls and properly firestop penetrations. These documents shall be submitted to the Designer.

Z. Cables routing under slab or outside shall be rated outside plant & provide water blockage. Upon entering the building & exiting the conduit, the outdoor cable shall be transitioned to a plenum rated cable. This will be accomplished by placing transition points within 50-feet of the cable's entry into the building.

AA. Provide over voltage protection on both ends of cabling exposed to lighting or accidental contact with power conductors.

3.2 SECURITY ROOM (SR) / CROSS CONNECT AREA – IDF:

A. Data Racks:
1. Contractor to utilize existing telecom racks when space is available. A minimum of 6U spaces shall remain open and unused for the owner's future equipment. Contractor to provide additional wall mounted racks / enclosures when necessary.
2. Data racks/enclosures contained within the SR and shown on the Construction Drawings are for the purpose of providing a base installation requirement in each cross connect area and for the Contractor to perform take offs for their cost estimating.
3. All additional racks to be provided by the Contractor shall be heavy duty EIA compliant, 19-inches wide. Rack height & location shall be coordinated with the Owner. Racks shall have a black finish. Side channels shall be drilled & tapped on both sides.
4. All new wall mounted racks shall be mounted on Contractor provided ¾" fire-rated plywood.
    a. New racks shall be anchored to type of wall being installed on with proper rack mount hardware from the rack manufacturer and approved for the rack installation environment.
5. Unused rack equipment mounting screws shall be bagged & attached to the racks upon completion of the project.
6. All new racks & enclosures shall have a horizontal grounding bus bar installed at the top of each rack. See section 3.2D, Grounding and Bonding, below.
7. All existing racks and enclosures shall be provided with a new grounding bus bar and grounding to to data room ground bus bar if the existing racks do not have proper grounding. If the IDF room does not have a ground bus bar then the contractor shall provide a 6" pre-drilled ground bus bar with grounding to building steel.
8. Coordinate all placements of new racks with Owner.

B. Cable Management:
1. Horizontal Wire Management shall be provided and utilized by the Contractor. The system provided shall be comprised of equipment to manage cables on both the front & rear of the rack. The Wire Management shall protect network performance by controlling bend radius & providing cable strain relief.
2. All cable management channels shall have covers.
3. Horizontal Wire Managers shall be placed above & below each new patch panel.
4. D-Rings shall be metallic & used in areas of the Security Room or electrical room where cables are not supported by cable runway or cable tray. The D-Rings shall be minimum size of 4-inches. The Contractor shall be responsible for determining quantity and placement of D-Rings at strategic points throughout these areas.

C. Plywood Backboards:

1. If additional wall mounted racks are required & there is no existing fire-rated plywood at the proposed rack location, Contractor shall provide new ¾" fire retardant plywood with fire-rated stamped band on plywood facing outwards. Plywood is to remain unpainted.
2. ¾" fire retardant plywood shall be installed vertically for the ability to mount the rack/enclosure on the plywood.

D. Grounding and Bonding:
   1. Grounding shall be installed per NEC, J-STD-607-A and manufacturer's grounding requirements as minimum
   2. If there is no existing ground bus bar in the room where new racks/enclosures are to be installed, Contractor shall provide a new 6" ground bus bar.
      a. Provide conductor to bond the ground bus bar to building steel and to closest power panel. Size conductor per TIA guidelines.
   3. Bond and ground equipment racks with a #6 AWG stranded green insulated conductor. #12 AWG stranded insulated green conductor shall be used to bond surface mounted metallic raceways. However, in plenum areas, the grounding conductor shall be a bare, solid conductor for all grounding applications.
   4. Provide horizontal rack busbar at the top of each new rack / enclosure. Connect rack bus bars to wall mounted bus bar via home-run stranded #6 AWG stranded green insulated conductor.

E. UTP Cable Termination Hardware:
   1. Each horizontal cabling run will be terminated using appropriate connectors or connecting blocks depending upon the cable type.
   2. Horizontal networked cables will be terminated on new modular patch panels installed in the rack / enclosure.
   3. Cables shall be dressed & terminated in accordance with recommendations made in the TIA/EIA 568-B standard, manufacturer's recommendations & industry standards.
   4. Pair untwist at the termination shall not exceed .5"
   5. Bend radius shall not exceed 4 times (4x) the outside diameter of cable.
   6. Splitting the pairs prior to termination is not acceptable.
   7. Cables shall be neatly bundled & dressed into their respective panels. Each panel shall be fed by an individual bundle separated & dressed back to the point of cable entrance into the rack or frame.
   8. The cable jack shall be maintained as close as possible to the termination point.
   9. Each cable will be clearly labeled on the cable jacket behind the patch panel. Labels shall be machine printed & clearly visible within the bundle.
   10. 4-pair Category 6 UTP cabling shall be terminated onto a 4-pair Category 6 module. All modules shall be terminated using the T568B (B) wiring scheme. The eight position module shall exceed the connector requirements of the proposed TIA/EIA Category 6 standard.
   11. Modular Patch Panels shall be of the manufacturer & part number as listed in these specifications. The patch panels shall accept the Category 6 jacks specified. Mount patch panels in the data racks. Cables shall be neatly groomed with Velcro Integral cable ties. Port & panels shall be easy to identify with write-on areas. Patch panels shall be completely populated with jacks.
       a. Modular patch panels shall be angled type.

   12. Copper patch cords.
       a. Provide and install patch cords for connection from ceiling mounted outlet box to security camera & cross connect.
       b. Provide patch cords for connections from patch panels to Owner provided switches.

1. Contractor to plug the correct length of patch cord into the patch panel only. The other end will be left unconnected for Owner to provide the final connections to the Owner network electronics.
2. Patch cords shall be onsite no later than two (2) weeks prior to when IP connectivity is needed to occur.
3. Provide 10% spare patch cords of each needed length for Owner's future use. Turn these over to the Owner prior to close out.

13. See labeling section of these specifications for labeling requirements.

F. Fiber Terminated Hardware:
   1. Horizontal networked optical fiber cables will be terminated in the fiber enclosure installed in the rack / enclosure.
   2. All fiber optic cables are to be directly terminated utilizing ST connectors for the type & mode of the fiber optic cable being terminated.
   3. All fiber optic terminations shall be accomplished by fusion or no epoxy/no-polish field terminations.
   4. The terminated strands shall be secured within fiber optic enclosures. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure.
   5. Contractor will supply the appropriate number of fiber coupler panel blanks for each fiber enclosure where fiber optic terminations are not made.
   6. The cables strength member shall be securely attached to the cable strain relief bracket in the enclosure.
   7. When terminating the fiber via splicing, each fiber bundle shall be stripped upon entering the splice tray & then route the individual fibers in the splice tray.
   8. Fiber patch cords:
      a. Provide 10% spare patch cords of each needed length for Owner's future use. Turn these over to the Owner prior to close out.

3.3 WORK AREA OUTLETS:

A. Cables slack shall be coiled in the near the camera or other IP device neatly coiled and properly supported via j-hooks in areas of accessible ceilings. In areas where there is no ceiling and the area is open to structure, contractor shall coil the slack in junction boxes. In either case, the cable coil shall not exceed the bend radius or be secured where the cable is kinked or the cable jacket is deformed in any way.

B. Copper cables pair untwist at the termination shall not exceed .5".

C. Bend radius limitations shall be observed at each termination points.

D. The cable jacket shall be maintained to as close as possible to the termination point.

E. Copper UTP cables shall be terminated on a white RJ45 jacks. All RJ45 jacks shall meet or exceed the TIA/EIA-568-B.2-1 standard for Category 6.

F. If the IP security devices are required to terminate in 4”x4” outlets, then populate the faceplates with modules from the top left position, with the outlet being in a vertical position.

G. 106 Frames, if required, shall be a 2 or 4 port frame that mounts onto U.S. NEMA standard junction boxes and wall board adapters with screw-to-screw dimensions of 3.28" (83.3mm) and behind NEMA standard “106” duplex electrical faceplates. Frame shall accept individual modules that can be individually inserted and removed as required.

3.4 CAMERA LOCATIONS:

A. Provide & install plenum rated surface mounted outlet boxes for horizontal terminations at the device end.

B. Secure surface mounted outlet box to structure with appropriate hardware for the type of structure being mounted to.

C. For cameras being cabled with Category 6 UTP, cable final length shall not exceed 275 feet.
1. Cable slack shall be loosely coiled & stored in the accessible ceiling above each camera location. In areas of no accessible ceiling, cable slack shall be loosely coiled & supported above camera in a Contractor provided junction box.
2. Pair untwist at the termination shall not exceed .25”
3. Bend radius of the cable in the termination area shall not be less than 4 times (4x) the outside diameter of the cable.
4. The cable jacket shall be maintained as close as possible to the termination point.
5. Camera cables shall be terminated on RJ-45 jacks. Jack color shall be white, cable color shall be green. All RJ-45 jacks shall meet or exceed the TIA-568-C standard for Category 6.
6. Provide & install patch cord from ceiling mounted terminations to the security cameras, or other security IP devices.

D. For cables being cabled with 2 strand 50 micron, OM3 fiber, where the length of cable from the cross connect point in the telecommunications room/security room to the camera location exceeds 275 feet and less than 900feet.
1. Cable slack shall be loosely coiled & stored in the accessible ceiling above each camera location. In areas of no accessible ceiling, cable slack shall be coiled & supported above camera in a Contractor provided plenum rated junction box.
2. Correct bend radius shall be provided at all times.
3. All fiber shall be terminated with ST connectors & connected to Contractor provided media converter.
   a. Coordinate location of media converter with Owner and an existing receptacle to power the media converter.
   b. Provide UTP Category 6 cable from media converter to security camera areas and terminate with RJ-45 connector (this is required to be a plenum rated patch cord).
   c. Install media converter per manufacturer’s instructions.
   d. Coordinate settings on media converter with Owner.

E. Terminate horizontal cabling with connectors for the type of media being installed.

3.5 IDENTIFICATION AND LABELING:

A. All cables, patch panels, ports, grounding conductors & junction boxes shall be labeled with self-adhesive printed labels. Cables shall be labeled on each end. Refer to TIA/EIA 606 and Owner requirements to coordinate labeling schemes. Font size on labels shall be consistent throughout the facility. Label placement on face plates shall be consistent throughout facility. Font size shall be as large as possible yet still functional for the item being labeled.

B. All labels shall be black lettering on white labels.

C. Labels shall be placed 6" from the termination point on each end of the cables. Labels shall be clearly visible during construction & after construction is completed.

D. The label for the security camera cabling shall be as follows:
   1. CR#-TR#(IC#)-C-##-A-12 where "CR# school courier number, "TR#" or "IC#" designates the Telecom Room (telecom, electrical room, etc); "C##" designates camera number; "A" designates the patch panel; "12" designates the port number on the patch panel (match telecommunications labeling for patch panel and port numbers.

E. The label for the patch panel will be alphabetical in order from top to bottom, "A", "B", etc.

F. The label for the rack will be TR or IC-1, IC-2, etc., indicating "TR" or "IC" telecommunications room, "1", "2", etc indicates the number of the security room cross connect area. Coordinate labeling scheme with owner.

G. If a camera resides above the accessible ceiling, Contractor shall also label the ceiling grid below the camera. Label the grid with the camera and cable number.

3.6 TESTING:

A. The Owner reserves the right to test all delivered goods, and to use a portion of any goods before the results of the tests are delivered, without prejudice to any final adjustments, rejecting the unused portion of the delivery, and making payment on an adjusted basis for the used portion. The cost of inspections & tests of any item, which fails to meet the advertised specifications, shall be borne by the contractor.

B. All cables and termination hardware shall be 100% tested for defects to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA 568-B and 526-14A. The field test equipment shall meet the requirements of ANSI/TIA/EIA 568-B. Testing shall be accomplished using level III field testers for copper, and a power meter and light source tester for fiber.

C. Test each copper pair & shield of each cable for opens, shorts, grounds and pair reversal. Correct grounded and reversed pairs. Examine open & shorted pairs to determine if problem is caused by improper termination.

D. Test each fiber strand to measure input and output power levels to determine attenuation.

E. Testing equipment shall be calibrated prior to testing. (Calibration results from the manufacturer are required in the Close Out Document submittal for each tester used on the project.)

F. Test results shall be submitted within ten (10) days of the completion of each testing phase.

G. When repairs & re-tests are performed, the problem found & corrective action taken shall be noted, and both the failed and passed test data shall be documented and included in the final close-out documents.

H. The Designer and/or Owner may request that at 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Test shall be a repeat of those defined above. If findings contradict the documentation submitted by the Contractor, additional testing can be requested to the extent determined necessary by the Designer and/or Owner, including a 100% re-test by outside agency. This re-test shall be at no additional cost to the Owner.

I. Copper Permanent Link Testing

1. Perform testing of copper cables with tester meeting ANSI/TIA/EIA 568 requirements.
2. If horizontal cables contain bad conductors or shield, remove & replace cable. '*Pass' results will not be accepted
3. Continuity – Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs.
    a. Shielded / screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturer's recommended procedures, and referenced to the appropriate cable identification number & circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
4. Length – Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA/EIA 568-B standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. This documentation shall be in a sequential format. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.
5. Category 6 Performance:
    a. Follow the Standards requirements established in ANSI/TIA/EIA 568-B-1.
    b. A level III test unit is required to verify category 6 performance.
    c. Required tests:
        1. Wire Map.
        2. Insertion Loss.
        3. Length.
        4. NEXT loss, pair to pair, measured from local end.
        5. NEXT loss, pair to pair, measured from far end.
        6. NEXT loss, power sum, measured from local end.
        7. NEXT loss, power sum, measured from far end.
        8. Return Loss, measured from local end.
        9. Return Loss, measured from far end.
        10. ELFEXT, pair to pair.
        11. ELFEXT, power sum.
        12. Propagation Delay.
        13. Delay skew.
        14. ACR.
        15. Power Sum (PSACR).

J. Fiber Testing:

1. All horizontal cabling, which is terminated by the Contractor, shall be tested to applicable EIA/TIA Standards.
2. The insertion loss for each mated fiber optic connector pair shall be ≤ 0.75 dB. Reflectance for single-mode single fiber UPC cable assemblies shall be ≤ -55dB.
3. In addition to connector insertion loss for each mated pair, the SC shall perform end-to-end insertion loss testing for each multimode fiber at 850 nm and 1300 nm from one direction for each terminated fiber span in accordance with EIA/TIA-526-14A (OFSTP 14). For spans greater than 90 meters, each tested span must test to a value less than or equal to the value determined by calculating a link loss budget. For horizontal spans less than or equal to 90 meters, each tested span must be ≤ 2.0 dB.
4. Inspect each terminated multimode fiber span for input and output levels to determine attenuation. Use the 1 port method to determine attenuation associated with each terminated connector and their associated insertion losses.

K. Horizontal testing results are to be presented in electronic format.

L. Tests are to be performed utilizing the graphic chart option on the cable tester. Test results will not be accepted without graph representation.

3.7 SYSTEM DOCUMENTATION AND OWNER ACCEPTANCE:

A. The Contractor shall maintain at the site, one (1) record copy of all Contract Documents in good order & marked currently to record all changes made during construction; and shall also maintain at the site copies of approved shop drawings, product data operation and maintenance.

B. The final inspection by the Designer and/or Owner shall be the closure of all previously listed punch list items.

C. The Completion Date of Project is defined as the date that all documentation obligations have been met under the Construction Documents and these specifications.

D. The final inspection by Building Standards shall be the closure of required Electrical Permits.

E. Upon completion of the installation, the Contractor shall provide electronic files of all Close Out Document materials.

F. Close-Out Document Submittal:
   1. Electronic files.
      a. The test results shall include a record of test frequencies, cable type, conductor pair and identified in the same format required in the "Identification and labeling" section of this specification, measurement direction, reference setup, and crew member name(s). Results shall have all cables sequentially listed. The test documents shall detail the test method used & the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
         1. Copper Test Results (Permanent Link).
         2. Copper Test Summary (Single Line).
         3. Copper Test Detail for each cable.
         4. Fiber Test Results, Basic Link.
         5. Fiber Test Summary (single line).
         6. Patch panel logs in editable electronic format, either Word Document or Excel Document.

2. Draft (marked up) as-built drawing submitted may be requested by the Owner within 30 days of the Completion Date of Project.
3. Calibration Sheets in PDF format – Include test equipment name, manufacturer, model number, serial number, software version and last calibration date. Submit sheets for each tester being used for the project.
4. Patch Panel Log in PDF and Excel format – Labeling shall be consistent with the "Identification and Labeling" section of this specification.
5. Electrical Permit Inspection Detail – PDF format.
6. Final As-Built Drawings:
    a. Submitted drawings shall be neat, clear and professionally produced. Do not place text over objects where the label indicator cannot be deciphered. Use care to keep the test size consistent throughout the drawings. Do not use colored ink to distinguish between symbols or lines. Provide another symbol or line type designation to represent different components. Any final as-built drawing will be subject to rejection if the Designer and/or Owner find the information on the printed drawings unclear.
    b. Final drawings shall indicate all horizontal cable routes. They will also indicate final outlet locations labeled according to the "Identification and Labeling' section of this specification. Indicate final pathway locations and final locations of all equipment. Use a different line-type for each type of cable installed.
    c. Include a legend on the first sheet indicating line-type of each cable, and any additional symbols the Contractor has added.
    d. PDF and .dwg format.
7. Provide facility assignment records which include patch panel logs and as-built C size (11"x22") in a laminated protective cover at each Security Room location that is specific to the facilities terminated therein.
8. Warranty Information:
    a. The Contractor shall guarantee all equipment, wiring and software for this system to be free of defects in workmanship & material for a period of one (1) year from the date of acceptance by the Owner.
    b. The Contractor shall provide a minimum period of twenty (20) years manufacturer's warranty on materials & equipment. Any manufacturer's warranty that may exceed a twenty (20) year period shall also be provided through the Contractor.
    c. Warranty service by the Contractor shall include eight (8) hour emergency response service during normal contractor working hours; and twelve (12) hour emergency response service after normal contractor working hours, on weekends and on holidays. Response time shall be measured from the time of Contractor notification to the arrival of service personnel at the affected site to initiate repairs. The Contractor shall provide a method of requesting emergency service after normal working hours, on weekends, and on holidays appropriate to the required response time.
    d. The Owner shall be presented with the horizontal cable materials warranties no later than ninety (90) days after project completion.

3.8 SITE CLEAN UP:

A. All areas where work is conducted, shall be cleaned up on a daily basis.

3.9 SECURITY/TELECOM ROOM CLEAN UP:

A. All room locations must be broom and/or vacuum swept. This includes the space between the racks & the trough between the base footprint of the rack.

B. All data racks and enclosures shall be wiped clean.

C. All cabinet locations must be broom and/or vacuum swept. This includes the bottom space of the cabinet.

END OF SECTION

This Master Specification Section summarizes Charlotte-Mecklenburg Schools' standards and requirements for the Work of this Section. This document may be edited by holders of a valid Masterspec license: www.Masterspec.com. Design professional of record shall edit this document to correspond to Project requirements. Obtain CMS approval for manufacturers and products not listed in this Master Section.

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE

A. This standard provides the functional requirements for the installation, programming, configuration, warranty and maintenance of a complete Class B Analog/Addressable Intelligent Fire Alarm / Life Safety System.

B. This Fire Alarm / Life Safety System Standard must be conformed to in its entirety to ensure that the installed and programmed Life Safety System will function as designed, and will accommodate the future requirements and operations required by the building owner. All specified operational features will be met without exception.

C. Section Includes:
1. Fire-alarm control unit or fire alarm control panel.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Air-sampling smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Standby Power Supplies.
8. Device guards.
9. Magnetic door holders.
10. Remote annunciator.
11. Addressable interface device.
12. Digital alarm communicator transmitter.
13. Surge Protection and Grounding.
14. CO Detector.
15. Programming, Commissioning and Training of Operators.
16. Conduit, wire and accessories required to furnish a complete and Operational Life Safety System.

D. Related Requirements:
1. Section 28 05 13 "Conductors and Cables for Electronic Safety and Security" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. NICET: National Institute for Certification in Engineering Technologies.

1.4 PERFORMANCE REQUIREMENTS

A. Statutory and Reference Standard Compliance:
   1. The latest edition of the North Carolina State Building Code.
   2. North Carolina Department of Insurance "Requirements for Fire Alarm Detection and Alarm Systems", latest revision.
   3. National Fire Protection Association Standards:
      a. NFPA 70 - National Electric Code
      b. NFPA 72 - National Fire Alarm Code
      c. NFPA 90A - Air Conditioning Systems
      d. NFPA 101 - Life Safety Code
   4. Underwriters Laboratories Inc. for use in fire protective signaling systems shall list the system and all components. The UL Label shall be considered as evidence of compliance with this requirement. The equipment shall be listed by UL under the following standards as applicable:
      a. UL 864/UOJZ, APOU - Control Units for Fire Protective Signaling Systems.
      b. UL 1076/APOU - Proprietary Burglar Alarm Units and Systems.
      c. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.
      d. UL 268A - Smoke Detectors for Duct Applications.
      e. UL 217 - Smoke Detectors Single Station.
      f. UL 521 - Heat Detectors for Fire Protective Signaling Systems.
      g. UL 228 - Door Holders for Fire Protective Signaling Systems.
      h. UL 464 - Audible Signaling Appliances.
      i. UL 1638 - Visual Signaling Appliances.
      j. UL 38 - Manually Activated Signaling Boxes.
      k. UL 346 - Water flow Indicators for Fire Protective Signaling Systems.
      l. UL 1971 - Visual Signaling Appliances.
      m. UL 1481 - Power Supplies for Fire Protective Signaling Systems.
   5. Americans with Disabilities Act (ADA).

1.5 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.

B. Shop Drawings: For fire-alarm system.
   1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   2. Include plans, elevations, sections, details, and attachments to other work.
   3. 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.

4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Locate detectors according to manufacturer's written recommendations.
    d. Show air-sampling detector pipe routing.
13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
    a. Trained and certified by manufacturer in fire-alarm system design.
    b. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.7 Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

B. REVIT and AUTOCAD copy of the as-built fire alarm map (not just the system as-builts). This is the as-built map that is posted by the annunciator.
1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
   a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
   d. Riser diagram.
   e. Device addresses.
   f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
   g. Record copy of site-specific software.
   h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
      1) Equipment tested.
      2) Frequency of testing of installed components.
      3) Frequency of inspection of installed components.
      4) Requirements and recommendations related to results of maintenance.
      5) Manufacturer's user training manuals.
   i. Manufacturer's required maintenance related to system warranty requirements.
   j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

C. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.9 COMMISSIONING

A. At Commissioning provide the following:

1. Warranty Statement from the manufacturer: Warranty statement will state the period of warranty for all of the products proposed for the project and shall include the name and address of the authorized manufacturers' agent who will honor any and all warranty claims.
2. Written Certification by the Fire Alarm Installer that no power supply or circuit in the system has an electrical load greater than 80% of its rated capacity.
3. A scaled plan of each building showing the placement of each individual item of fire alarm equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
4. A Single Line System Block Diagram and written System Operational Overview.
5. Complete calculations showing the electrical load on the following system components.
6. Each system Power Supply
7. Each standby Power Supply (batteries)
8. Each Notification Appliance Circuit.
9. ach auxiliary control circuit that draws power from any system power supply.
10. Field Connection Drawings: A complete set of drawings, one for each Fire Alarm Control Panel module which has any external (field) wiring connected to it, and one for each system detector, module or signaling appliance, shall be supplied. The Field Connection Drawings shall be provided in paper (hard-copy) format.
11. Print-out report detailing the sensitivity of each smoke detector installed in the system. Include date on report.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: The installer shall be a licensed low voltage contractor and a factory authorized distributor to ensure proper specification adherence, final connection, test, turnover, warranty compliance and service. The installer shall maintain a service organization with adequate spare parts stock within 50 miles of the installation. Installer shall have training certification by the manufacturer of the Fire Alarm Control Equipment. This certification shall not be more than two years old, to ensure up-to-date product and application knowledge on the part of the installing installer.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level IV technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.11 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
1. Notify Architect and Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Architect's written permission.

C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.12 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.13 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 Extent: All equipment and components not covered in the Maintenance Service Agreement.
   2. Warranty Period: Two years from date of Substantial Completion.

B. Installer Warranty: Installer shall warrant the installed fire alarm system to be free from any defects of material and installation for a period of 2 years from acceptance by the professional engineer and/or owner.
   1. Any deficiencies shall be immediately corrected at no additional cost to the owner.
   2. Any defects that render the system inoperative shall be repaired within 24 hours of the owner notifying the contractor. Other defects shall be repaired within 48 hours of the owner notifying the contractor.

1.14 INSPECTIONS

A. All work shall be inspected and approved by the Mecklenburg County Engineering and Building Standards Department, the Charlotte - Mecklenburg Fire Marshal, School Enforcement Inspectors and the CMS Electronics Department prior to final payment. The Installer shall provide all material, equipment and labor necessary to pass inspections by the Mecklenburg County Engineering and Building Standards Department and the Charlotte - Mecklenburg Fire Marshal Office. Written documentation of inspections shall be provided to the CMS Electronics Department.

B. A complete set of as-built wiring schematics, drawn to scale; showing all device locations, wire routing and connections, etc. shall be provided to the CMS Electronics Dept. prior to final inspection.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment furnished for this project shall be new and unused. All equipment, materials, accessories, devices, and other facilities covered by this guideline or noted on contract drawings and installation specifications shall be the best suited for the intended use and shall be provided by a single manufacturer.

B. Manufacturer's representative and a Record of Completion presented upon completion shall verify system installation and operations. The manufacturer's representative shall be responsible for an on-site demonstration of the operation of the system and initial staff training.

2.2 SYSTEM DESCRIPTION

A. All Control Panel Assemblies and the connected Automatic and Manual Alarm and Notification Appliances shall be designed and manufactured by the same company, shall be tested and cross-listed as compatible (to category UOJZ) to ensure that a fully functioning Life Safety System is designed and provided.

B. The Fire Alarm / Life Safety System supplied under this guideline shall be a microprocessor-based direct wired system. System shall utilize independently addressed, microprocessor-based smoke detectors, heat detectors, and modules, as described in this specification.

C. All initiation devices shall be analog addressable devices. The notification devices shall be installed where required to meet ADA, NFPA 72 and Charlotte- Mecklenburg Building Standards codes.

D. Locate the Fire Alarm Panel in the main electrical room. Locate a full function annunciator in the main office and a display only alpha-numeric display at the front door.

E. All Fire Alarm / Life Safety equipment shall be arranged and programmed to provide an integrated system for the early detection of fire, the notification of building occupants, the notification of CMS security, the override of the HVAC system operation, the shut-down of the kitchen hood, and the activation of other auxiliary systems to inhibit the spread of smoke and fire and to facilitate the safe evacuation of building occupants.

F. All strobes shall be synchronized. A strobe unit shall be installed in every occupied space which includes all classrooms, restrooms, conference rooms, tutor rooms, science prep rooms and waiting areas/lobbies. Smoke and thermal detectors shall be installed in compliance with NFPA 72 codes. Duct detectors shall interface with HVAC systems to shut down necessary air-handling units.

G. The fire alarm system shall be microprocessor driven with stored program controllers. Each panel (node) on the network shall use a multiple microprocessor design so that the failure of a single microprocessor will not result in a local failure. Fire alarm systems that utilize only one microprocessor for system (node) and SLC control will not be accepted.

H. The Life Safety System shall be UL listed under Standard 864 (Control Units for Fire-Protective Signaling Systems) under categories UOJZ and APOU. The specified modules shall also be listed under UL 1076 (Proprietary Burglar Alarm Units and Systems) under category APOU.

I. A standby power supply shall automatically supply electrical energy to the system upon primary power supply failure. Use "Emergency Generator" circuit where available. Standby power shall be an electrical battery with capacity to operate the system under maximum supervisory load for 24 hours and capable of operating the system for 5 minutes in the alarm mode at 100% load, 15 minutes for voice components. Fire alarm shall include a charging circuit to automatically maintain the electrical charge of the battery.

J. Do not install notification appliances on the exterior of the building unless specifically directed to do so by the Project Manager.

K. Remote LED indicators must be installed at each duct detector location. Install the indicator in the ceiling so it can be seen while standing in the corridor/classroom.

L. All power supplies must be on dedicated circuits. Existing building circuits (receptacles, lights, etc.) cannot be used. Use generator power where available.

M. Smoke detectors shall be installed a minimum of 3' from air supply diffusers and lighting fixtures.

N. Automatic door closers to be activated by local smoke detectors only.

O. Use toggle bolts for all wall mounted equipment/components/appliances

P. All Fire Alarm wiring shall be FPLR or FPLP in conduit or duct, or MC fire alarm cable.

Q. Provide remote LED indicator lights for all duct detectors. Locate indicators in corridors.

R. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

S. Automatic sensitivity control of certain smoke detectors.

T. All components provided shall be listed for use with the selected system.

U. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Automatic sprinkler system water flow.
6. Fire-extinguishing system operation.
7. Fire standpipe system.
8. Fire pump running.
9. Preaction system.

B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances, including voice evacuation notices.
2. Local sounding device at panel shall be activated.
3. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
4. Transmit an alarm signal to the remote alarm receiving station.
5. Unlock electric door locks in designated egress paths.

6. Release fire and smoke doors held open by magnetic door holders.
7. Activate voice/alarm communication system.
8. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
10. Recall elevators to primary or alternate recall floors.
11. Activate emergency shutoffs for gas and fuel supplies.
12. Mute elective audio systems installed permanently within the facility (Intercom, sound systems).
13. Activate preaction system.
14. 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 dry-pipe or preaction sprinkler system.
3. Alert and Action signals of air-sampling detector system.
4. Elevator shunt-trip supervision.
5. User disabling of zones or individual devices.
6. Loss of communication with any panel on the network.
7. Carbon monoxide detectors.
8. Fire pump running.
9. Fire-pump loss of power.
10. Fire-pump power phase reversal.
11. ERRS
    a. Donor antenna malfunction.
    b. Active RF-emitting device failure.
    c. Low battery capacity indication when 70 percent of the 12-hour operating capacity has been depleted.
    d. Active system component failure.
    e. Loss of normal AC power
    f. Failure of battery charger
    g. Communication link between fire alarm system and ERRS.
12.

D. System Supervisory Signal Actions:
1. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
2. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
3. Display system status on graphic annunciator.
4. Transmit an alarm signal to the remote alarm receiving station.

E. 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 communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.

8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.

F. System Trouble Signal Actions:
1. Trouble indicator shall flash.
2. A local sounding device in the panel shall be activated
3. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
4. Unacknowledged alarm messages shall have priority over trouble messages, and if such an alarm must also be displayed, the trouble message will not be displayed until the operator has acknowledged all alarm messages.
5. Transmit an alarm signal to the remote alarm receiving station.

G. Preaction System Functionality:

a. Initiate Presignal Alarm: This function must cause audible and visual alarm and indication to be provided at FACU. Activation of initiation device connected as part of preaction system must be annunciated at FACU only, without activation of general evacuation alarm.

2.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.5 FIRE-ALARM CONTROL UNIT

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated in these specifications or a comparable product by one of the following:
1. EST IO1000
2. Fire-Lite MS-9600UDLS
3. Notifier Onyx NFS320(Elementary only) or NFS640(middle, K8, high school).
4. Siemens Cerberus Pro FV922/924

B. The above constitute the minimum type and quality of equipment to be installed.

C. General Requirements for Fire-Alarm Control Unit:
1. Operators' Interface:
a. Character Graphical Display shall provide the means to inform the System Operator with detailed information about the off-normal status of the installed Fire Alarm / Life Safety System. Character Graphical Display shall automatically respond to the status of the system and shall display that status in character front panel display.
2. Automatic Functions: The following status functions shall be annunciated by the Character Graphical Display:
a. When the Fire Alarm / Life Safety System is in the "Normal" Mode, the panel displays: Current Date and Time, Custom System Title (minimum 2 lines X 21 characters), and a summary total of system events.
b. The Character Graphical Display shall provide separate event queues for ALARM, TROUBLE, SUPERVISORY and MONITOR.
3. Loop Controller Interface:

a. An Electronic 100% digital Loop Controller shall be provided in each Fire Alarm Control Panel (where needed), to interface between the panel and the Analytical Microprocessor-based Detectors and modules.
b. It shall be possible to connect the electronic loop controller to the Analytical Microprocessor-based Detectors and modules utilizing any wiring material or method complying with Chapter 3 of the National Electrical Code (ANSI/NFPA 70-1996) as Class A (Style 6 or Style 7) or Class B (Style 4) circuits without the use of special shielding, twisted wire, or conduits. It must be possible to wire branch circuits (T-Taps) from Class B Circuits (Style 4). Each Electronic Protection Loop shall be configurable to operate as a Style 7 loop without the need for additional hardware modules.
c. All system programming and history shall be permanently stored in non-volatile memory to ensure that no programming or history is lost. Systems which store initial programming or field programming changes in battery backed memory will not be accepted.
d. The Electronic Loop Controller shall be capable of setting the address of all Analytical Microprocessor-based Detectors and modules connected to it electronically, without the need to set switches at any of the individual devices.
e. The Electronic Loop Controller shall notify the System Operator when any connected smoke detector reports a "Routine Maintenance Required" signal to the system.

4. Notification Appliance Circuits:
   a. Provide where indicated on the plans supervised hard-wired Notification Appliance Circuits (NAC) for the control of 24VDC signaling appliances. Each NAC shall operate as a Class B (Style Y) circuit and shall be capable of controlling up to 3.5 amps of signaling power.
   b. NAC's shall be power limited to 3.5A at 24VDC and 4.1A at 20.4VDC to support higher current demand by visible appliances at lower battery voltages.
5. Remote Diagnostic Utility - RDUEU-E or equal:
   a. The Fire Alarm System shall have the ability to report its status and sensitivity remotely over modem to a personal computer. The system shall be capable of generating sensitivity, system status, and trend analysis reports from data downloaded from the panel. Installer to provide the modem at the panel. The personal computer is existing at CMS Building Services office location.

2.6 MANUAL FIRE-ALARM BOXES

A. The Microprocessor-based Addressable Fire Alarm Stations shall be a Lexan double action fire alarm stations and fit in to a standard electrical box

B. Stations shall be key reset.

C. Station shall be in red with white "PULL IN CASE OF FIRE" lettering.

D. EST # SIGA-278.

2.7 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:
   1. System shall use Analytical Microprocessor-based Detectors that are capable of full digital communications with the Fire Alarm / Life Safety System using both broadcast and polling communications protocols. Each detector shall be capable of performing

independent advanced fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted nuisance alarms caused by environmental events. Signal patterns that are not typical of fires shall be eliminated by digital filters and will not cause a system alarm condition. Devices not capable of combining different fire parameters or employing digital filters will not be acceptable.

2. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detectors' memory. Detectors not capable of making independent alarm decisions are not be acceptable. Maximum total loop response time for detectors changing state (alarm or trouble) shall be 0.5 seconds.
3. Each detector shall be capable of identifying diagnostic codes to be used for system maintenance. All diagnostic codes shall be stored in the detector. Each smoke detector shall be capable of transmitting pre-alarm, alarm, and maintenance signals to the Fire Alarm Control Panel via the Electronic Loop Controller.
4. All of these devices and their bases will also be required to be labeled with engraved Lexan labels to identify device address and intended location. Labels shall be red background with white letters, letters shall be a minimum of 1/4" in height.

B. Photoelectric/Multi-Criteria Smoke Detectors:
1. Photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to detect visible particulates produced by combustion. The integral microprocessor shall dynamically examine values from the sensor and initiate a system alarm based on the analysis of data. Detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity. Information shall be stored in the detectors' memory and shall be transferred to the electronic loop controller for retrieval using a laptop PC or the Intelligent Detector Program/Service Tool designed by the manufacturer specifically for the purpose.
2. The alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5% smoke obscuration per foot. The photo detector shall be suitable for operation in the following environment:
   a. Temperature: 32° F to 120° F (0oC to 49oC)
   b. Humidity: 0-93% RH, non-condensing
   c. Elevation: no limit
3. EST #SIGA-OSD, Siemens OP921 or OH941.

2.8 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.
1. System shall use Analytical Microprocessor-based Detectors that are capable of full digital communications with the Fire Alarm / Life Safety System using both broadcast and polling communications protocols. Each detector shall be capable of performing independent advanced fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted nuisance alarms caused by environmental events. Signal patterns that are not typical of fires shall be eliminated by digital filters and will not cause a system alarm condition. Devices not capable of combining different fire parameters or employing digital filters will not be acceptable.
2. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detectors' memory.

Detectors not capable of making independent alarm decisions are not be acceptable. Maximum total loop response time for detectors changing state (alarm or trouble) shall be 0.5 seconds.

3. Each detector shall be capable of identifying diagnostic codes to be used for system maintenance. All diagnostic codes shall be stored in the detector. Each smoke detector shall be capable of transmitting pre-alarm, alarm, and maintenance signals to the Fire Alarm Control Panel via the Electronic Loop Controller.
4. All of these devices and their bases will also be required to be labeled with engraved Lexan labels to identify device address and intended location. Labels shall be red background with white letters, letters shall be a minimum of 1/4" in height.

B. Detectors - Fixed Temperature/Rate of Rise Heat Detector:
1. Heat Detector shall have a solid-state heat sensor, and shall transmit an alarm at a fixed temperature of 135° F (57°C) or due to a temperature Rate of Rise of 15°F/minute (9°C/minute). The detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
2. The heat detector shall be rated for ceiling installation at 70 ft (21.3m) centers and be suitable for wall mount applications.
3. EST # SIGA-HRD, Siemens HI921.
4. Heat detectors provided for kiln rooms shall be standard rated.

2.9 DETECTOR MOUNTING BASES

A. Mounting base will not contain any electronics, shall support all Microprocessor-based Smoke detector types detailed in this specification, and have the following minimum requirements:
1. Removal of the respective detector will not affect electronic loop communications with other detectors on that loop.
2. Field Wiring Connections shall be made to the room side of the base, so that wiring connections can be made or disconnected by the installer without the need to remove the mounting base from the electrical box.
3. The base shall be capable of supporting remote alarm annunciation.
4. Bases will have the option of external L.E.D. operation, Relay base or data line isolator base.
   a. Relay base shall mount in a standard electrical box described above and provide Form "C" contacts rated at 1 amp @ 30VDC and listed for "pilot duty".
   b. Isolator bases shall operate within a minimum of 23 msec. Of a short circuit on the data line, shall run self-test procedure to re-establish normal operation, and shall operate in a class 'A' operation as well as class 'B'.
5. EST # SIGA-SB4, #SIGA-IB4, or SIGA-RB4, Siemens DB-11.

2.10 DUCT DETECTOR HOUSING

A. The Analytical Microprocessor-based photoelectric smoke detector shall be readily adaptable for use in air duct smoke detection applications, using a housing that mounts to the outside of the duct. When used for duct smoke detection, the smoke detectors will not forfeit any of the system functionality which they have when used as area smoke detectors.

B. The duct smoke detection housing shall allow the detector to sample and compensate for, variations in duct air velocity between 300 and 4000 feet per minute.

C. Remote alarm LEDs and Remote Test Stations shall be supported by the duct smoke detector and provided where indicated.

D. All detectors used in duct applications shall be located in accordance with NFPA 72 recommendations.

E. EST # SIGA-SD.

2.11 CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire-alarm system.

B. Edwards # SIGA-COD or equal.

C. Kitchen carbon monoxide detector, where applicable shall have (1) detector with an output screen that reads carbon monoxide parts per million. Unit shall have battery back up with a test/reset switch and a peak level switch for personnel recording. Unit shall be plug-in type and not centrally connected to the fire alarm system. Based on the following, but not limited to:
   1. KIDDIE KN-COPP-3

2.12 NOTIFICATION APPLIANCES

A. General:
   1. All appliances which are supplied for the requirements of this specification shall be U.L. Listed for Fire Protective Service and shall be capable of providing the "Equivalent Facilitation" which is allowed under the Americans with Disabilities Act Accessibilities Guidelines (ADA (AG)), and shall be UL 1971, and ULC S526 Listed.
   2. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure absolute compatibility between the appliances and the control panels, and to ensure that the application of the appliances are done in accordance with the single manufacturers' instructions.
   3. All horns shall be electronic, with field selectable jumpers to set operation for either continuous ring or temporal pattern and shall provide an adjustable high output or low output at 98dB or 94dB - EST Genesis series horn-strobe. In - Out screw terminals shall be provided for wiring, the use of 'pig-tail' type connectors are not acceptable.
   4. Wall or ceiling mount notification devices are acceptable.
   5. All speaker/strobes shall be Genesis series with selectable candela output and wattage switch.
   6. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
   7. Matching Transformers: Tap range matched to acoustical environment of speaker location.
   8.
   9. Voice notification systems shall be used as a basis of design where required in any portion of the school. Do not mix horn audible notifications and speaker voice notifications.

B. Self - Synchronized Strobes - Genesis series as required:

1. Strobes shall be supplied by the same manufacturer as the Fire Alarm Control Equipment. In - Out screw terminals shall be provided for wiring. The Strobes shall have a red or white plastic faceplate. They shall provide the proper candela output for the project per NFPA 72 spacing guidelines and synchronized flash outputs minimum requirements. The strobe shall have lens markings oriented for wall mounting.
2. In - Out screw terminals shall be provided for wiring. They shall provide synchronized flash outputs as required to comply with code requirements.
3. EST Genesis series horn-strobe.

2.13 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
   1. Electromagnets: Require no more than 3 W to develop 25-lbf (111-N) holding force.
   2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
   3. Rating: 24-V ac or dc.

B. Material and Finish: Match door hardware.

2.14 REMOTE ANNUNCIATOR

A. Remote LCD annunciators shall have the full ability and duplicate in all fashion the main user interface located on the control panel. This includes the ability to control all system functions, tests, programming, and annunciations.

B. Annunciator shall also include the ability to add programmable switches and or LED's as required for special functions without the need to add additional wires or cabinets.

C. Locate one remote full function LCD annunciator in the administration area of the building.

D. Locate one display only alpha-numeric annunciator adjacent to the front door.

E. EST # RLCD/C

2.15 ADDRESSABLE INTERFACE DEVICE

A. General:
   1. Fire Alarm / Life Safety System shall incorporate microprocessor-based addressable modules for the monitoring and control of system Input and Output functions over a 2 wire electronic communications loop, using both broadcast and serial polling protocols. All modules shall display communications and alarm status via LED indicators.
   2. The function of each connected module shall be determined by the module type, and shall be defined in the system software through the application of a personality code. Simply changing the associated personality code may change module operation at any time.
   3. All addressing of the Microprocessor-based Addressable Modules shall be done electronically, and the electrical location of each module shall be automatically reported to the Fire Alarm Control Panel, where it may be downloaded into a PC, or printed out. The addressing of the modules will not be dependent on their electrical location on the circuit.

4. All field wiring to the Microprocessor-based Addressable Modules shall be supervised for opens and ground faults and shall be location annunciated to the module of incidence.
5. Diagnostic circuitry, and their associated indicators, with reviewable Trouble Codes, shall be integral to the Microprocessor-based Addressable Modules to assist in troubleshooting system faults.
6. The module shall be suitable for operation in the following environment:
   a. Temperature: 32oF to 120oF (0oC to 49oC)
   b. Humidity: 0-93% RH, non-condensing

B. Single Input Module:
1. Microprocessor-based Addressable Modules shall be used to provide one (1) supervised Class B (style B) input circuit capable of latching operation for use with contact devices, non-damped water flow switches, non-latching supervisory sprinkler switches.
2. EST # SIGA-CT1.

C. Dual Input Module:
1. Microprocessor-based Addressable Modules shall be used to provide two (2) independent supervised Class B (style B) input circuits capable of operating with two (2) contact devices. Both of the input circuits shall be terminated to, and operated from, the same microprocessor-based addressable module. The Initiating Device Circuit connected to the module shall be fully supervised for open circuits and ground faults.
2. EST # SIGA-CT2.

D. Single Riser Signal Module:
1. The Microprocessor-based Addressable Single Input Signal Module shall provide one (1) supervised Class B (style Y) Notification Appliance Circuit capable of a controlling 2A of polarized 24 VDC Notification Appliances, 50W speaker circuit power @ 25VRMS, or 35W speaker circuit power @ 70VRMS.
2. EST # SIGA-CC1.

E. Control Relay Module:
1. Microprocessor-based Addressable Control Relay Modules shall provide one form "C" dry relay contact rated at 2 amps @ 24 VDC or 0.5 amps at 120 VAC to, control external appliances or equipment processes. The control relay module shall be rated for pilot duty applications and releasing systems service. The position of the relay contact shall be confirmed by the system firmware.
2. EST # SIGA-CR.

2.16 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
1. Cellular line – single main source. Provide Napco Starlink (SLD-CMDA-FIRE) fire alarm communicator and SLE-ANTEXT50 external antenna to match existing CMS cellular dial out service. Cellular dial out shall be backed up as part of battery backup as well as generator backed up where available.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture a preset number for a remote central station.

When contact is made with central station(s), signals shall be transmitted. If service on the cellular line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal. Transmitter shall automatically report cellular service restoration to the central station. If service is lost, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:
   1. Verification that cellular line is 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.

D. 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.
   4. Loss of ac supply.
   5. Loss of power.
   6. Low battery.
   7. Abnormal test signal.
   8. Communication bus failure.

2.17 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the smoke detector, or notification device requiring protection.
   1. Factory fabricated and furnished by device manufacturer.
   2. Finish: Paint of color to match the protected device.

B. Description: ADA compliant Stopper II pull station covers with alarm signal.
   1. STI-1130 for surface mount.
   2. STI-1100 for flush-mount.

2.18 FIRE PULL STATION SIGNAGE

A. Description: The signs shall read "FIRE PULL STATION". Signs shall be 3"x 8" x.0.13" made of molded styrene. White 0.132" raised copy letters with red background and Braille Grade 2. Letters to be ¾" high, Helvetica medium and all caps.

2.19 MAPS

A. Description: Identification map showing all initiating devices and their address numbers.

2.20 SURGE PROTECTION

A. AC Protection provide Surge Suppression Incorporated Model S-SPT120-15 or equal.

B. Notification Appliance Circuit (NAC) Protection provide Surge Suppression Incorporated Models TC24D2-B, TP224D4-B, or TP224D8-B or equal.

C. Initiating Device Circuit (IDC) Protection provide Surge Suppression Incorporated Models DP24C2-B, DC24C2-B, TC24D2-B, TP224D4-B, or TP224D8-B or equal.

D. Signaling Line Circuit (SLC) Protection provide Surge Suppression Incorporated Models DP24C2-B, DC24C2-B, TC24D2-B, TP224D4-B, or TP224D8-B or equal.

E. Auto Dialer Lines Protection provide Surge Suppression Incorporated Models TC130D2-B, TC130D4-B, or TC130D6-B or equal.

F. Point of Use AC Protection provide Surge Protection Incorporated Model S-SPIU2 or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
   1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
   1. Devices placed in service before all other trades have completed cleanup shall be replaced.
   2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. The entire system shall be installed in a workmanlike manner in accordance with approved manufacturers manuals and wiring diagrams. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation.
   1. All wiring shall be of the type recommended by the NEC, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated raceways throughout. All wiring shall be in conduit or the special MC cable noted below. Wiring shall be in rigid conduit when run outside above ground and in PVC when run outside below ground. Wiring run below ground shall be suitable for wet locations. Wiring shall be color coded red. All wiring shall be installed by the low voltage installer. All final connections shall be made by the low voltage installer.
   2. Run all fire alarm cable in separate pathways from other low voltage circuits.
   3. For indoor use, an acceptable alternative to cable in rigid conduit in most locations will be plenum rated MC fire alarm/control cable equal to AFC Cable Systems type FPLP.

Cable will be color coded red. In new construction, EMT will be run in walls to a surface mounted box above the ceiling. MC cable will be run to the box with the armor stripped off enough to feed the device connected to the conduit without using additional splices. Use separate cables for data and signals. Cable will be supported in a similar manner as conduit. The fire alarm installer will be responsible for the installation of the fire alarm MC cable and fire alarm devices. The electrical contractor will provide AC power and conduit stub-ups in walls and related boxes. Connectors used will be those designed specifically for this type of cable.

4. All junction and connection boxes shall be painted red for easy identification.
5. All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.
6. End of Line Resistors: Shall be furnished as required for mounting as directed by the manufacturer.
7. All wiring and equipment shall be installed according to the NEC and North Carolina Building Codes per the drawings submitted by the authorized Engineered Systems Distributor.
8. Field Connected Devices must be installed and wired by a Factory Trained and Authorized Fire Alarm Installer or a licensed electrical contractor under direct supervision of a Factory Trained and Authorized Fire Alarm Installer.
9. All auxiliary Power Supplies or other Fire Panels shall be located in electrical or mechanical rooms. They shall be mounted at a height between 48 to 60 inches from floor level. All such panels shall be "supervised" by the main Fire Alarm Panel.

C. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
   1. Connect new equipment to existing control panel in existing part of the building.
   2. Connect new equipment to existing monitoring equipment at the supervising station.
   3. Expand, modify, and supplement existing [control] [monitoring] equipment as necessary to extend existing [control] [monitoring] functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

D. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.
   1. Comply with requirements for seismic-restraint devices specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

E. Manual Fire-Alarm Boxes:
   1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
   2. Mount manual fire-alarm box on a background of a contrasting color.
   3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.
   4. Install ADA compliant Stopper II pull station covers with alarm signal over all pull stations.
   5. Install identification signs next to all pull stations. Mount signs securely with screws or liquid nails. The center point of the signs shall correspond with the center point of the pull stations.

F. Carbon Monoxide Detectors:
   1. Install in kitchen for supervisory alarm detection.

G. Smoke- or Heat-Detector Spacing:
1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches ((910 mm)) from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

H. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

I. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.
1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

J. Air-Sampling Smoke Detectors: If using multiple pipe runs, the runs shall be pneumatically balanced.

K. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

L. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

M. Audible/Visible or Visible Only Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
1. Protective covers shall be placed over the horn / strobe units in the Gym and Multi - Purpose room.

N. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 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 Section 08 71 00 "Door Hardware." Connect hardware and devices to fire-alarm system.
1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device

controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Magnetically held-open doors.
2. Electronically locked doors and access gates.
3. Alarm-initiating connection to elevator recall system and components.
4. Alarm-initiating connection to activate emergency lighting control.
5. Supervisory connections at valve supervisory switches.
6. Supervisory connections at elevator shunt-trip breaker.
7. Data communication circuits for connection to building management system.
8. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
9. Supervisory connections at fire-pump engine control panel.

C. Provide relay connection to all permanently installed elective audio systems (auditoriums, gym sound systems, etc) to mute the respective system during general alarm.
1.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems." All initiating devices will also be required to be labeled with engraved Lexan labels to identify device address and intended location. Labels shall be red background with white letters, letters shall be a minimum of 1/4” in height. Install framed instructions in a location visible from fire-alarm control unit.

B.

C. Install framed instructions in a location visible from fire-alarm control unit.

D. Install identification map showing all initiating devices and their address numbers beside the main panel for quick and easy location of alarmed or troubled devices.
1. Map shall be mounted under glass.

3.5 SURGE PROTECTION AND 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.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

C. All equipment shall be properly grounded. Main panel shall be grounded directly to ‘earth ground’.

D. Surge protection shall be installed on the AC supply circuit at the Fire Alarm Panel and on all initiating, notification and monitoring circuits at the Fire Alarm Panel. In addition, surge protection shall be installed on all initiating, notification and monitoring circuits at all points of entry to a building from the outside.

3.6 FIELD QUALITY CONTROL

A. All work shall be inspected and approved by the Mecklenburg County Engineering and Building Standards Department, the Charlotte - Mecklenburg Fire Marshal, School Enforcement Inspectors and the CMS Electronics Department prior to final payment. The Contractor shall provide all material, equipment and labor necessary to pass inspections by the Mecklenburg County Engineering and Building Standards Department and the Charlotte - Mecklenburg Fire Marshal Office. Written documentation of inspections shall be provided to the CMS Electronics Department.
   1. A complete set of as-built wiring schematics, drawn to scale; showing all device locations, wire routing and connections, etc. shall be provided to the CMS Electronics Dept. prior to final inspection.

B. Field tests shall be witnessed by authorities having jurisdiction.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   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 the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
      b. Comply with the "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 the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   3. Test audible appliances for the private operating mode according to manufacturer's written instructions.
   4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
   5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

F. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

G. Fire-alarm system will be considered defective if it does not pass tests and inspections.

H. Prepare test and inspection reports.

3.7 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated

service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.8 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.9 COMMISSIONING

A. The system shall be commissioned in accordance with the needs of the occupants of the protected building. Both "Complete System Commissioning" and "Phased System Commissioning" shall be possible with the specified system, and the execution of either method of commissioning shall be treated as stand-alone projects, and shall be documented as such, including the need for a complete contract close out submittal package for each Project Phase.

B. Complete System Commissioning:

1. The Factory Trained and Authorized Fire Alarm Installer in the presence of the Local AHJ, the Building Owners' Representative, and a Representative of the General Contractor shall perform commissioning of the entire installed system, if deemed appropriate.
2. A complete system documentation package shall be provided to the Local Authority Having Jurisdiction and the Building Owners' Representative at the time of commissioning.

3.10 DEMONSTRATION

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

1. The Fire Alarm Installer shall schedule and execute an instruction class for the Building owner, which details the proper operation of the installed fire alarm system. The instruction shall also cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer.

2. This instruction shall also be separately furnished to the Local Municipal Fire Department if so requested by the Local Authority Having Jurisdiction.
3. The instruction shall be a minimum of 8 hours in duration and presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.
4. The Fire Alarm Installer shall provide service and operation manuals or any other curricula that may enhance the instruction of the Building Owners or Local Municipal Fire Department in the operation and maintenance of the system. Also provide software and hardware necessary to troubleshoot and completely program the system

B. Add alternate: The manufacturer's service training school for four (4) CMS Electronics Technicians to become certified for installing, maintaining, and programming the fire alarm system. Price is to include necessary air flight and hotel accommodations.

C. This add alternate is only required when the Fire Alarm System manufacturer significantly changes their system to require recertification of electronic technicians to service the equipment. A/E to consult and remove if not required by the CMS Design Manager and Glen Weckbacher (CMS electrical engineer).

D. The completely installed fire alarm system will be fully tested in compliance with Testing Procedures for Signaling Systems (ANSI/NFPA 72) under the supervision of a trained manufacturer's representative. The system shall be demonstrated to perform all the functions as specified.

E. The Fire Alarm Installer shall test:
1. Every alarm initiating device for proper response and program execution.
2. Every notification appliance for proper operation and audible/visual output.
3. All auxiliary control functions such as elevator capture, smoke door and damper release, and functional override of HVAC, ventilation, and pressurization controls.

F. The Project Manager and CMS Electronics Department Supervisor must be notified at least 10 working days prior to the scheduled testing so that he/she may be present for such testing.

G. After the system has been completely tested to the satisfaction of the Project Manager and the CMS Electronics Department Supervisor, the Fire Alarm Installer shall complete the Fire Alarm System Certification of Completion form published by the NFPA (Figure 1-7.2.1 in the National Fire Alarm Code).

H. The completed form signed by a principal of the Fire Alarm System installer shall be delivered to the Project Manager with the other system documentation required by these specifications.

I. All installation inspections are required prior to the walk through with the Fire Marshal.

END OF SECTION

SECTION 321216.02 - ASPHALT PAVING (Renovation)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt paving.
2. Asphalt surface treatments.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices. Refer to Division 01 Section "Unit Prices.".

1.4 DEFINITION

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review condition of subgrade and preparatory work.
c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
e. Review contractors QA/QC program. Review testing and inspections during construction

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: For each job mix proposed for the Work. Use of current NCDOT approved mix designs is acceptable.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified manufacturer and Installer.

B. Material Certificates: For each paving material, from manufacturer.

C. Material Test Reports: For each paving material.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by NCDOT.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of applicable state and local DOT and authorities having jurisdiction for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.
2. Tack Coat: Minimum surface temperature of 60 deg F.
3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of standard specifications of North Carolina Department of Transportation (NCDOT).

1. Standard Specification: NCDOT "Standard Specifications for Roads and Structures" (NCSSRS), current edition.

2.2 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations; identify by NCDOT standard classifications.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone or crushed gravel meeting NCDOT specifications.

C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone or gravel, meeting NCDOT specifications.

2.3 ASPHALT MATERIALS

A. Asphalt Binder: Type H, conforming to NCSSRS Section 640.

B. Asphalt Cement: Type I-2, conforming to NCSSRS Section 645.

C. Prime Coat: Asphalt emulsion prime coat complying with conforming to NCSSRS Section 600.

D. Tack Coat: Emulsified asphalt conforming to NCSSRS Section 605.

E. Fog Seal: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

F. Water: Potable.

2.4 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement (RAP): reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials. Do not exceed more that 35 percent RAP.

B. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

C. Sand: ASTM D 1073, Grade Nos. 2 or 3.

D. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

E. Joint Sealant for Existing Pavement Crack Filling: ASTM D 6690, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.

2.5 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction, designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Standard Pavement Section: Refer to Drawings.
3. Heavy Duty Pavement Section: Refer to Drawings.

B. Emulsified-Asphalt Slurry: ASTM D 3910, Type 2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material 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.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course in accordance with NCDOT specifications. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic.

Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.

2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement in accordance with NCDOT specifications.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 PAVING GEOTEXTILE INSTALLATION

A. Apply tack coat uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd.

B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.

1. Protect paving geotextile from traffic and other damage and place hot-mix asphalt paving overlay the same day.

3.5 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt in accordance with NCDOT specifications
2. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
3. Spread mix at minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F. Use rubber tire rollers to compact when asphalt temperature is below 185 degrees.
2. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

B. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

C. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

D. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

E. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

C. Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch of height indicated above pavement surface.

3.9 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement per NCDOT specifications.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.11 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Curbs and gutters.
2. Walkways.

B. Related Information:

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.
b. Quality control of concrete materials and concrete paving construction practices.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

C. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Applied finish materials.
6. Bonding agent or epoxy adhesive.
7. Joint fillers.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who 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."

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches by 96 inches.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

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. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

D. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

E. Plain Steel Wire: ASTM A 82, as drawn.

F. 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.

G. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

H. 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, Type I/II, gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S 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 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
3. Do not use fine or coarse aggregates that contain substances that cause spalling.
4. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect.

C. Water: ASTM C 94/C 94M.

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.
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. Water: Potable.

B. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

C. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

D. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

2.6 RELATED MATERIALS

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

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.
2. Limit use of fly ash to 25 percent of cement content by weight.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
3. Slump Limit: 3 inches, plus or minus 1 inch.

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: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture, high-range, water-reducing admixture high-range, water-reducing and retarding admixture, or plasticizing and retarding 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.

E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements as follows:

1. Fly Ash or Pozzolan: 25 percent.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

1. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
2. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving."

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
2. Provide tie bars at sides of pavement strips where indicated.
3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
4. 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.

C. Isolation 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. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows to match jointing of existing adjacent concrete pavement:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
3. Doweled Contraction 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.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

H. 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 concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.

I. Screed pavement surfaces with a straightedge and strike off.

J. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

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 specified for formed concrete. If results are not approved, remove and replace with formed concrete.

L. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.

M. 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 air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F 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 specified and approved in mix designs.

N. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 CONCRETE FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and 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. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

C. Final Tooling: Tool edges of paving, gutters, curbs, and joints formed in fresh concrete with a jointing tool to the following radius. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.

1. Radius: 1/4 inch.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moist 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. 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 written instructions. Recoat areas subjected to heavy

rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Joint Spacing: 3 inches.
5. Contraction Joint Depth: Plus 1/4 inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

3.10 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section , including match of finished appearance of approved mockup or reference existing concrete paving.

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 pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes painted markings applied to asphalt and concrete pavement.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.

B. Shop Drawings: For pavement markings.

1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Samples: For each exposed product and for each color and texture specified; on rigid backing, 8 inches square.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of North Carolina DOT for pavement-marking work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, 40 deg F (4 deg C) for oil-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint (Inside public right-of-way) Thermo-plastic, comply with NCDOT Standards Section 1205.

1. Color: As indicated on Drawings.

B. Pavement-Marking Paint (Outside public right-of-way): MPI #97, latex traffic-marking paint.

1. Color: As indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

SECTION 323131 - METAL UTILITY GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal utility gates.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Gate hardware.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal gates and their connections. Show anchorage and accessory items including hardware installation.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

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

PART 2 - PRODUCTS

2.1 METAL GATE FRAMES

A. Posts: 6-inch diameter Schedule 80 steel pipe.

B. Gate Configuration: Single and double leaf swinging gates of size and configuration indicated on Drawings.

1. Steel Frames and Bracing: Fabricate members from 2-inch diameter Schedule 40 steel pipe. Hot-dip galvanize frames after fabrication to G90.
2. Frame Corner Construction: Welded.
3. Configuration: Provide as indicated on Drawings.

C. Latches, Keepers, and Padlocks: As indicated on Drawings.

D. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.

2.2 GATE CLADDING

A. Corrugated-Profile, Exposed-Fastener Metal Wall Panels: Formed with alternating curved ribs spaced at 2.67 inches o.c. across width of panel.

1. Available 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. ATAS International, Inc.
b. CENTRIA, a Nucor Brand.
c. Elevate; Holcim Building Envelope.
d. Englert, Inc.
e. Fabral; a brand of Flack Global Metals.
f. MBCI; Cornerstone Building Brands.
g. McElroy Metal, Inc.
h. Morin - A Kingspan Group Company.
i. PAC-CLAD; Petersen; a Carlisle company.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.040 inch/20 ga.
b. Exterior Finish: Two-coat fluoropolymer.
c. Color: As selected by Architect from manufacturer's full range.

3. Rib Spacing: 2.67 inches o.c.
4. Panel Coverage: 34.6 inches.
5. Panel Height: 0.75 inch.

2.3 GATE HARDWARE

A. Hinges: As detailed on Drawings.

B. Cane Bolts and Receivers: Locking cane bolt as indicated on Drawings.

2.4 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.5 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.6 FASTENERS

A. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593hex nuts, ASTM F 594where indicated, flat washers; Alloy Group 1.

B. Material for Exterior Locations: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.7 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings" for items indicated to receive high-performance coating.

B. Concrete Footings: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 4000 psi.

2.8 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

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

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.9 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime using primer specified in Section 099600 "High-Performance Coatings".

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

F. Painting, Frame: Refer to Section 099600 "High Performance Coatings." Paint frame to match selected prefinished metal panel color, unless otherwise directed by Architect.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING METAL GATES

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

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

END OF SECTION

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SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Hydroseeding.
3. Erosion-control material(s).
4. Maintenance for lawns.
5. Warranty for new lawns.

1.3 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 ACTION SUBMITTALS

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

1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

1.5 INFORMATIONAL SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

B. Qualification Data: For qualified landscape Installer.

C. Product Certificates: For soil amendments and fertilizers, from manufacturer.

D. Material Test Reports: For standardized ASTM D 5268 topsoil, existing native surface topsoil, existing in-place surface soil, and imported or manufactured topsoil.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.

1. Experience: Three years' experience in turf installation in addition to requirements in Division 01 Section "Quality Requirements."
2. Installer's Field Supervision: Maintain experienced full-time supervisor able to communicate with Contractor and workers, on Project site when work is in progress.
3. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network www.landcarenetwork.org:

a. Landscape Industry Certified Technician - Exterior.
b. Landscape Industry Certified Lawncare Manager.

4. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
5. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for turf growth.

    a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

C. Sod: Deliver sod in a timely manner which will allow installation to occur within 48 hours.

1. Notify Architect 48 hours in advance when sod, fertilizer, soil conditioners, soil amendments, and sand will be delivered to the site.

2. Furnish an itemized list of actual quantities for each type of material. Materials shall be delivered to the site in sealed standard size containers, where applicable showing weight, analysis, name of vendor, and germination test. Materials which have become wet, moldy, or otherwise damaged will not be acceptable.
3. Deliver the necessary inspection certificates to accompany fertilizer, and soil amendment bag. Sod shall be NC Crop Improvements Blue Tag Certified. Certification must accompany sod.
4. When shipment is made by truck, pack all materials to provide adequate protection against climate and breakage during transit.
5. When ship is made by rail, pack boxcars carefully and adequately ventilate materials to prevent "sweating" of materials during transit.
6. Use a suitable method to handle sod to insure careful, workmanlike delivery of materials.
7. Prevent any damage to pad or pad ends.
8. Harvest, deliver, store and handle sod according to requirements in TPI's "Specifications for Turf Grass Sod Materials" and "Specifications for Turf Grass Sod Transplanting and Installation" in its "Guideline specifications to Turf Grass Sodding."

1.9 COORDINATION AND SCHEDULING

A. Planting Restrictions: Sow lawn seed during normal planting seasons for type of lawn work required. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion. Contractor shall assure established lawn prior to substantial completion. Coordinate planting areas with overall project schedule accordingly.

1.10 Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions

1.11 PROJECT CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: February 15 – May 15.
2. Fall Planting: September 15 – November 15.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.12 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately

after each area is planted and continue until acceptable turf is established but for not less than the following periods:

1. Seeded Lawns: until accepted at the date of Substantial Completion.
2. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established at that time, continue maintenance during next planting season.
3. Sprigged, and Sodded Lawns: 30 days after acceptance of lawns.

    a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established at that time, continue maintenance during next planting season.

B. Continuing Maintenance One Year Agreement: From Contractor to Owner, in the form of a standard yearly maintenance agreement, starting 30 days after acceptance of lawns. Agreement in this contract shall include the following services:

1. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.
2. Replant bare areas with same materials specified for lawns. The contractor is responsible for an acceptable stand of grass as defined by this contract and owner. Should an acceptable stand of grass fail to be established, contractor shall continue efforts without regard for initial maintenance periods required by the contract.
3. Add new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.
4. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches.
5. Lay out temporary lawn-watering system and arrange watering schedule to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly seeded areas.
6. Water lawn at the minimum rate equal to 1 inch per week of rainfall.
7. Postfertilizer: Apply fertilizer to lawn after first mowing and monthly throughout the growing season when grass is dry.

    a. Use fertilizer that will provide actual nitrogen of at least 1 lb per 1000 sq. ft. of lawn area, per month during contract period.

8. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height without cutting more than 40 percent of the grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain following grass height:

    a. Mow grass 2-inch high (Bermuda) 3 1/2-inch high (Fescue)
    b. Mow under the one-year agreement no less than bi-weekly during active growing season

9. Maintain and submit a log to the Owner's project manager that identifies dates each required activity is performed through the construction and maintenance period.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

1. Seed Mixture: Provide seed of grass species and varieties, proportions by weight, and minimum percentages of purity, germination, and maximum percentage of weed seed as indicated on Schedules at the end of this Section.
2. Seed Type 1 (non-athletic field areas):

a. 30 % Blend of two turf type fall fescues, "Rebel", "Rebel II" at 5 lbs /1000 sq. ft.
b. 50% Common Bermuda (Hulled at 3 lbs /1000 sq. ft.)
c. 20% Annual Ryegrass at 2 lbs/1000 sq. ft.

B. Sod: Sod shall be two years old minimum, free of weeds, insects, and other grasses, fresh, moist, and from a certified sand based sod farm. The species is listed below. Provide sod of uniform pad sizes with maximum 5% deviation in entire length or width, broken pads or pads with uneven ends will not be acceptable. Sod pads incapable of supporting their own weight when suspended vertically with a firm grasp on upper 10% of pad will be rejected.

1. Turf Type Fescue.
2. Identify sod source: Include name, address and telephone number of supplier that complies with TPI's "Specifications for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding". Furnish viable sod of uniform density, color, and texture; strongly rooted and capable of vigorous growth and development when planted.
3. Sod of grass with not less than 95% germination, not less than 98% pure seed and not more than 0.5% weed seed.
4. Sod shall have prior approval by Owner's Representative and shall consist of NC Crop Improvement Blue Tag Certified Fescue Grass. Sod shall be fresh cut, delivered and installed within 48 hours, and consist of live, growing plants secured from sources where the soil is fertile and shall have a healthy, virile root system or dense, thickly matted roots throughout the soil of the sod for a minimum of one inch. Sod shall be free from noxious weeds or other grasses and shall not contain any matter deleterious to growth or which might affect its subsistence or hardiness when transplanted.
5. See plan for limits of sod.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
2. Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

E. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

F. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

G. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.4 PLANTING SOILS

A. Planting Soil: Re-use surface soils stockpiled from onsite stripping, with pH range of 5.5 to 7, a minimum of 6 percent organic material content; free of stones ½" inch or larger in any dimension and other extraneous materials harmful to plant growth. Seed beds and lawn areas shall not contain gravel or construction materials. Gravel embedded soils shall be removed and replaced with suitable planting soil. Mix ASTM D 5268 topsoil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

1. Weight of Lime per 1000 Sq. Ft.: 100 lbs.
2. Weight of Superphosphate per 1000 Sq. Ft.: 30 lbs.

3. Weight of Commercial Fertilizer per 1000 Sq. Ft.: 6 lbs.
4. Weight of Slow-Release Fertilizer per 1000 Sq. Ft.: 4 lbs.

B. Soil Source: Reuse surface soil stockpiled on the site. Verify suitability of surface soil to produce topsoil meeting requirements and amend when necessary. Supplement on-site topsoil when quantities are insufficient. On-site topsoil shall come from an area that has good drainage and not from a marsh or bog. A sample of proposed topsoil shall be submitted to the landscape architect 15 calendar days prior to installation and be approved prior to installation. Contractor shall estimate quantities on site and those required per plans and specifications as necessary to provide topsoils to depths indicated. Soil shall be clean sandy loam free of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth. Additional topsoil shall be used in the ballfields when excess is encountered.

C. Topsoil shall contain the following specified percentages of constituents:

1. Maximum 30% clay, (red clay, well pulverized); clay shall be sterile.
2. Minimum 10% well-rotted organic material, sawdust, leaf mold or other approved partially decomposed organic matter.
3. Maximum 40% coarse clean sandy loam free of rock, plants, roots and other debris.
4. Topsoil Source: Re-use surface soil on the site per plans and specifications as necessary to provide topsoils to depths indicated. Topsoil shall be clean sandy loam free of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.

D. Contractor shall include in all final lawn areas an average thickness of no less than 6" topsoil incorporated per part 3 – 3.3 turf area preparation. Contractor shall estimate quantities on site and those required per plans and specifications as necessary to provide planting soil to depths indicated.

2.5 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

1. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

B. Fiber Mulch: Biodegradable, undyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

1. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.6 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and

as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.7 EROSION-CONTROL MATERIALS

A. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended biodegradable retention devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install 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.

3.3 TURF AREA PREPARATION

A. Limit turf subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen compacted subgrade within 60’ of building to a minimum depth of 12 inches. Areas beyond that shall be loosen to a minimum depth of 8 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

C. Mix soil amendments and fertilizers with topsoil at rates indicated Delay mixing fertilizer if planting does not follow placing of planting soil within a few days. Either mix soil before spreading or apply soil amendments on surface of spread topsoil and mix thoroughly into top 6 inches (100 mm) of topsoil before planting.

1. "Planting Soil Amendments Schedule" is included at the end of this Section.
2. Mix lime with dry soil prior to mixing fertilizer
3. Apply superphosphate fertilizer directly to subgrade before tilling, at the rate indicated.
4. For Athletic Field Areas uniformly spread and thoroughly incorporate sand and organic material at the following rates to a depth of 12”:

    a. Sand, 1” or 135 cubic yd. Per acre of turf area.
    b. 100% compost soil conditioner, 1 ½” or 200 cubic yd. Per acre of turf area.

D. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.

    a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    b. Mix lime with dry soil before mixing fertilizer.

2. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

    a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.

E. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 6 inches of soil. Till soil to a homogeneous mixture of fine texture.

a. Apply superphosphate fertilizer directly to surface soil before loosening.

3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

F. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

G. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

H. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

I. Finished grade for athletic field turf areas shall include soil amendments.

J. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

C. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 PREPARATION FOR GRASS-PAVING MATERIALS

A. Reduce subgrade elevation soil to allow for thickness of grass-paving system. Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade so that installed paving is within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions.

B. Install base course and approved soil mix as recommended by paving-material manufacturer for site conditions; comply with details shown on Drawings. Compact according to paving-material manufacturer's written instructions.

C. Install paving mat and fasten according to paving-material manufacturer's written instructions.

D. Before planting, fill cells of paving mat with soil mix and compact according to manufacturer's written instructions.

E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.6 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.
2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 8lb. per 1000 sq. ft.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

F. Protect areas seeded between May 15 and September 15 from hot, dry weather or drying winds by applying compost mulch, peat mulch, or planting soil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.7 SEEDING NON-ATHLETIC FIELD LAWNS

A. Sow seed with a spreader or a seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in 2 directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.
2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. The following schedule will be required for the specified seed type:

1. Type 1 Seed: March 1-Apr. 15, Aug. 15-Nov. 1
2. Non-athletic field areas sown between April 15-Aug. 15 and Nov. 1-March 1 shall be overseeded with Tall Fescue blend during the next appropriate season.

C. Sow seed at the following rates:

1. Seed type 1 for non-athletic field areas:

a. 2 lbs. Annual Rye per 1,000 sq. ft.
b. 3 lbs. Common Bermuda per 1,000 sq. ft.
c. 5 lbs. Fescue per 1,000 sq. ft.

D. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray

E. Protect seeded slopes as shown on plan against erosion with erosion-control blankets installed and stapled according to manufacturer's recommendations.

F. Protect seeded areas with slopes less than 1:6 against erosion by spreading straw mulch after completion of seeding operations. Spread uniformly at a minimum rate of 2 tons per acre (45 kg per 100 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into topsoil by suitable mechanical equipment

G. Protect seeded areas against hot, dry weather or drying winds by applying peat mulch within 24 hours after completion of seeding operations. Soak and scatter uniformly to a depth of 3/16 inch (4.8 mm) thick and roll to a smooth surface.

3.8 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
2. Mix slurry to provide the following application rates:

a. Seed: 2 lb. per 1000 sq. ft.
b. Fertilizer: 20 lb. per sq. ft.

3. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.9 TURF RENOVATION

A. Renovate existing turf where indicated.

B. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.

2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

J. Apply seed and protect with straw mulch as required for new turf.

K. Water newly planted areas and keep moist until new turf is established, received initial mowing, and is accepted by Owner.

3.10 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Continuing Maintenance One Year Agreement: (SEE ADDITIONAL REQUIREMENTS IN SECTION 1.10B)

C. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
3. If acceptable to Owner, use completed irrigation system to provide watering.

D. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow perennial ryegrass and zoysiagrass to a height of 1 to 2 inches.
2. Mow Kentucky bluegrass, annual ryegrass, and chewings red fescue to a height of 1-1/2 to 2 inches.
3. Mow turf-type tall fescue Insert grass species to a height of 2 to 3 inches.

E. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry, unless a slow release fertilizer has been applied prior to planting.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.11 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.12 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.13 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Plants.
2. Planting soils.
3. Tree stabilization.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required, unless otherwise indicated on Drawings; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

I. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

J. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

K. Planting Area: Areas to be planted.

L. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

M. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

N. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

O. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

P. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

Q. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

R. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including soils.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.
3. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Mulch: 1-pint volume of each mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
2. Weed Control Barrier: 12 by 12 inches.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Material Test Reports: For existing native surface topsoil, existing in-place surface soil, and imported or manufactured topsoil.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

    a. Certified Landscape Technician - Exterior, with installation and maintenance specialty area(s), designated CLT-Exterior.
    b. Certified Ornamental Landscape Professional, designated COLP.

5. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for plant growth.

    a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1. Selection of plants purchased under allowances will be made by Architect, who will tag plants at their place of growth before they are prepared for transplanting.

E. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

F. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

G. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

C. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 15 – May 1.
2. Fall Planting: September 15 – November 1.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

D. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.10 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
b. Structural failures including plantings falling or blowing over.
c. Faulty performance of tree stabilization, edgings, and tree grates.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods from Date of Planting Completion:

a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
c. Annuals: Three months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.11 MAINTENANCE SERVICE

A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: 6 months from date of planting completion.

B. Initial Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period: 6 months from date of planting completion.

C. Continuing Maintenance One Year Agreement – all Plants: From Installer to Owner, in the form of a standard yearly maintenance agreement, starting on date of substantial completion. Agreement in this contract shall include the following services:

1. Maintain and establish plants by watering, fertilizing, weeding, trimming, replanting if necessary, and other operations.
2. The contractor is responsible for acceptable plant material as defined by this contract and owner. Should acceptable plants fail to be installed or established, contractor shall continue efforts without regard for initial maintenance periods required by the contract.
3.
4. Add new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.
5. Watering: Provide and maintain temporary piping, hoses, and watering equipment to convey water from sources and to keep plants uniformly moist to a depth of 4 inches (100mm).
6. Lay out temporary watering system and arrange watering schedule to prevent wilting, puddling, erosion, and displacement of mulch.
7. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated past management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark");

crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.

2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

F. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.2 SHADE AND FLOWERING TREES

A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.

1. Provide balled and burlapped trees.
2. Branching Height: One-half of tree height.

B. Small Upright Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1.

1. Stem Form: Single stem.
2. Provide balled and burlapped trees.

C. Small Spreading Trees: Pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1

1. Stem Form: Multi-stem.
2. Provide balled and burlapped.

2.3 DECIDUOUS SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.

1. Provide container-grown shrubs.

2.4 CONIFEROUS EVERGREENS

A. Form and Size: Specimen-quality, exceptionally heavy, tightly knit, symmetrically shaped coniferous evergreens and the following grade:

1. Heavy Grade: "X."
2. Provide balled and burlapped trees.

2.5 BROADLEAF EVERGREENS

A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.

1. Provide balled and burlapped trees.

2.6 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
2. Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Perlite: Horticultural perlite, soil amendment grade.

D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

E. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

2.7 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

2.8 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 10-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

F. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.9 PLANTING SOILS

A. Planting Soil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1/2 inch or larger in any dimension and other extraneous materials harmful to plant growth. Mix ASTM D 5268 topsoil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

1. Ratio of Loose Compost to Topsoil by Volume: 1:3 or 33%.
2. Ratio of Loose Sphagnum Peat to Topsoil by Volume: 33%.
3. Weight of Superphosphate per 1000 Sq. Ft.: 30%.
4. Weight of Commercial Fertilizer per 1000 Sq. Ft.: per loose directions.

2.10 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Wood and bark chips.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

2.11 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as

required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.12 TREE STABILIZATION MATERIALS

A. Stakes and Guys: Comply with City of Charlotte requirements; refer to details on Drawings.

2.13 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA C2, with waterborne preservative for soil and freshwater use, acceptable to authorities having jurisdiction, and containing no arsenic; including ammoniacal copper arsenate, ammoniacal copper zinc arsenate, and chromated copper arsenate.

B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

C. Burlap: Non-synthetic, biodegradable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install 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.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

A. Loosen subgrade of planting areas to a minimum depth of 6 inches. Remove stones larger than 1 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply superphosphate fertilizer directly to subgrade before loosening.
2. Thoroughly blend planting soil off-site before spreading.

    a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    b. Mix lime with dry soil before mixing fertilizer.

3. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

    a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

1. Excavate approximately three times as wide as ball diameter.

2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
8. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Subsoil and topsoil removed from excavations may be used as planting soil, if properly amended.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.

1. Use planting soil for backfill.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Set balled and potted and container-grown stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Use planting soil for backfill.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Set fabric bag-grown stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Use planting soil for backfill.
2. Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

F. Set and support bare-root stock in center of planting pit or trench with root flare 1 inch above adjacent finish grade.

1. Use planting soil for backfill.
2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.
3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch from root tips; do not place tablets in bottom of the hole or touching the roots.
4. Continue backfilling process. Water again after placing and tamping final layer of soil.

G. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE STABILIZATION

A. Stakes and Guys: Comply with City of Charlotte requirements; refer to details on Drawings.

3.7 TREE, SHRUB, AND VINE PRUNING

A. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

B. Do not apply pruning paint to wounds.

3.8 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated in even rows with triangular spacing.

B. Use planting soil LPS#2 for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Tree-like Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.10 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated past management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.11 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.12 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.13 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 329300

SECTION 331000 - WATER UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for fire-service mains.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1. Wiring Diagrams: Power, signal, and control wiring for alarms.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.

2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. 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.

D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.

2. Protect valves against damage to threaded ends and flange faces.

3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping 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.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of service.

2. Do not proceed with interruption of water-distribution service without Architect's and Owner's written permission.

1.10 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC, AWWA Pipe: AWWA C900, Class 150 and Class 200, with bell end with gasket, and with spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.

2. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2.2 JOINING MATERIALS

A. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.3 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Nonrising-Stem, Resilient-Seated Gate Valves:
   a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      1) Standard: AWWA C509.
      2) Minimum Pressure Rating: 200 psig.
      3) End Connections: Mechanical joint.
      4) Interior Coating: Complying with AWWA C550.

2. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:
   a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
      1) Standard: AWWA C509.
      2) Minimum Pressure Rating: 200 psig.

3) End Connections: Flanged.

B. UL/FMG, Cast-Iron Gate Valves:

1. UL/FMG, Nonrising-Stem Gate Valves:
   a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
      1) Standards: UL 262 and FMG approved.
      2) Minimum Pressure Rating: 175 psig.
      3) End Connections: Flanged.

2.4 CHECK VALVES

A. UL/FMG, Check Valves:

1. Description: Swing-check type with pressure rating; rubber-face checks, unless otherwise indicated; and ends matching piping.
   a. Standards: UL 312 and FMG approved.
   b. Pressure Rating: 175 psig.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Description: Sleeve and valve compatible with drilling machine.
   a. Standard: MSS SP-60.
   b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
   c. Valve: AWWA, cast-iron, nonrising-stem, [**metal**] [**resilient**]-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.6 WATER METERS

A. Water meters will be furnished by the utility.

2.7 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013 or AWWA C511.

2. Operation: Continuous-pressure applications.

3. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

4. Size: As indicated on Drawings.

5. 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.

6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

7. Configuration: Designed for vertical inlet, horizontal center section, and vertical outlet flow.

8. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y 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. Backflow Preventer Test Kits:

1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.8 PROTECTIVE ENCLOSURES

A. Freeze-Protection Enclosures:

1. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of 40 deg F when external temperatures reach as low as minus 34 deg F.
   a. Standard: ASSE 1060.
   b. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
   c. Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
      1) Housing: Reinforced-aluminum or -fiberglass construction.
         a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
         b) Drain opening for units with drain connection.
         c) Access doors with locking devices.
         d) Insulation inside housing.
         e) Anchoring devices for attaching housing to concrete base.
      2) Electric heating cable or heater with self-limiting temperature control.

B. Enclosure Bases:

1. Description: 4-inch- minimum thickness precast concrete, of dimensions required to extend at least 6 inches beyond edges of enclosure housings. Include openings for piping.

2.9 FIRE HYDRANTS

A. Dry-Barrel Fire Hydrants:

1. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
   a. Standards: UL 246, FMG approved.
   b. Pressure Rating: 150 psig minimum.
   c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
   d. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
   e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
   f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

2.10 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:

1. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch-high brass sleeve; and round escutcheon plate.
   a. Standard: UL 405.
   b. Connections: Two NPS 2-1/2 inlets and one NPS 6 outlet.
   c. Inlet Alignment: Inline, horizontal.
   d. Finish Including Sleeve: Polished chrome-plated.
   e. Escutcheon Plate Marking: "FDC."
   f. Knox box caps required on FDC’s

2.11 ALARM DEVICES

A. Alarm Devices, General: UL 753 and FMG approved, of types and sizes to mate and match piping and equipment.

B. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 4 to NPS 8 shall be any of the following:

1. NPS 8: PVC, AWWA Class 200 pipe; mechanical-joint, ductile-iron fittings; and gasketed joints.

F. Underground Fire-Service-Main Piping NPS 4 to NPS 12 shall be any of the following:

1. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 200 fabricated fittings; and gasketed joints.

G. Aboveground and Vault Fire-Service-Main Piping NPS 4 to NPS 12 shall be ductile-iron, grooved-end pipe; ductile0iron-pipe appurtenances; and grooved joints

3.2 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.

2. Underground Valves, NPS 4 and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.

3. Use the following for valves in vaults and aboveground:
   a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.
   b. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated UL/FMG, cast iron, OS&Y rising stem.
   c. Check Valves: AWWA C508 UL/FMG, swing type.

4. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.

5. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

3.3 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.

2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.

3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.

4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

C. Comply with NFPA 24 for fire-service-main piping materials and installation.

D. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

E. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:

1. Under Driveways: With at least 36 inches cover over top.

F. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.

G. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

H. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

I. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

J. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

K. See Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.

3.4 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

3.5 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.

2. Locking mechanical joints.

3. Set-screw mechanical retainer glands.

4. Bolted flanged joints.

5. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.6 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.

E. MSS Valves: Install as component of connected piping system.

3.7 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.8 PROTECTIVE ENCLOSURE INSTALLATION

A. Install concrete base level and with top approximately 2 inches above grade.

B. Install protective enclosure over valves and equipment.

C. Anchor protective enclosure to concrete base.

3.9 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. AWWA Fire Hydrants: Comply with AWWA M17.

C. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.10 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install ball drip valves at each check valve for fire department connection to mains.

B. Install protective pipe bollards on two sides of each fire department connection. Pipe bollards are specified in Section 055000 "Metal Fabrications."

3.11 ALARM DEVICE INSTALLATION

A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.

B. Supervisory Switches: Supervise valves in open position.

1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.

2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.

C. Locking and Sealing: Secure unsupervised valves as follows:

1. Valves: Install chain and padlock on open OS&Y gate valve.

2. Post Indicators: Install padlock on wrench on indicator post.

D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.

E. Connect alarm devices to building fire alarm system. Wiring and fire-alarm devices are specified in Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System."

3.12 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water-distribution piping to utility water main provided by utility.

C. Connect water-distribution piping to interior domestic water and fire-suppression piping.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.13 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.14 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping.

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel.

3.15 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.

2. Use purging and disinfecting procedure for fire-protection water piping not connected to potable water supply prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

3. Use purging and disinfecting procedure for water distribution piping connected to potable water supply prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
   a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
   b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
   c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION

SECTION 220800 Commissioning of Plumbing Systems

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Drawings and general provisions of the Contract, including General Conditions and Division-1 Specifications Sections, apply to Work of this section.

B. Provisions of Section 019113, Building Commissioning, shall be made an integral part of this Section with all requirements, responsibilities, and recourse described in those sections.

C. Certain building systems on this project are to be commissioned using a team approach. The intent of the commissioning program is to provide documentation, testing, and training to help insure that the project meets the needs of the owner and the designer's intent and to satisfy the requirements for commissioning. The commissioning program includes:

1. Start up and testing of specified equipment and systems in accordance with the commissioning plan, FIV& FPT approved forms.
2. Identification of and documentation of equipment and system deficiencies and normal operating parameters.
3. Corrective actions and acceptance of corrected equipment and systems.
4. Operation and maintenance manuals.
5. Preventative maintenance equipment and system data collection.
6. Equipment and systems use and maintenance training.

1.02 WORK INCLUDED

A. Participate in the Commissioning program as outlined in this section.

1.03 COMMISSIONING PROGRAM CRITERIA

A. Intent:

1. The intent of System Commissioning is to assure delivery to the Owner of plumbing systems that are fully functioning in accordance with all specifications, and which the Owner's personnel are fully trained and equipped to operate, maintain and troubleshoot.

2. The General Contractor and all subcontractors shall participate in the Commissioning Program, which delivers the intended results of System Commissioning, using whatever personnel, time, equipment and resources are required.

3. This Section provides minimum program requirements; however, the Contractor shall exceed those requirements whenever necessary to achieve the intent of Building Commissioning.

B. Commissioning Authority (CxA):

1. The Commissioning Authority is contracted directly with the Owner and is responsible for the overall enforcement and implementation of the Commissioning Program. The Commissioning Authority will schedule and chair all commissioning meetings and be responsible for all documentation and final acceptance of the commissioning phase of the project.

C. Plumbing Trade Representative:

1. The Plumbing Contractor shall assign a qualified individual to function as the Trade Representative to coordinate the Commissioning Program. The Trade Representative reports to the Commissioning Authority.

D. Definitions and Abbreviations:

1. Maintenance Orientation and Inspection: At prescribed times during the Work the Contractor will walk the Owner's Maintenance personnel through the Work, orient them to equipment types and locations, assist access for any requested inspections, answer all questions concerning performance of the Work, workmanship standards and quality control.

2. Equipment Placement Completion: Stage of the Work at which the major items of Division 22 equipment have been placed at final locations, but have not received ductwork, piping and electrical connections. Major equipment includes, but is not limited to: Water Heaters, Pumps.

3. Distribution Completion: Stage of the Work at which distribution piping has been installed and tested, but not insulated or concealed by further work.

4. O&M Manuals: Operation and Maintenance Manuals as specified in Contract Documents.

5. Trade Representative: Person who competently represents the work force engaged by the Contractor for the individual trade named. This person shall be completely familiar with the work performed for this Contract at all levels of detail of his trade and with coordination to other trades. This person shall be capable of and have authority to execute all commissioning responsibilities of the trade as described in these Contract Documents.

7. Participate: Attend commissioning events, provide technical expertise or knowledge, equipment, measurements and observation needed or requested by the Commissioning Authority or Owner. Provide follow-up analysis, equipment data, design data, or other trade or professional service needed in response to commissioning events.

8. Verify: To positively determine that the measured or observed quantity satisfies all required criteria. Simply performing the test, measurement or observation

does not constitute "verification". The test result must also pass all Contract criteria. Tests that fail must be repeated at no additional cost to the Owner after repairs or adjustments are made, until full verification is achieved.

9. Pre-functional Testing: Ensure that individual pieces of equipment are capable of performing in accordance with the Specifications, Drawings, and manufacturers' requirements. This is documented with a Field Installation Verification checklist provided by the CxA and completed by the contractor. The Commissioning Authority shall overview this testing.

E. Scope: For coordination purposes, the entire commissioning scope involving all parties is described here. The responsibilities of Division 22 Trades with respect to commissioning are separated out under Section 3.03 - RESPONSIBILITIES.

1. Document plumbing design intent.

2. Verify that equipment and systems have been properly installed in accordance with the contract documents and manufacturer's written installation instructions.

3. Verify that piping systems have been properly cleaned.

4. Verify that equipment has been placed into operation with manufacturer's oversight and approval.

5. Assemble contract documents and record drawings.

6. Assemble operation and maintenance instructions and submittal data.

7. Perform pre-functional testing

8. Verify the performance of each piece of equipment and each system through functional testing.

9. Train Owner's personnel in the proper operation of each piece of equipment and each system.

10. Document warranty start and end dates.

11. Assemble all records of Code authority inspections and approvals.

12. Monitor and enforce accessibility of all work versus maintenance requirements of each piece of equipment.

13. Identify, document and report all deficiencies of the work versus Contract specifications and performance requirements.

F. Commissioning Cost:

1. Each Trade and supplier of equipment shall include in his quoted price the cost of furnishing the material requested and manpower necessary for the operation and maintenance manuals, training and system verification as specified under this section.

PART 2 - PRODUCTS

2.01 NOT APPLICABLE.

PART 3 - EXECUTION

3.01 PREPARATION OF COMMISSIONING PLAN

A. The Commissioning Plan shall be prepared by the CxA. The plan shall take full cognizance of all intent and specific requirements for the Commissioning Program described in the Contract Documents.

B. The Commissioning Plan shall be submitted to the Owner and shall be subject to approval in all aspects by the Owner. The Owner reserves the right to require changes in the Commissioning Plan or personnel assigned at any time to satisfy the Owner's quality assurance within the Commissioning Program.

3.02 COMMISSIONING TEAM

A. A Commissioning Team shall be designated consisting of all members needed to execute the approved Commissioning Program. Membership shall include:

1. CxA
2. General Contractor
3. Mechanical Trade Representative
4. Plumbing Trade Representative
5. Electrical Trade Representative
6. Testing, Adjusting and Balancing Trade Representative
7. Facility Management and Control System (FMCS) Trade Representative
8. Owner's Representative
9. Owner’s HVAC Maintenance Representative
10. Architect and Engineer of Record

B. The Contractor's personnel shall be made available to execute all aspects of the Commissioning Program until the Owner accepts final results. Commissioning Program tasks and meetings may be repeated until the Owner is satisfied and will not be fixed as one-time, one-chance events for the Contractor.

3.03 RESPONSIBILITIES

A. Owner:

1. Assign maintenance and engineering personnel and schedule them to participate in the various meetings, training sessions and inspections as required:

B. Commissioning Authority:

1. Prepare Commissioning requirements sections of the Contract.

2. Prepare the Commissioning Plan. Include list of all Trade Representatives for commissioning events by name, firm and trade specialty.

3. Execute the Commissioning Plan, through organization of all meetings, tests, demonstrations, training events and performance verifications described in the Contract Documents and approved Commissioning Plan. Organizational responsibilities include preparation of agendas, attendance lists, arrangements for facilities and timely notification to participants for each commissioning events. The Commissioning Authority shall act as chairman at all commissioning events and assure execution of all agenda items. The Commissioning Authority shall prepare minutes of every commissioning event and send copies to all attendees within five (5) workdays of the event.

4. Review the plans and specifications with respect to their completeness in all areas relating to the commissioning program. This includes ensuring that the commissioning guidelines have been followed.

5. The plan and specification review by the Commissioning Authority does not include any responsibility for the system evaluation, adequacy of the system to meet design intent, capacity of the system, quality control check or any of the other elements of the system design which are the strict responsibility of the Engineer of record.

6. Schedule a pre-commissioning coordination meeting within ninety (90) days of the award of the contract, at some convenient location and at a time suitable to the Contractor and Engineer of Record. This pre-commissioning meeting will be for the purpose of reviewing the complete commissioning program and establishing tentative schedules for Maintenance orientation and inspections, O&M submittals, training sessions, system flushing and testing, job completion, system start-up, test, adjust and balance work, and functional testing.

7. Receive and review operation and maintenance (O&M) manuals as submitted by the contractor through the Engineer of Record.

8. Adequate accessibility for maintenance and component replacement or repair is the Plumbing Contractor's responsibility and will be checked by the Commissioning Authority at shop drawings, and during initial and final phases for each item of equipment.

9. Witness the piping test and flushing and sterilization procedure. Incorporate the documentation in the final commissioning report. Prepare report of this observation, with separate summary of deficiency findings by the Commissioning Authority.

10. Schedule regular commissioning coordination meetings during construction.

11. Schedule the Owner training sessions. These training sessions are to be attended by the Owner, Commissioning Authority, Engineer of Record, Plumbing Contractor, Trade Representatives and equipment suppliers as necessary. The format will follow the outline in the O&M Manuals.

12. Upon receipt of notification from the Plumbing Contractor that the system has been started, that all systems have been started, tested, that the systems and equipment are functioning as designed and specified, and that all Field

Installation Verification forms and checklists have been completed, schedule the verification demonstrations. These demonstrations will be conducted by the Contractor and witnessed by the Commissioning Authority. Prepare minutes of each verification event, with separate summary of deficiency findings by the Commissioning Authority. Distribute to attendees.

13. Prepare final commissioning report and submit to Owner. Schedule final review with Owner. Present all documentation and turn over signed acceptance of the system to the Owner.

C. Engineer of Record:

1. Provide Basis of Design Narrative. Incorporate in the appropriate sections of the O&M Manual.

2. Attend initial pre-commissioning coordination meeting to be scheduled by the Commissioning Authority within ninety (90) days of the award of the contract.

3. Verify adequate maintenance accessibility for each piece of equipment in shop drawings and actual installation. Visit site periodically and inspect construction.

4. Review O&M Manuals submitted by the Plumbing Contractor. Insert Design Narrative.

D. Plumbing Contractor:

1. Include cost for commissioning requirements in the contract price.

2. Include commissioning requirements in the plumbing sub-contracts and ensure full cooperation of all parties in the commissioning program.

3. Provide an approved Plan to the Commissioning Authority to prepare and coordinate execution of the Commissioning Program. Provide the Commissioning Authority with means and authority to execute Commissioning Program.

4. Coordinate the interface of the Commissioning Program.

5. Prepare record drawings as required by contract documents and submit to the Owner.

E. Plumbing Trade Representative:

1. Include requirements for submittal data, O & M data and training in each purchase order or sub-contract written.

2. Ensure participation of major equipment manufacturers and their representatives.

3. Coordinate this commissioning program with the Electrical Trade Representative.

4. Attend initial pre-commissioning coordination meeting scheduled by the Commissioning Authority. Prepare necessary preliminary schedule for

Maintenance orientation and inspections, O & M manual submission, training sessions, pipe system testing, flushing and cleaning, equipment start-up, and job completion for use by the Commissioning authority. Update schedule as appropriate throughout the construction period.

5. Obtain O & M data on all equipment and assemble in binders using tabs as required. Submit to Engineer of Record for approval prior to the Distribution completion stage.

6. Notify the Commissioning Authority of the time for the piping system pressure tests and piping system flushing.

7. Notify the Commissioning Authority of the time for all equipment start up activities.

8. Conduct and schedule vendors and other Trade Representatives to participate in the training sessions set up by the Commissioning Authority.

9. Attend all regularly scheduled commissioning coordination meetings.

10. Provide written certification and completed Field Installation Verification forms and checklists documenting that the following work has been completed in accordance with the plans and specifications and that they are functioning as designed. Where the Work has been sub-contracted, the sub-Trade Representative shall be responsible for the initial certification with the Plumbing Trade Representative recertifying that he has inspected the Work and that it has been completed and functioning as designed. This certification must be submitted to the Commissioning Authority prior to the final verification and functional testing.

    a. Domestic hot water system.

    b. Circulating Pumps.

11. Demonstrate the performance of each piece of equipment to the Commissioning Authority. Provide advance notification for CxA to witness all video of waste systems.

12. Provide set of record mark-ups to the Engineer of Record for inclusion into record documents.

3.04 OPERATION AND MAINTENANCE MANUALS

A. Operating and Maintenance Manuals:

1. Initial preparation shall be made by the Plumbing Trade Representative.

2. Quantity: provide four (4) hard copies of the manual and one (1) electronic copy in PDF format on a CD.

3. Format: 3" thick, 8-1/2" x 11 loose leaf binders. Provide as many as required. Binders shall not be overloaded.

4. Content:

a. Cover sheet.

b. Table of contents (as follows):

c. Description of systems.

The description of systems will be provided by the Engineer of Record for insertion at the time of review and before turn-over to the Commissioning Authority.

d. Contract Plumbing Specifications.

e. Wiring and control diagrams, with data to explain detailed operation and control of each component.

f. Installation instructions.

g. Operating Instructions.

h. Preventative Maintenance Instructions.

i. Maintenance and overhaul instructions.

j. Lubricating schedule including type, grade, temperature, and frequency range.

k. Corrected shop drawings and submittal data.

l. Product information identifying all performance curves, rating data, features, and options on all installed equipment

m. Copies of approved certifications and laboratory test reports.
n. Copies of warranties.

o. Test procedures.

p. Parts list, including source of supply and recommended spare parts.

q. Name, address, and 24-hour telephone number of each subcontractor who installed equipment and systems and local representative for each type of equipment for each system.

r. Other pertinent data applicable to the operation and maintenance of particular systems or equipment and/or other data specified in technical sections of the specification.

s. The documentation during the construction phase shall be updated to match the equipment supplied on the project.

t. Procedures for starting, operation, and shutdown for every system, including all required emergency instructions and safety precautions.

5. Detailed Preparation Requirements:

a. The cover sheet shall list: project name, location, names of the project manager, architect, structural engineer, mechanical engineer and electrical engineer, name of the firms, address and telephone number.

b. Each major heading in the table of contents shall have a large distinctive, clearly marked, non-erasable, plastic encased tab.

c. Each section shall have the following sub-tabs. Sub-tabs shall be similar to the main tabs but of a different color.

1) Specifications:

The specification shall be copied and inserted complete with all addenda.

2) Submittal and Product Data:

This section shall include all approved submittal data. If submittal was not required for approval, descriptive product data shall be included.

3) Installation Instructions:

If the product, such as pipe, etc., does not have any written installation instructions, include a statement "Manufacturer's Written Installation Instructions not Available - Product Installed in Accordance with Specifications and Good Practice".

4) Operation and Maintenance Instructions:

These shall be the written manufacturer's data edited to omit reference to products or data not applicable to this installation.

5) Parts List:

These shall be edited to omit reference to items which do not apply to this installation.

6) Equipment Supplier:

This section shall include the name, address and telephone number of the manufacturer's agent and/or service agency supplying or installing and starting up of the equipment.

7) Field Installation Verification forms, checklists, and Commissioning Checklist:

This will be filled out by the Contractor with the specified data and submitted data and inserted into the manual for submission to the Engineer of Record.

8) System Description:

This section shall include that portion of the overall description included in the beginning of the manual as it applies to each sub-section. In sections such as pumps, the pump designations and their use shall be listed as shown in the equipment schedule.

9) Condensed Operating Instructions:

This section shall include condensed instructions for start-up, shut-down, emergency operation, safety precautions, unusual features and troubleshooting suggestions. Where control is clearly covered in controls description, it is not to be duplicated here.

10) Preventative Maintenance Instructions:
This section shall include condensed typewritten excerpts from the manufacturers written instructions on weekly, monthly, quarterly, annually, etc. This summary shall be prepared by the plumbing Trade Representative with help from the equipment supplier. It will be reviewed by the Engineer of Record prior to turning over to the Commissioning Authority. It shall be prepared for all items listed under "Condensed Operating Instructions" above.

B. Submittal Requirement:

1. The O&M manuals shall be submitted prior to the start of functional testing and prior to the start of any Owner's training.

3.05 TRAINING OF OWNERS OPERATORS:

A. The owners shall be given comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of equipment.

B. The CxA, in cooperation with the Engineer of Record and Contractor, will be responsible for scheduling the training which shall start with classroom sessions followed by hands on training on each piece of equipment. Hands on training shall include start-up, operation in all modes possible, shut-down and any emergency procedures.

C. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.

D. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual.

E. The manufacturer's representative shall provide the instructions on each major piece of equipment. These sessions shall use the printed installation, operation and maintenance instruction material included in the O&M manuals and shall include a review of the written O&M installations emphasize safe and proper operating requirements and preventative maintenance. Training will be included for all major pieces of equipment including pumps and hot water heaters. Qualified service engineers employed by the manufacturers or their qualified sales representatives shall do equipment training. The operation and function of the equipment in the system shall be discussed.

F. Each classroom training session shall be followed by an inspection, explanation and demonstration of the equipment. The start-up and shut-down modes of operation shall be demonstrated.

G. The Contractor shall attend all sessions and shall add to each session any special information relating to the details of installation of the equipment as it might impact the operation and maintenance.

H. The Commissioning Authority shall conduct a final session summarizing the commissioning program.

3.06 NOTIFICATION OF SYSTEM COMPLETION AND REQUEST FOR FINAL PLUMBING SYSTEM COMMISSIONING VERIFICATION

A. When systems are ready for final commissioning verification, the plumbing Trade Representative shall notify the Commissioning Authority in writing and provide completed Field Installation Verification forms and checklists.

B. Should the verification test reveal that the equipment is not performing as specified or control operation is not acceptable, the Contractor will be entitled to one re-inspection of any failed item at no additional cost.

C. Should the verification test determine that the equipment is still not performing as specified or control operation is not acceptable on the second inspection, the time and expenses to make further verification shall be considered as additional cost to the Owner. The total sum of such costs shall be deducted from the final payment to the Contractor.

3.07 VERIFICATION OF PERFORMANCE

A. Verification of performance will take place after certification of the completion of the construction, and completion of all functional test form checklists. Performance demonstration shall be done by the plumbing Trade Representative and shall be witnessed by the CxA and/or the Owner's Representative.

1. Demonstrate capacity of installed equipment where requested with temperature, pressure and flow measurements as required.

2. If a piece of equipment fails a functional performance test the contractor will repair the equipment and will schedule a retest with the commissioning agent. The contractor will be responsible for all commissioning costs for retesting.

3.08 PHASING OF CONSTRUCTION AND COMMISSIONING:

A. The commissioning plan shall take into account the staged start-up of each phase. Commissioning documentation and verification to begin with each phase completion.

3.09 COMMISSIONING DATA SHEETS

A. The Commissioning Data Sheets for various equipment shall be as provided in the Commissioning Plan. They shall be completed as described in Para. 3.07 - Verification of Performance.

3.10 REPORT REQUIREMENTS

A. The Commissioning Authority shall document each commissioning event with meeting minutes or a report. The documents shall separately list deficiencies observed or discovered during the event. The document shall be distributed to Commissioning Team.

B. The Commissioning Authority shall prepare a final formal report to the Owner which will include a narrative in the form of an Executive Summary of the results of program, impressions of the training sessions and the level of operating competence and a certification that the verification of each item is complete and all systems are operating as intended.

C. Transmitted with the report shall be edited Operation and Maintenance Manuals including:

1. Commissioning Data Sheets.

2. Warranties.

3. Permits and Inspection Reports.

END OF SECTION 220800

SECTION 230800 Commissioning of Mechanical Systems

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Drawings and general provisions of the Contract, including General Conditions and Division-1 Specifications Sections, apply to Work of this section.

B. Provisions of Section 01 91 13, Building Commissioning, shall be made an integral part of this Section with all requirements, responsibilities, and recourse described in those sections.

C. Certain building systems on this project are to be commissioned using a team approach. The intent of the commissioning program is to provide documentation, testing, and training to help insure that the project meets the needs of the owner and the designer's intent and to satisfy the requirements for commissioning. The commissioning program includes:

1. Start up and testing of specified equipment and systems in accordance with the commissioning plan, FIV & FPT approved forms.
2. Identification of and documentation of equipment and system deficiencies and normal operating parameters.
3. Corrective actions and acceptance of corrected equipment and systems.
4. Operation and maintenance manuals.
5. Preventative maintenance equipment and system data collection.
6. Equipment and systems use and maintenance training.

1.02 WORK INCLUDED

A. Participate in the Commissioning program as outlined in this section.

1.03 COMMISSIONING PROGRAM CRITERIA

A. Intent:

1. The intent of System Commissioning is to assure delivery to the Owner of HVAC systems that are fully functioning in accordance with all specifications, and which the Owner's personnel are fully trained and equipped to operate, maintain and troubleshoot.

2. The General Contractor and all subcontractors shall participate in the Commissioning Program, which delivers the intended results of System Commissioning, using whatever personnel, time, equipment and resources are required.

3. This Section provides minimum program requirements; however, the Contractor shall exceed those requirements whenever necessary to achieve the intent of Building Commissioning.

B. Commissioning Authority (CxA):

1. The Commissioning Authority is contracted directly with the Owner and is responsible for the overall enforcement and implementation of the Commissioning Program. The Commissioning Authority will schedule and chair all commissioning meetings and be responsible for all documentation and final acceptance of the commissioning phase of the project.

C. Mechanical Trade Representative:

1. The Mechanical Contractor shall assign a qualified individual to function as the Trade Representative to coordinate the Commissioning Program. The Trade Representative reports to the Commissioning Authority.

D. Definitions and Abbreviations:

1. Maintenance Orientation and Inspection: At prescribed times during the Work the Contractor will walk the Owner's Maintenance personnel through the Work, orient them to equipment types and locations, assist access for any requested inspections, answer all questions concerning performance of the Work, workmanship standards and quality control.

2. Equipment Placement Completion: Stage of the Work at which the major items of Division 23 equipment have been placed at final locations, but have not received ductwork, piping and electrical connections. Major equipment includes, but is not limited to, heating and cooling equipment such as Chillers, Boilers, Water Heaters, Cooling towers, Pumps and air-handling units.

3. Distribution Completion: Stage of the Work at which distribution piping and ductwork have been installed and tested, but not insulated or concealed by further work.

4. O&M Manuals: Operation and Maintenance Manuals as specified in Contract Documents.

5. TAB: Testing, Adjusting and Balancing of Division 23 equipment as specified in Contract Documents.

6. Trade Representative: Person who competently represents the work force engaged by the Contractor for the individual trade named. This person shall be completely familiar with the work performed for this Contract at all levels of detail of his trade and with coordination to other trades. This person shall be capable of and have authority to execute all commissioning responsibilities of the trade as described in these Contract Documents.

7. Participate: Attend commissioning events, provide technical expertise or knowledge, equipment, measurements and observation needed or requested by the Commissioning Authority or Owner. Provide follow-up analysis, equipment data, design data, or other trade or professional service needed in response to commissioning events.

8. Verify: To positively determine that the measured or observed quantity satisfies all required criteria. Simply performing the test, measurement or observation does not constitute "verification". The test result must also pass all Contract

criteria. Tests that fail must be repeated at no additional cost to the Owner after repairs or adjustments are made, until full verification is achieved.

9. Pre-functional Testing: Ensure that individual pieces of equipment are capable of performing in accordance with the Specifications, Drawings, and manufacturers' requirements. This is documented with a Field Installation Verification checklist provided by the CxA and completed by the contractor. The Commissioning Authority shall overview this testing.

E. Scope: For coordination purposes, the entire commissioning scope involving all parties is described here. The responsibilities of Division 23 Trades with respect to commissioning are separated out under Section 3.03 - RESPONSIBILITIES.

1. Document HVAC design intent.

2. Verify that equipment and systems have been properly installed in accordance with the contract documents and manufacturer's written installation instructions.

3. Verify that piping systems have been properly cleaned.

4. Verify that duct systems have been properly cleaned.

5. Verify that equipment has been placed into operation with manufacturer's oversight and approval.

6. Verify that adjusting, balancing and system testing has been properly done in accordance with Testing, Adjusting and Balancing requirements.

7. Assemble contract documents and record drawings.

8. Assemble operation and maintenance instructions and submittal data.

9. Perform Pre-Functional testing

10. Verify the performance of each piece of equipment and each system through functional testing.

11. Train Owner's personnel in the proper operation of each piece of equipment and each system.

12. Document warranty start and end dates.

13. Assemble all records of Code authority inspections and approvals.

14. Monitor and enforce accessibility of all work versus maintenance requirements of each piece of equipment.

15. Identify, document and report all deficiencies of the work versus Contract specifications and performance requirements.

F. Commissioning Cost:

1. Each Trade and supplier of equipment shall include in his quoted price the cost

of furnishing the material requested and manpower necessary for the operation and maintenance manuals, training and system verification as specified under this section.

PART 2 - PRODUCTS

2.01 NOT APPLICABLE.

PART 3 - EXECUTION

3.01 PREPARATION OF COMMISSIONING PLAN

A. The Commissioning Plan shall be prepared by the CxA. The plan shall take full cognizance of all intent and specific requirements for the Commissioning Program described in the Contract Documents.

B. The Commissioning Plan shall be submitted to the Owner and shall be subject to approval in all aspects by the Owner. The Owner reserves the right to require changes in the Commissioning Plan or personnel assigned at any time to satisfy the Owner's quality assurance within the Commissioning Program.

3.02 COMMISSIONING TEAM

A. A Commissioning Team shall be designated consisting of all members needed to execute the approved Commissioning Program. Membership shall include:

1. CxA
2. General Contractor
3. Mechanical Trade Representative
4. Electrical Trade Representative
5. Testing, Adjusting and Balancing Trade Representative
6. Facility Management and Control System (FMCS) Trade Representative
7. Owner's Representative
8. Owner’s HVAC Maintenance Representative
9. Architect and Engineer of Record

B. The Contractor's personnel shall be made available to execute all aspects of the Commissioning Program until the Owner accepts final results. Commissioning Program tasks and meetings may be repeated until the Owner is satisfied and will not be fixed as one-time, one-chance events for the Contractor.

3.03 RESPONSIBILITIES

A. Owner:

1. Assign maintenance and engineering personnel and schedule them to participate in the various meetings, training sessions and inspections as required:

B. Commissioning Authority:

1. Prepare Commissioning requirements sections of the Contract.

2. Prepare the Commissioning Plan. Include list of all Trade Representatives for

commissioning events by name, firm and trade specialty.

3. Execute the Commissioning Plan, through organization of all meetings, tests, demonstrations, training events and performance verifications described in the Contract Documents and approved Commissioning Plan. Organizational responsibilities include preparation of agendas, attendance lists, arrangements for facilities and timely notification to participants for each commissioning events. The Commissioning Authority shall act as chairman at all commissioning events and assure execution of all agenda items. The Commissioning Authority shall prepare minutes of every commissioning event and send copies to all attendees within 5 workdays of the event.

4. Review the plans and specifications with respect to their completeness in all areas relating to the commissioning program. This includes ensuring that the commissioning guidelines have been followed.

5. The plan and specification review by the Commissioning Authority does not include any responsibility for the system evaluation, adequacy of the system to meet design intent, capacity of the system, quality control check or any of the other elements of the system design which are the strict responsibility of the Engineer of record.

6. Schedule a pre-commissioning coordination meeting within 90 days of the award of the contract, at some convenient location and at a time suitable to the Mechanical Contractor and Engineer of Record. This pre-commissioning meeting will be for the purpose of reviewing the complete commissioning program and establishing tentative schedules for Maintenance orientation and inspections, O&M submittals, training sessions, system flushing and testing, job completion, system start-up, test, adjust and balance work, and functional testing.

7. Receive and review operation and maintenance (O&M) manuals as submitted by the contractor through the Engineer of Record.

8. Adequate accessibility for maintenance and component replacement or repair is the Mechanical Contractor's responsibility and will be checked by the Commissioning Authority at shop drawings, and during initial and final phases for each item of equipment.

9. Witness the piping test and flushing procedure. Incorporate the documentation in the final commissioning report. Prepare report of this observation, with separate summary of deficiency findings by the Commissioning Authority.

10. Witness ductwork testing and cleaning. Document the results and incorporate it in the final commissioning report.

11. Schedule a meeting with the test, adjust and balance (TAB) Trade Representative prior to the start of the test, adjust and balance procedure. This meeting should be attended by the Owner, mechanical Trade Representative, Commissioning Authority, Engineer of Record and TAB Trade Representative. The TAB Trade Representative will outline the TAB procedure and get concurrence from the Engineer of Record and Commissioning Authority. Ensure that the TAB Trade Representative has all forms required for the job and understands their importance and use.

12. Schedule regular commissioning coordination meetings during construction.

13. Schedule the Owner training sessions. These training sessions are to be attended by the Owner, Commissioning Authority, Engineer of Record, Mechanical Contractor, Trade Representatives and equipment suppliers as necessary. The format will follow the outline in the O&M Manuals.

14. Upon receipt of notification from the Mechanical Contractor that the system has been started, that all air, water and control systems have been started, tested, adjusted and balanced, that the systems and equipment are functioning as designed and specified, and that all Field Installation Verification forms and checklists have been completed, schedule the verification demonstrations. These demonstrations will be conducted by the Contractor and the TAB and controls Trade Representative and witnessed by the Commissioning Authority. Prepare minutes of each verification event, with separate summary of deficiency findings by the Commissioning Authority. Distribute to attendees.

15. Prepare final commissioning report and submit to Owner. Schedule final review with Owner. Present all documentation and turn over signed acceptance of the system to the Owner.

C. Engineer of Record:

1. Provide HVAC system Basis of Design Narrative. Incorporate in the appropriate sections of the O&M Manual.

2. Attend initial pre-commissioning coordination meeting to be scheduled by the Commissioning Authority within 90 days of the award of the contract.

3. Verify adequate maintenance accessibility for each piece of equipment in shop drawings and actual installation. Visit site periodically and inspect construction.

4. Conduct the first HVAC training session on the overview of the system design, the system design goals and the reasoning behind the selection of equipment.

5. Review O&M Manuals submitted by the Mechanical Contractor. Insert Design Narrative.

6. Attend initial meeting with TAB Trade Representative as scheduled by Commissioning Authority.

7. Review TAB report from Contractor against design requirements. Issue a report noting deficiencies requiring correction to the Commissioning Authority.

D. Mechanical Contractor:

1. Include cost for commissioning requirements in the contract price.

2. Include commissioning requirements in the mechanical and electrical sub-contracts and ensure full cooperation of all parties in the commissioning program.

3. Provide an approved Plan to the Commissioning Authority to prepare and coordinate execution of the Commissioning Program. Provide the Commissioning Authority with means and authority to execute Commissioning Program.

4. Coordinate the interface of the Commissioning Program.

5. Prepare record drawings as required by contract documents and submit to the Owner.

E. Mechanical Trade Representative:

1. Include requirements for submittal data, O & M data and training in each purchase order or sub-contract written.

2. Ensure cooperation and participation of specialty sub-Trade Representatives such as Ductwork, Piping, Testing, Adjusting and Balancing, Chemical treatment and Refrigeration.

3. Ensure participation of major equipment manufacturers and their representatives.

4. Coordinate this commissioning program with the Electrical Trade Representative.

5. Attend initial pre-commissioning coordination meeting scheduled by the Commissioning Authority. Prepare necessary preliminary schedule for Maintenance orientation and inspections, O & M manual submission, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, test, adjust and balance start and job completion for use by the Commissioning authority. Update schedule as appropriate throughout the construction period.

6. Obtain O & M data on all equipment and assemble in binders using tabs as required. Submit to Engineer of Record for approval prior to the Distribution completion stage.

7. Notify the Commissioning Authority of the time for the duct and piping system pressure tests and piping system flushing.

8. Notify the Commissioning Authority of the time for all equipment start up activities.

9. Notify the Commissioning Authority of the time for start of the TAB work. Attend the initial TAB meeting for the review of the TAB procedures.

10. Conduct and schedule vendors and other Trade Representatives to participate in the training sessions set up by the Commissioning Authority.

11. Attend all regularly scheduled commissioning coordination meetings.

12. Provide written certification and completed Field Installation Verification forms and checklists documenting that the following work has been completed in accordance with the plans and specifications and that they are functioning as designed. Where the Work has been sub-contracted, the sub-Trade

Representative shall be responsible for the initial certification with the Mechanical Trade Representative recertifying that he has inspected the Work and that it has been completed and functioning as designed. This certification must be submitted to the Commissioning Authority prior to the final verification and functional testing.

a. All mechanical systems and equipment including air handling units, fans, ductwork, piping, dampers, air terminal units and air devices.

b. Fuel supply systems

c. Fire stopping in the fire rated construction including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.

d. Facility Management and Control System (FMCS).

13. Demonstrate the performance of each piece of equipment to the Commissioning Authority. Schedule the TAB, FMCS and other sub-Trade Representatives as may apply to demonstrate the performance of the equipment and systems.

14. Provide set of record mark-ups to the Engineer of Record for inclusion into record documents.

F. Testing, Adjusting and Balancing Trade Representative:

1. Include cost for commissioning requirements in the contract price.

2. Attend initial pre-commissioning coordination meeting scheduled by the Commissioning Authority.

3. Attend the TAB review meeting scheduled by the Commissioning Authority. Be prepared to discuss the TAB procedures that will be followed in testing, adjusting and balancing the HVAC system.

4. Attend regularly scheduled commissioning meetings.

5. Participate in training sessions as set up by the Commissioning Authority.

6. At the completion of the TAB work, notify the Mechanical Trade Representative, and demonstrate to the Commissioning Authority the performance of the equipment covered by the TAB sub-contract as specified under "Verification of Performance" in this Section.

7. Repeat any measurement contained in the TAB report where required by the Commissioning Authority for verification or diagnostic purposes.

G. Facility Management and Control System (FMCS) Trade Representative:

1. Include cost for commissioning requirements in the contract price.

2. Attend initial pre-commissioning coordination meeting scheduled by the CxA.

3. Attend regularly scheduled commissioning meetings.

4. Participate in training sessions as set up by the Commissioning Authority.

5. At the completion of the Facility Management and Control System start-up and adjustment work, provide a complete start-up report and notify the Mechanical Trade Representative, and demonstrate to the Commissioning Authority the performance of the systems through functional performance tests developed by the commissioning authority.

6. Coordinate with TAB subcontractor to obtain control settings that are determined from balancing procedures. Record the following control settings as obtained from TAB contractor, and note any TAB deficiencies in the FMCS start-up report.

   a. Optimum duct static pressure setpoints for VAV air handling units.
   b. Minimum outside air damper settings for air handling units.
   c. Optimum differential pressure setpoints for variable speed pumping systems.
   d. Calibration parameters for flow control devices such as VAV boxes and flow measuring stations.

3.04 OPERATION AND MAINTENANCE MANUALS

A. Operating and Maintenance Manuals:

1. Initial preparation shall be made by the Mechanical Trade Representative.

2. Quantity: provide four (4) hard copies of the manual and One (1) electronic copy in PDF format on a CD.

3. Format: 3" thick, 8-1/2" x 11 loose leaf binders. Provide as many as required. Binders shall not be overloaded.

4. Content:

   a. Cover sheet.

   b. Table of contents (as follows):

   c. Description of systems.

      The description of systems will be provided by the Engineer of Record for insertion at the time of review and before turn-over to the Commissioning Authority.

   d. Contract Mechanical Specifications.

   e. Wiring and control diagrams, with data to explain detailed operation and control of each component.

   f. Control sequences describing start-up, all modes of operation, and shutdown.

   g. Installation instructions.

h. Operating Instructions.

i. Preventative Maintenance Instructions.

j. Maintenance and overhaul instructions.

k. Lubricating schedule including type, grade, temperature, and frequency range.

l. Corrected shop drawings and submittal data.

m. Product information identifying all performance curves, rating data, features, and options on all installed equipment

n. Copies of approved certifications and laboratory test reports.

o. Copies of warranties.

p. Test procedures.

q. Parts list, including source of supply and recommended spare parts.

r. Name, address, and 24-hour telephone number of each subcontractor who installed equipment and systems and local representative for each type of equipment for each system.

s. Other pertinent data applicable to the operation and maintenance of particular systems or equipment and/or other data specified in technical sections of the specification.

t. Uninterruptible power supplies, including a list of equipment and design kW load on each.

u. Emergency power generation, including a list of equipment and design kW load on each.

v. The documentation during the construction phase shall be updated to match the equipment supplied on the project.

w. Procedures for starting, operation, and shutdown for every system, including all required emergency instructions and safety precautions.

5. Detailed Preparation Requirements:

a. The cover sheet shall list: project name, location, names of the project manager, architect, structural engineer, mechanical engineer and electrical engineer, name of the firms, address and telephone number.

b. Each major heading in the table of contents shall have a large distinctive, clearly marked, non-erasable, plastic encased tab.

c. Each section shall have the following sub-tabs. Sub-tabs shall be similar to the main tabs but of a different color.

1) Specifications:

The specification shall be copied and inserted complete with all addenda.

2) Submittal and Product Data:

This section shall include all approved submittal data. If submittal was not required for approval, descriptive product data shall be included.

3) Installation Instructions:

If the product, such as pipe, etc., does not have any written installation instructions, include a statement "Manufacturer's Written Installation Instructions not Available - Product Installed in Accordance with Specifications and Good Practice".

4) Operation and Maintenance Instructions:

These shall be the written manufacturer's data edited to omit reference to products or data not applicable to this installation.

5) Parts List:

These shall be edited to omit reference to items, which do not apply to this installation.

6) Equipment Supplier:

This section shall include the name, address and telephone number of the manufacturer's agent and/or service agency supplying or installing and starting up of the equipment.

7) Field Installation Verification forms, checklists, and Commissioning Checklist:

This will be filled out by the Contractor with the specified data and submitted data and inserted into the manual for submission to the Engineer of Record. A copy shall be given to the test, adjust and balance (TAB) Trade Representative so that (TAB) data can be added. Upon completion of this entry, the form shall be forwarded with the certification of system completion and commissioning request.

8) System Description:

This section shall include that portion of the overall description included in the beginning of the manual as it applies to each sub-section. In sections such as pumps, the pump designations and their use shall be listed as shown in the equipment schedule.

9) Controls Description:

This will be included in each section covering controlled equipment. It will include the description from the approved temperature control submission, complete with schematic diagram showing piping arrangement and control location on 8-1/2" x 11" or 11" x 17" sheet. This data shall be provided by the FMCS Trade Representative in a form suitable for insertion into the O&M Manuals by the Mechanical Trade Representative and for review by the Engineer of Record.

10) Condensed Operating Instructions:

This section shall include condensed instructions for start-up, shut-down, emergency operation, safety precautions, unusual features and troubleshooting suggestions. Where control is clearly covered in controls description, it is not to be duplicated here.

11) Preventative Maintenance Instructions:
This section shall include condensed typewritten excerpts from the manufacturers written instructions on weekly, monthly, quarterly, annually, etc. This summary shall be prepared by the mechanical Trade Representative with help from the equipment supplier. It will be reviewed by the Engineer of Record prior to turning over to the Commissioning Authority. It shall be prepared for all items listed under "Condensed Operating Instructions" above.

d. Testing, Adjusting and Balancing shall contain the following sections:

1) Specifications.

2) Submittal.

3) TAB Data.

This shall be the final TAB data. It will have to be added after the owner has received his training and the O&M manuals.

e. Commissioning of Mechanical Systems shall be prepared by the Commissioning Authority and shall contain the following sections:

1) Specifications.

2) Commissioning Plan.

3) Final Report of the Commissioning Authority.

B. Submittal Requirement:

1. The O&M manuals shall be submitted prior to the start of functional testing and prior to the start of any Owner's training.

3.05 TRAINING OF OWNERS OPERATORS:

A. The owners shall be given comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of equipment.

B. The FMCS contractor shall provide 8 hours of detailed training for people provided by the Commissioning Authority in the design, programming and operation of the FMCS system and equipment. This training shall be provided within two months after award of a contact. FMCS contractor shall provide to the CxA and install on a computer designated by the CxA one copy of all software required to access, program, manipulate or otherwise interface with the control system.

C. The CxA, in cooperation with the Engineer of Record and Contractor, will be responsible for scheduling the training which shall start with classroom sessions followed by hands on training on each piece of equipment. Hands on training shall include start-up, operation in all modes possible, shut-down and any emergency procedures.

D. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.

E. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual.

F. The Engineer of Record will conduct the first session on the overall system design concept and the design concept portion of each equipment section.

G. The manufacturer's representative shall provide the instructions on each major piece of equipment. These sessions shall use the printed installation, operation and maintenance instruction material included in the O&M manuals and shall include a review of the written O&M installations emphasize safe and proper operating requirements and preventative maintenance. Training will be included for all major pieces of equipment including pumps, chillers, boilers, hot water heaters, heat rejection equipment, air conditioning units, air handling units, fans, air terminals, controls and water treatment systems. Qualified service engineers employed by the manufacturers or their qualified sales representatives shall do equipment training. The operation and function of the equipment in the system shall be discussed.

H. Each classroom training session shall be followed by an inspection, explanation and demonstration of the equipment. The start-up and shut-down modes of operation shall be demonstrated.

I. The Contractor shall attend all sessions and shall add to each session any special information relating to the details of installation of the equipment as it might impact the operation and maintenance.

J. The FMCS Trade Representative shall attend all sessions and be prepared to conduct the controls portion of the training as it relates to each equipment section.

K. The FMCS Trade Representative shall conduct the training session on the controls system hardware and software.

L. The piping, insulation and sheet metal Trade Representatives shall conduct sessions on

their respective trades with emphasis on any peculiarities of the systems, pressure limitations and maintenance requirements.

M. The TAB Trade Representative shall conduct a training session reviewing the procedures and methods used in the TAB process, shall review the TAB data and shall demonstrate use of test equipment which may have been turned over to the owner and shall point out the locations of all pitot traverse locations for the owner's future use.

N. The Commissioning Authority shall conduct a final session summarizing the commissioning program.

3.06 NOTIFICATION OF SYSTEM COMPLETION AND REQUEST FOR FINAL HVAC SYSTEM COMMISSIONING VERIFICATION

A. When systems are ready for final commissioning verification, the mechanical Trade Representative shall notify the Commissioning Authority in writing and provide completed Field Installation Verification forms and checklists. Commissioning data sheets must be complete through the column labeled "Balanced" and included with the request.

B. Should the verification test reveal that the equipment is not performing as specified or control operation is not acceptable, the Contractor will be entitled to one re-inspection of any failed item at no additional cost.

C. Should the verification test determine that the equipment is still not performing as specified or control operation is not acceptable on the second inspection, the time and expenses to make further verification shall be considered as additional cost to the Owner. The total sum of such costs shall be deducted from the final payment to the Contractor.

3.07 VERIFICATION OF PERFORMANCE

A. Verification of performance will take place after certification of the completion of the construction, and completion of all functional test form checklists. Performance demonstration shall be done by the mechanical Trade Representative, the TAB Trade Representative, or the FMCS Trade Representative as appropriate, and shall be witnessed by the CxA and/or the Owner's Representative.

B. Test and Balance Work

1. Verification to include demonstration of performance listed in Testing, Adjusting and Balancing. The specified, submitted and as balanced data shall be entered on the Commissioning Data Sheets by the Contractor as included in the Commissioning Plan prior to the verification. The witnessed performance data shall be added to the data sheet at the time of verification.

2. The original TAB contractor will execute the checks, witnessed by the Commissioning Authority. The TAB contractor will use the same test instruments as used in the original TAB work. All test instruments shall have had certified calibration within the past 12 months.

3. A failure of more than 10% of the selected items of a given system shall result in the failure of acceptance of the system TAB report and the TAB contractor shall be responsible to rebalance the system, provide a new system TAB report and repeat random verifications of the new TAB report. The contractor shall pay for all

commissioning costs associated with repeat verifications of the new TAB report.

a. Failure of airflow and water flow is defined as a deviation of more than 10% from report data or from design value.

b. Failure of temperature reading is defined as a deviation of more than 1 degree from report data or design value.

c. Failure of air and water pressure is defined as a deviation of more than 5% from report data or design value.

4. The following tests and checks will be conducted:

a. A random sample of up to 25% of air terminal units and diffusers including air flow, water flow, differential pressure, sound , and electrical data.

b. TAB readings for all major pieces of equipment including air handling units, fans, chillers, boilers, pumps, etc.

c. Major Duct flow and pressure - The TAB Trade Representative shall identify all places where temperature, pressure and/or velocity readings were taken. On up to 20% of the locations, performance, as listed in the TAB Report, shall be demonstrated

d. Verification that final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked by the TAB Contractor.

e. Verification that the air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity. This shall include a review of TAB methods, control set points established by TAB and a physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units (TUs) taking off downstream of the static pressure sensor, the TU on the critical leg has its damper 90% or more open.

f. Verification that the water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity. This shall include a review of TAB methods, control setpoints established by TAB and a physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90% or more open

C. Performance Tests

1. For all pieces of equipment test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including but not limited to startup, shutdown, unoccupied & manual modes and power failure. Test functionality of equipment and system in all control strategies, interfaces with other systems, and interlocks with which it is associated. The Commissioning Authority will prepare detailed descriptions of the test procedures that the Contractor will perform to demonstrate conformance of the completed mechanical systems to the plans and specifications.

2. Provide trend logs for any control system monitored point as requested to demonstrate system performance.

    a. The Commissioning Authority will analyze trend logs of the system operating parameters to evaluate normal system functionality. The contractor shall establish requested trends, ensure they are being stored properly, and forward the data in electronic format to the commissioning Authority.
    b. Data shall include a single row of field headings and the data thereafter shall be contiguous. Each record shall include a date and time field. Recorded parameters for a given piece of equipment or component shall be trended at the same intervals and be presented in a maximum of two separate two dimensional formats with time being the vertical axis and field name being the horizontal axis. Data shall be forwarded in Microsoft Excel format.
    c. Trend graphs shall generally be used during the acceptance phase to facilitate and document testing. Prepare controller and workstation software to display graphical format trends during the acceptance period. Trend graphs shall demonstrate compliance with contract documents. Trended values and intervals shall be the same as those specified for the functional performance tests.
    d. Lines shall be labeled and shall be distinguishable from each other by using either different line types or different line colors.
    e. Indicate engineering units on the y-axis values, e.g. degrees F., inches WG, percent open, etc.
    f. The y-axis scale shall be chosen so that all trended values are in a readable range. Do not mix trended values on one graph if their unit ranges are incompatible.
    g. Trend outside air temperature, humidity and enthalpy during each period in which any other points are trended.
    h. All points trended or one HVAC subsystem shall be trended during the same trend period.
    i. Each graph shall be clearly labeled with system title, date and times.

3. Demonstrate capacity of installed equipment where requested with temperature, pressure and flow measurements as required.

4. FMCS Trade Representative shall demonstrate calibration of all sensors and measurement devices as requested by the Commissioning Authority. Calibration means FMCS readout vs. field measurement with a hand held calibrated instrument. Instruments shall be provided by the FMCS Trade Representative and approved by the Commissioning Authority.

    a. Instruments shall be traceable to the National Institute for Standards and Technology, and shall be at least twice as accurate as the device to be calibrated (i.e. if field device is ±0.5% accurate the test equipment shall be ±0.25% accurate over the same range).

5. In addition to equipment control, FMCS Trade Representative shall demonstrate all specified features and capabilities of the FMCS including graphics, communications to remote sites, setpoint changing features and functions, security features, O&M schedules and alarms, trending, etc.

6. If a piece of equipment fails a functional performance test the contractor will repair the equipment and will schedule a retest with the commissioning agent. The

contractor will be responsible for all commissioning costs for retesting.

7. Acceptance criteria –

    a. For the conditions, sequences and modes tested, the equipment, integral components and related equipment shall respond to varying loads and changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

    b. In general, equipment with supporting systems shall be able to maintain temperature set points within 1.0F either side of the deadband of the current set point without excessive hunting. Air and water pressures and flows shall be controlled to not drift more than an amount equal to 5% of the setpoint value either side of the deadband without excessive hunting.

    c. Calibration of sensors, transmitters and other control devices (FMCS readout vs. hand held calibrated instrument) shall be within ±0.5 degrees for temperature, ±4% for humidity, ±4% for pressures and flows and ±5% for CO_2 measurement.

8. Fire and smoke damper installation and operation - All dampers shall be inspected and checked for proper operation. Smoke detectors shall be checked for proper performance. Smoke dampers shall be checked for proper operation. Fire damper operation shall be checked by removing fusible link and demonstrating closure.

9. FMCS Contactor is to provide access to the FMCS system to the Commissioning Authority through the Internet at whatever access level requested.

3.08 PHASING OF CONSTRUCTION AND COMMISSIONING:

A. The commissioning plan shall take into account the staged start-up of each phase. Commissioning documentation and verification to begin with each phase completion.

3.09 COMMISSIONING DATA SHEETS

A. The Commissioning Data Sheets for various equipment shall be as provided in the Commissioning Plan. They shall be completed as described in Para. 3.07 - Verification of Performance.

3.10 REPORT REQUIREMENTS

A. The Commissioning Authority shall document each commissioning event with meeting minutes or a report. The documents shall separately list deficiencies observed or discovered during the event. The document shall be distributed to Commissioning Team.

B. The Commissioning Authority shall prepare a final formal report to the Owner which will include a narrative in the form of an Executive Summary of the results of program, impressions of the training sessions and the level of operating competence and a certification that the verification of each item is complete and all systems are operating as intended.

C. Transmitted with the report shall be edited Operation and Maintenance Manuals including:

1. Commissioning Data Sheets.
2. Warranties.
3. Permits and Inspection Reports.
4. TAB Reports

END OF SECTION 230800

SECTION 019113 General Commissioning Requirements

PART 1 – GENERAL

1.1 SUMMARY

A. General

1. Certain building systems on this project are to be commissioned using a team approach. The intent of the commissioning program is to provide documentation, testing, and training to help insure that the project meets the needs of the owner and the designer's intent and to satisfy the requirements for commissioning. The commissioning program includes:

a. Start up and testing of specified equipment and systems in accordance with the commissioning plan, FIV& FPT approved forms.
b. Identification of and documentation of equipment and system deficiencies and normal operating parameters.
c. Corrective actions and acceptance of corrected equipment and systems.
d. Operation and maintenance manuals.
e. Preventative maintenance equipment and system data collection.
f. Equipment and systems use and maintenance training.

2. Furnish labor and materials to accomplish Building Commissioning as specified herein.

3. Project Schedule: The General Contractor shall include the systems commissioning in the total project schedule as required by other spec sections. Schedule information to be included will be provided by the Commissioning Agent.

1.2 RELATED DOCUMENTS:

A. Section 22 08 00 Commissioning of Plumbing Systems
B.Section 23 08 00 Commissioning of Mechanical Systems
C. Section 26 08 00 Commissioning of Electrical Systems

1.3 DEFINITIONS

A. FIV: Field Installation Verification
B. FPT: Functional Performance Test
C. RFI: Request for Information.
D. ASI: Architectural Supplemental Instruction.
E. CCD: Construction Change Directive.
F. RFP: Request for Proposal.
G. COR: Change Order Request.
H. TBD: To be Determined.
I. IAW: In accordance with.
J. IOM: Installation, operating and maintenance instructions.
K. FBO: Furnished by Others.
L. Deficiency: A system or piece of equipment that does not function as expected.
M. A/E: Architect, Architect & Engineer and or Engineer
N. General Contractor: The General Contractor shall be that single Contractor who has the binding contract with the owner or owner's legally authorized representative.

O. Subcontractor: Subcontractors shall be those contractors who are hired by the General Contractor for the project.
P. DID – Design intent document (a dynamic document changing during the course of the project if the design changes. How the owner expects the building systems to perform upon project completion. It represents the objectives of the project from a systems performance view and is intended to improve the communications process of the project team.
Q. BOD – Basis of Design. A narrative of how the designer plans to achieve the design intent. A description of systems and their operation. A narrative of the system design.

1.4 COMMISSIONING AGENT

A. The Commissioning Agent (CxA) shall be FBO under a separate contract.

1.5 SYSTEMS TO BE COMMISSIONED

1. HVAC Systems in their entirety including but not limited to:

   a. Supply and Exhaust duct distribution systems including ductwork, diffusers, fans, air terminal devices and controls.

   b. Hot Water Systems including piping, pumps, heat exchangers, controls, and all associated appurtenances.

   c. Air Handling Systems including air handling units, rooftop units, heat recovery units, outside air preconditioning units, split dx systems, controls, and all associated appurtenances.

   d. Test and Balance verification.

2. Facility Management and Control System (FMCS) in its entirety.

3. Plumbing Systems including:

   a. Domestic Hot Water Heaters

4. Electrical Systems including:

   a. Lighting control systems

   b. Emergency Power systems

   c. Fire Alarm

   d. Intercom / Paging

   e. Security

1.6 DOCUMENTATION

A. The CxA at no charge to them shall be provided with the following documentation from the General Contractor and respective subcontractors:

1. General Contractor:

    a. Project plans and specifications (contract documents), approved (and others requested) shop drawings and submittals, RFI, ASI, RFP, COR, CCD, equipment start-up and certification reports, etc.
    b. Records of required code authority inspections, documentation signoffs, etc.
    c. Equipment IOM's
2. Contractors, subcontractors:

    a. Approved (and other requested) shop drawings and submittals, RFI, ASI, RFP, COR, CCD, equipment start-up and certification reports, etc.
    b. Equipment IOM's

1.7 COMMISSIONING TEAM

A. The Commissioning Team for this project includes:

1. The Owner or Owner's authorized representative
2. The CxA
3. The General Contractor
4. The Mechanical, Electrical and Plumbing Sub-contractors.
5. The FMCS Contractor
6. The TAB Contractor
7. A/E firm of record

1.8 SUBMITTALS

A. All contractors and subcontractors through the General Contractor will submit a list of required equipment/system submittals to the CxA within 30 days after award of the contract. The CxA will identify submittals to be submitted to the CxA concurrent with submission to the A/E for review.

B. All contractors and subcontractors through the General Contractor will submit required preventative maintenance equipment data sheets to the CxA within 45 days of equipment approval by the design A/E.

C. All contractors and subcontractors through the General Contractor will submit O&M data for systems and equipment being commissioned under this specification, as specified elsewhere and as applicable in accordance with ASHRAE Guideline 3-1993. O&M data shall be submitted 8 weeks prior to the beginning of FIV work.

D. All contractors and subcontractors through the General Contractor will deliver the required extra materials to a TBD specified party and or place not later than 4 weeks prior to the start of the FPT phase.

E. The TAB Contractor through the General Contractor will submit the final TAB report for review and approval to the CxA and the A/E within 1 week of completion of work and prior to the commencement of FPT.

F. The General Contractor will submit a copy of the construction meeting minutes, updated construction schedule, RFI, ASI, RFP, CCD and or COR to the CxA within 5 days of each occurrence.

PART 2 – PRODUCTS

2.1 MATERIALS

A. The General Contractor, contractors and all subcontractors shall provide their own respective tools, services, instruments and consumables required to test, demonstrate, adjust and remediate documented deficiencies during and subsequent to the commissioning process as specified by the contract documents.

PART 3 – EXECUTION

3.1 CxA

A. The CxA will actively participate in the construction phase of the project to assure compliance with Total Building Commissioning requirements.

1. During the construction phase of the commissioning process, the building systems shall be installed, started, and put into operation.
2. The objectives of the commissioning process during the construction phase shall be to:
    a. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations, the contract documents, and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
    b. Verify that all equipment can be maintained as installed.
    c. Verify and document proper performance of equipment and systems.
    d. Verify that O&M documentation left on site is complete.
    e. Verify that the Owner's operating personnel are adequately trained.
3. Prior to construction of the building systems, advise the owner or authorized owner's representative that maintenance personnel should observe and monitor construction of the building systems in order to develop a better understanding of the intended operation, performance, physical installation, and the location of systems, equipment and devices.
4. Specific commissioning activities shall be implemented in accordance with the approved commissioning plan.

B. Construction-Phase Procedures:

1. The CxA shall perform the following activities:
    a. Review submittals.
    b. Update and finalize the Commissioning Plan.
    c. Create project specific FIV & FPT forms
    d. Observe construction, installation, start-up, operation, and testing and balancing.
    e. Coordinate systems verification and validation procedures.
    f. Verify the accuracy of the Test and Balance Report.
    g. Conduct periodic commissioning team meetings.
    h. Report progress and deficiencies.

i. Coordinate training of operations and maintenance personnel.
j. Update documentation.

2. The CxA shall update the Commissioning Plan to reflect the installed equipment and system(s), incorporating design changes that occurred during the construction phase.
   a. Commissioning activities shall be scheduled in concert with the overall project schedule.
   b. Parties responsible for performing the tasks necessary to implement the commissioning specification shall be identified.
   c. The Commissioning Plan shall be revised and submitted regularly to the Commissioning Team throughout the construction period so as to maintain an up to date program.

3. Observations shall be conducted to ensure compliance with the manufacturer's installation instructions. These observations shall include, but not be limited to the following building systems and activities:
   a. Air handling, distribution, and ventilation systems.
   b. Heating systems.
   c. Cooling systems.
   d. Piping.
   e. Controls.
   f. Building automation systems.
   g. Domestic hot water systems.
   h. Indoor air quality methods and procedures.
   i. Lighting control systems
   j. Compliance with codes and standards.
   k. Witness testing, pressure testing, leakage testing, flushing, and cleaning

4. The system operation descriptions shall be updated and combined with equipment data, including performance data, for training of and subsequent use by the operations and maintenance staff. The updated system operation descriptions shall be included as part of the O&M Manual.

5. The CxA shall facilitate regular scheduled meetings of the entire commissioning team for the purpose of site coordination, communication, conflict resolution, progress of the commissioning process, urgent work issues, and deficiencies.

6. The CxA shall coordinate the maintenance personnel training program and shall structure said program to reflect the level of sophistication of the building systems.

7. Start-up activities shall be observed and documented.

8. Testing and balancing work shall be completed prior to FPT. FPT tests shall be conducted on equipment, duct, pipe, and control systems to verify that pressures, temperatures, flow rates, and control functions meet design requirements.

9. Document deficiencies discovered during the commissioning process within one working day of discovery.

C. Commissioning Plan:

1. The Commissioning Plan shall be continuously updated by the CxA to define the on-site activities required for implementing the commissioning specifications. This plan shall be customized to be project specific and shall reflect the actual equipment and systems that will be installed.

2. The following basic program functions shall be defined:

   a. Define the schedule of inspections required during construction.
   b. Develop the schedule for verification, operational and functional performance testing.
   c. Define the process for reporting and correcting any deficiencies identified.
   d. Detail any training sessions for operations and maintenance personnel that are to take place during this phase.

3. At a minimum, the Commissioning Plan shall identify the following specific action items:

   a. Document all equipment and systems involved in the commissioning process.
   b. Document pre-start and start-up checklists for all equipment and systems involved in the commissioning process.
   c. Detail the procedures for conducting the functional performance tests on each piece of equipment and each system, with provisions for verifying all relevant data, recording the results obtained, and listing the parties involved in each test.
   d. Detail the schedule for all commissioning activities to include specific dates consistent with the overall project construction schedule.

D. Documentation:

1. All commissioning activities that occur during the construction phase shall be documented, including but not limited to the following items:

   a. Reports from site observations shall be submitted with the required information in the agreed upon format and within the specified time.
   b. Documentation required for the O&M Manual and the final commissioning report shall continue to be collected during the construction phase.
   c. Progress reports shall be distributed to keep all parties informed of the commissioning process. Progress reports shall include:

      1) Activities since the last report.

      2) Description of changes to the commissioning schedule, Commissioning Plan, and design; along with their effect on the design intent and Basis of Design.

      3) Listing of equipment and systems not passing verification inspections, functional performance tests, or acceptance tests.

      4) Follow-up of all items listed in the previous reports that required action.

      6) Critical items that will occur in the next reporting period.

   d. Training documentation shall include the following items:

      1) Copy of the training plan, including schedule, syllabus, and agenda.

      2) Copy of the design intent document.

      3) Copy of the Basis of Design.

4) Specification sheets for each piece of equipment and control.

5) Operations manuals.

6) Installation manuals.

7) Maintenance manuals.

8) Manufacturer training manuals.

9) As-built record drawings.

e. Operations and maintenance manuals (O&M Manuals) shall be prepared by the General Contractor. The O&M Manuals shall be organized into permanently labeled binders with indexing tab section dividers and a table of contents. The organization, layout, and content shall be as defined in this section of the specifications and in sections 22 08 00, 23 08 00 and 26 08 00. Manual content shall include, but not be limited to the following data:

1) Detailed description of each system and each of its components.

2) Wiring and control diagrams, with data to explain detailed operation and control of each component.

3) Control sequences describing start-up, all modes of operation, and shutdown.

4) Installation instructions.

5) Maintenance and overhaul instructions.

6) Lubricating schedule including type, grade, temperature, and frequency range.

7) Corrected shop drawings.

8) Product information identifying all performance curves, rating data, features, and options on all installed equipment

9) Copies of approved certifications and laboratory test reports.

10) Copies of warranties.

11) Test procedures.

12) Parts list, including source of supply and recommended spare parts.

13) Name, address, and 24-hour telephone number of each subcontractor who installed equipment and systems and local representative for each type of equipment for each system.

14) Other pertinent data applicable to the operation and maintenance of particular systems or equipment and/or other data specified in technical sections of the specification.

15) Impact of testing and operation of fire and life safety systems.

16) Uninterruptible power supplies, including a list of equipment and design kW load on each.

17) Emergency power generation, including a list of equipment and design kW load on each.

18) The documentation during the construction phase shall be updated to match the equipment supplied on the project.

19) Procedures for starting, operation, and shutdown for every system, including all required emergency instructions and safety precautions.

2. Appropriate information gathered during the construction phase shall be added to the O&M Manual.

3.2 RESPONSIBILITIES

A. General Contractor:

1. Shall verify completeness of the building envelope, perimeter and interior items, which effect proper operation, and control of equipment and systems.

2. Shall schedule, coordinate and be responsible for the participation and cooperation of all subcontractors required for the commissioning process.

3. Shall incorporate commissioning tasks and TAB work into the master construction schedule.

4. Shall be responsible for providing additional information after the bidding phase to the CxA.

5. Shall provide a representative who will be responsible for communication between each individual contractor/subcontractor and the CxA. Responsibilities include:

a. Coordination meetings.
b. Planning.
c. Scheduling.
d. Documentation
e. Communication with the CxA.
f. Corrective actions.
g. Specified test.
h. Review of FIV and FPT forms and procedures.
i. Performance of FIV & FPT inspections and tests.
j. Providing four copies of the required O&M Manuals to the CxA for compilation into the final project documentation.
k. Specified training.
l. Preventative maintenance equipment data.
m. Extra materials submission.
n. Perform corrective actions for resolution of deficiencies during:
    1) FIV
    2) Test and Balance
    3) FPT

B. Subcontractors:

1. Shall be responsible for providing labor, material, equipment, test equipment, etc., required within the scope of their specialty to implement and facilitate the commissioning process.

2. Shall perform tests and verification procedures required by the commissioning process when requested by the CxA, coordinated and directed by the General Contractor and/or as specified throughout the contract documents.

3. Shall assist the General Contractor in the development of the master schedule as relates to commissioning and TAB tasks and milestones.

4. Shall provide a representative who will be responsible for communication between each individual contractor/subcontractor and the CxA. Responsibilities include:

   a. Coordination meetings.
   b. Planning.
   c. Scheduling.
   d. Documentation
   e. Communication with the CxA.
   f. Corrective actions.
   g. Specified test.
   h. Review of FIV and FPT forms and procedures.
   i. Performance of FIV & FPT inspections and tests.
   j. Providing the required O&M data to the CxA for compilation into the overall O&M manual.
   k. Specified training.
   l. Preventative maintenance equipment data.
   m. Extra materials submission.
   n. Perform corrective actions for resolution of deficiencies during:
      1) FIV
      2) Test and Balance
      3) FPT

C. Owner

1. Will schedule personnel to participate in Commissioning process.

   a. This may include building security personnel, HVAC operation/maintenance personnel and building maintenance personnel. Personnel operating and maintaining equipment and systems will attend training sessions, factory schools, and educational institutions where indicated.
   b. Will advise the CxA of any changes to the building's use or occupancy.

End of Section 019113

SECTION 260800 Commissioning of Electrical Systems

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. Drawings and general provisions of the Contract, including General Conditions and Division-1 Specifications Sections, apply to Work of this section.

B. Provisions of Section 01 91 13, Building Commissioning, shall be made an integral part of this Section with all requirements, responsibilities, and recourse described in those sections.

C. All electrical testing shall be in compliance with the latest edition of the International Electric Testing Association - Acceptance Testing Specifications (NETA-ATS).

D. All lighting and illumination testing shall be in compliance with the recommendations in the latest edition of Illuminating Engineering Society - Reference Volume (I.E.S.).

E. Certain building systems on this project are to be commissioned using a team approach. The intent of the commissioning program is to provide documentation, testing, and training to help insure that the project meets the needs of the owner and the designer's intent. The commissioning program includes:

1. Start up and testing of specified equipment and systems in accordance with the commissioning plan, FIV& FPT approved forms.
2. Identification of and documentation of equipment and system deficiencies and normal operating parameters.
3. Corrective actions and acceptance of corrected equipment and systems.
4. Operation and maintenance manuals.
5. Preventative maintenance equipment and system data collection.
6. Equipment and systems use and maintenance training.

1.02 WORK INCLUDED

A. Participate in the Commissioning program as outlined in this section.

1.03 COMMISSIONING PROGRAM CRITERIA

A. Intent:

1. The intent of Electrical System Commissioning is to assure delivery to the Owner of electrical systems, which are fully functioning in accordance with all specifications, and which the Owner's personnel are fully trained and equipped to operate, maintain and troubleshoot.

2. The General Contractor shall execute a Commissioning Program, which delivers the intended results of Electrical System Commissioning, using whatever personnel, time, equipment and resources are required.

3. This Section provides minimum program requirements; however, the Contractor shall exceed those requirements whenever necessary to achieve the intent of

Building Commissioning.

B. Commissioning Authority (CxA):

1. The Commissioning Authority is responsible for the overall enforcement and implementation of the Commissioning Program. The Commissioning Authority will schedule and chair all commissioning meetings and be responsible for all documentation and final acceptance of the commissioning phase of the project.

C. Electrical Trade Representative:

1. The Electrical Contractor shall assign a qualified individual to function as the Trade Representative to coordinate the Commissioning Program. The Trade Representative reports to the Commissioning Authority.

D. Definitions and Abbreviations:

1. Maintenance Orientation and Inspection: At prescribed times during the Work the Contractor will walk the Owner's Maintenance personnel through the Work, orient them to equipment types and locations, assist access for any requested inspections, answer all questions concerning performance of the Work, workmanship standards and quality control.

2. Equipment Placement Completion: Stage of the Work at which the major items of Division 26 equipment have been placed at final locations but have not received electrical connections. Major equipment includes, but is not limited to, Switchboards, Generators, Transformers, Automatic Transfer Switches, Motor Control Centers and Panelboards.

3. Distribution Completion: Stage of the Work at which distribution conduit and cable trays have been installed and tested, but not concealed by further work.

4. O&M Manuals: Operation and Maintenance Manuals as specified in Contract Documents.

5. Testing: Stage of work at which major feeders and grounding conductors have been installed and tested, but not terminated.

6. Trade Representative: Person who competently represents the work force engaged by the Contractor for the individual trade named. This person shall be completely familiar with the work performed for this Contract at all levels of detail of his trade and with coordination to other trades. This person shall be capable of and have authority to execute all commissioning responsibilities of the trade as described in these Contract Documents.

7. Participate: Attend commissioning events, provide technical expertise or knowledge, equipment, measurements and observation needed or requested by the Commissioning Authority or Owner. Provide follow-up analysis, equipment data, design data, or other trade or professional service needed in response to commissioning events.

8. Verify: To positively determine that the measured or observed quantity satisfies all required criteria. Simply performing the test, measurement or observation

does not constitute "verification". The test result must also pass all Contract criteria. Tests that fail must be repeated at no additional cost to the Owner after repairs or adjustments are made, until full verification is achieved.

9. Pre-functional Testing: Ensure that individual pieces of equipment are capable of performing in accordance with the Specifications, Drawings, and manufacturers' requirements. This is documented with a Field Installation Verification checklist provided and completed by the contractor. The Commissioning Authority shall overview this testing.

E. Scope:

For coordination purposes, the entire commissioning scope involving all parties is described here. The responsibilities of Division 26 Trades with respect to commissioning are separated out under Section 3.03 - RESPONSIBILITIES.

1. Document Electrical design intent.

2. Verify that equipment and systems have been properly installed in accordance with the contract documents and manufacturer's written installation instructions.

3. Verify that equipment has been placed into operation with manufacturer's oversight and approval.

4. Assemble contract documents and record drawings.

5. Assemble operation and maintenance instructions and submittal data.

6. Verify the performance of each piece of equipment and each system.

7. Train Owner's personnel in the proper operation of each piece of equipment and each system.

8. Document warranty start and end dates.

9. Assemble all records of Code authority inspections and approvals.

10. Monitor and enforce accessibility of all work versus maintenance requirements of each piece of equipment.

11. Identify, document and report all deficiencies of the work versus Contract specifications and performance requirements.

F. Commissioning Cost:

1. Each Trade and supplier of equipment shall include in his quoted price the cost of furnishing the material requested and manpower necessary for the operation and maintenance manuals, training and system verification as specified under this section.

PART 2 - PRODUCTS

2.01 NOT APPLICABLE.

PART 3 - EXECUTION

3.01 PREPARATION OF COMMISSIONING PLAN

A. The Commissioning Plan shall be prepared by the CxA. The plan shall take full cognizance of all intent and specific requirements for the Commissioning Program described in the Contract Documents.

B. The Commissioning Plan shall be submitted to the Owner and shall be subject to approval in all aspects by the Owner. The Owner reserves the right to require changes in the Commissioning Plan or personnel assigned at any time to satisfy the Owner's quality assurance within the Commissioning Program.

3.02 COMMISSIONING TEAM

A. A Commissioning Team shall be designated consisting of all members needed to execute the approved Commissioning Program. Membership shall include:

1. CxA
2. General Contractor
3. Electrical Trade Representative
4. Facility Management and Control System (FMCS) Trade Representative
5. Owner's Representative
6. Owner’s Electrical Maintenance Representative
7. Engineer of Record

B. The Contractor's personnel shall be made available to execute all aspects of the Commissioning Program until the Owner accepts final results. Commissioning Program tasks and meetings may be repeated until the Owner is satisfied and will not be fixed as one-time, one-chance events for the Contractor.

3.03 RESPONSIBILITIES

A. Owner:

1. Assign maintenance and engineering personnel and schedule them to participate in the various meetings, training sessions and inspections as required.

B. Commissioning Authority:

1. Prepare Commissioning requirements sections of the Contract.

2. Prepare the Commissioning Plan. Include list of all Trade Representatives for commissioning events by name, firm and trade specialty.

3. Execute the Commissioning Plan, through organization of all meetings, tests, demonstrations, training events and performance verifications described in the Contract Documents and approved Commissioning Plan. Organizational responsibilities include preparation of agendas, attendance lists, arrangements for facilities and timely notification to participants for each commissioning events. The Commissioning Authority shall act as chairman at all commissioning events and assure execution of all agenda items. The Commissioning Authority shall

prepare minutes of every commissioning event and send copies to all attendees within five (5) workdays of the event.

4. Review the plans and specifications with respect to their completeness in all areas relating to the commissioning program. This includes ensuring that the commissioning guidelines have been followed.

5. The plan and specification review by the Commissioning Authority does not include any responsibility for the system evaluation, adequacy of the system to meet design intent, capacity of the system, quality control check or any of the other elements of the system design which are the strict responsibility of the Engineer of record.

6. Schedule a pre-commissioning coordination meeting within ninety (90) days of the award of the contract, at some convenient location and at a time suitable to the Electrical Contractor and Engineer of Record. This pre-commissioning meeting will be for the purpose of reviewing the complete commissioning program and establishing tentative schedules for Maintenance orientation and inspections, O&M submittals, training sessions, job completion, system start-up and test work.

7. Receive and review operation and maintenance (O&M) manuals as submitted by the contractor through the Engineer of Record.

8. Adequate accessibility for maintenance and component replacement or repair is the Electrical Contractor's responsibility and will be checked by the Commissioning Authority at shop drawings, and during initial and final phases for each item of equipment.

9. Schedule the Owner training sessions. These training sessions are to be attended by the Owner, Commissioning Authority, Engineer of Record, Electrical Contractor, Trade Representatives and equipment suppliers as necessary. The format will follow the outline in the O&M Manuals.

10. Schedule regular commissioning coordination meetings during construction.

11. Upon receipt of notification from the Electrical Contractor that all systems have been started, tested, that the systems and equipment are functioning as designed and specified, and that all Field Installation Verification forms and checklists have been completed schedule the verification demonstrations. These demonstrations will be conducted by the Contractor and witnessed by the Commissioning Authority. Prepare minutes of each verification event, with separate summary of deficiency findings by the Commissioning Authority. Distribute to attendees.

12. Prepare final commissioning report and submit to Owner. Schedule final review with Owner. Present all documentation and turn over signed acceptance of the system to the Owner.

C. Engineer of Record:

1. Provide Electrical system Basis of Design Narrative. Incorporate in the appropriate sections of the O&M Manual.

2. Verify adequate maintenance accessibility for each piece of equipment in shop drawings and actual installation. Visit site periodically and inspect construction.

3. Conduct the first electrical training session on the overview of the system design, the system design goals and the reasoning behind the selection of equipment.

4. Review O&M Manuals submitted by the Electrical Contractor. Insert Design Narrative.

5. Prepare record drawings as required by contract documents and turn over to Owner.

D. Electrical Contractor:

1. Include cost for commissioning requirements in the contract price.

2. Include commissioning requirements in the Electrical and electrical sub-contracts and ensure full cooperation of all parties in the commissioning program.

3. Provide an approved Plan to the Commissioning Authority to prepare and coordinate execution of the Commissioning Program. Provide the Commissioning Authority with means and authority to execute Commissioning Program.

4. Coordinate the interface of the Commissioning Program.

5. Prepare record drawings as required by contract documents and submit to the Owner.

E. Electrical Trade Representative:

1. Include requirements for submittal data, O & M data and training in each purchase order or sub-contract written.

2. Ensure cooperation and participation of specialty sub-Trade Representatives.

3. Ensure participation of major equipment manufacturers and their representatives.

4. Coordinate this commissioning program with the Mechanical Trade Representative.

5. Attend initial pre-commissioning coordination meeting scheduled by the Commissioning Authority. Prepare necessary preliminary schedule for Maintenance orientation and inspections, O & M manual submission, training sessions, test, and job completion for use by the Commissioning authority. Update schedule as appropriate throughout the construction period.

6. Obtain O & M data on all equipment and assemble in binders using tabs as required. Submit to Engineer of Record for approval prior to the Distribution completion stage.

7. Notify the Commissioning Authority of the time for all equipment start up

activities.

8. Conduct and schedule vendors and other Trade Representatives to participate in the training sessions scheduled by the Commissioning Authority.

9. Attend all regularly scheduled commissioning coordination meetings.

10. Provide written certification and completed Field Installation Verification forms and checklists documenting that the following work has been completed in accordance with the plans and specifications and that they are functioning as designed. Where the Work has been sub-contracted, the sub-Trade Representative shall be responsible for the initial certification with the Electrical Trade Representative recertifying that he has inspected the Work and that it has been completed and functioning as designed. This certification must be submitted to the Commissioning Authority prior to the final verification.

    a. Correct labeling of all circuits with connected equipment.

    b. Automatic operation of emergency generator, bus transfer and UPS equipment.

    c. Lighting system controls operations, including occupancy sensors, automatic time controls or Energy Management control, override timers, manual dimming controls, exterior lighting controls, multi-level switching, as applicable to the Work.

11. Demonstrate the performance of each piece of equipment to the Commissioning Authority. Schedule sub-Trade Representatives as may apply to demonstrate the performance of the equipment and systems.

12. Provide set of record mark-ups to the Engineer of Record for inclusion into record documents.

3.04 OPERATION AND MAINTENANCE MANUALS

A. Operating and Maintenance Manuals:

1. Initial preparation shall be made by the Electrical Trade Representative.

2. Quantity: provide four (4) hard copies of the manual and One (1) electronic copy in PDF format on a CD.

3. Format: 3" thick, 8-1/2" x 11 loose leaf binders. Provide as many as required. Binders shall not be overloaded.

4. Content:

    a. Cover sheet.

    b. Table of contents

    c. Contract Electrical Specifications.

d. Wiring and control diagrams, with data to explain detailed operation and control of each component.

e. Control sequences describing start-up, all modes of operation, and shutdown.

f. Installation instructions.

g. Operating Instructions.

h. Preventative Maintenance Instructions.

i. Maintenance and overhaul instructions.

j. Lubricating schedule including type, grade, temperature, and frequency range.

k. Corrected shop drawings and submittal data.

l. Product information identifying all rating data, features, and options on all installed equipment

m. Copies of approved certifications and laboratory test reports.

n. Copies of warranties.

o. Test procedures.

p. Parts list, including source of supply and recommended spare parts.

q. Name, address, and 24-hour telephone number of each subcontractor who installed equipment and systems and local representative for each type of equipment for each system.

r. Other pertinent data applicable to the operation and maintenance of particular systems or equipment and/or other data specified in technical sections of the specification.

s. Uninterruptible power supplies, including a list of equipment and design kW load on each.

t. Emergency power generation, including a list of equipment and design kW load on each.

u. The documentation during the construction phase shall be updated to match the equipment supplied on the project.

v. Procedures for starting, operation, and shutdown for every system, including all required emergency instructions and safety precautions.

5. Detailed Preparation Requirements:

a. The cover sheet shall list: project name, location, names of the project manager, architect, and electrical engineer, name of the firms, address and telephone number.

b. Each major heading in the table of contents shall have a large distinctive, clearly marked, non-erasable, plastic encased tab.

c. Each section shall have the following sub-tabs. Sub-tabs shall be similar to the main tabs but of a different color.

1) Specifications:

The specification shall be copied and inserted complete with all addenda.

2) Submittal and Product Data:

This section shall include all approved submittal data. If submittal was not required for approval, descriptive product data shall be included.

3) Installation Instructions:

If the product, such as conduit, etc., does not have any written installation instructions, include a statement "Manufacturer's Written Installation Instructions not Available - Product Installed in Accordance with Specifications and Good Practice".

4) Operation and Maintenance Instructions:

These shall be the written manufacturer's data edited to omit reference to products or data not applicable to this installation.

5) Parts List:

These shall be edited to omit reference to items, which do not apply to this installation.

6) Equipment Supplier:

This section shall include the name, address and telephone number of the manufacturer's agent and/or service agency supplying or installing and starting up of the equipment.

7) Field Installation Verification forms, checklists, and Commissioning Checklist:

This will be filled out by the Contractor with the specified data and submitted data and inserted into the manual for submission to the Engineer of Record. The form shall be forwarded with the certification of system completion and commissioning request.

8) System Description:

This section shall include that portion of the overall description included in the beginning of the manual as it applies to each sub-section. In sections such as pumps, the pump designations and their use shall be listed as shown in the equipment schedule.

9) Preventative Maintenance Instructions:
This section shall include condensed typewritten excerpts from the manufacturers written instructions on weekly, monthly, quarterly, annually, etc. This summary shall be prepared by the Electrical Trade Representative with help from the equipment supplier. It will be reviewed by the Engineer of Record prior to turning over to the Commissioning Authority. It shall be prepared for all items listed under "Condensed Operating Instructions" above.

B. Submittal Requirement:

1. The O&M manuals shall be submitted prior to the start of functional testing and prior to the start of any Owner's training.

3.05 TRAINING OF OWNERS OPERATORS:

A. The owners shall be given comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of equipment.

B. The Commissioning Authority, in cooperation with the Engineer of Record and Contractor, will be responsible for scheduling the training which shall start with classroom sessions followed by hands on training on each piece of equipment. Hands on training shall include start-up, operation in all modes possible, shut-down and any emergency procedures.

C. The third portion, or the commissioning portion, shall be conducted after completion of this work.

D. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.

E. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual.

F. The Engineer of Record will attend all training sessions and conduct the first session on the overall system design concept and the design concept portion of each equipment section.

G. The manufacturer's representative shall provide the instructions on each major piece of equipment. These sessions shall use the printed installation, operation and maintenance instruction material included in the O&M manuals and shall include a review of the written O&M installations emphasize safe and proper operating requirements and preventative maintenance. Training will be included for all major pieces of equipment. Qualified service engineers employed by the manufacturers or their qualified sales representatives shall do equipment training. The operation and

function of the equipment in the system shall be discussed.

H. Each classroom training session shall be followed by an inspection, explanation and demonstration of the equipment. The start-up and shut-down modes of operation shall be demonstrated.

I. The Contractor shall attend all sessions and shall add to each session any special information relating to the details of installation of the equipment as it might impact the operation and maintenance.

J. The Commissioning Authority shall conduct a final session summarizing the commissioning program.

3.06 NOTIFICATION OF SYSTEM COMPLETION AND REQUEST FOR FINAL ELECTRICAL SYSTEM COMMISSIONING VERIFICATION

A. When systems are ready for final commissioning verification, the Electrical Trade Representative shall notify the Commissioning Authority in writing and provide completed Field Installation Verification forms and checklists. Commissioning data sheets must be complete through the column labeled "Tested" and included with the request.

B. Should the verification test reveal that the equipment is not performing as specified or control operation is not acceptable, the Contractor will be entitled to one re-inspection of any failed item at no additional cost.

C. Should the verification test determine that the equipment is still not performing as specified or control operation is not acceptable on the second inspection, the time and expenses to make further verification shall be considered as additional cost to the Owner. The total sum of such costs shall be deducted from the final payment to the Contractor.

3.07 VERIFICATION OF PERFORMANCE

A. Verification of performance will take place after certification of the completion of the construction, and completion of all functional test form checklists. Performance demonstration shall be done by the Electrical Trade Representative or the FMCS Trade Representative as appropriate and shall be witnessed by the Commissioning Authority and/or the Owner's Representative.

B. If a piece of equipment fails a functional performance test the contractor will repair the equipment and will schedule a retest with the commissioning agent. The contractor will be responsible for all commissioning costs for retesting.

C. The “specified”, “submitted” and as “tested” shall be entered on the Commissioning Data Sheets prior to the verification. The witnessed performance data shall be added to the data sheet at the time of verification.

D. The following demonstrations will be required:

1. Main Switchboard Overcurrent Protection Performance:

a. Main Switchboard Overcurrent Protection.

b. The main power circuit breaker and feeder circuit breakers overcurrent and ground fault sensor trip settings shall be tested by primary injection method and in accordance with NETA-ATS Section 7.6.
c. The switchboard assemblies shall be meggered in accordance with NETA-ATC Section 7.
d. The switchboard metering instrumentation shall be tested in accordance with NETA-ATC Section 7.10 and 7.11.
e. Switchboard single-phase monitors shall be tested for operation upon actual loss of a phase voltage.

2. Panelboard Installation and Branch Circuit Labeling Verification:

a. Panelboards.
b. Voltage and ampere measurements shall be made in accordance with NETA recommendations.
c. Panelboard circuit labeling and grounding continuity shall be verified (up to 10% of circuits in each panel).
d. Circuits/outlets found to be incorrectly labeled or grounded shall be compiled in a list form titled "Incorrect Branch Circuit Wiring".

3. Distribution Transformer Performance:

a. Distribution Transformer.
b. Voltage and ampere measurements shall be made in accordance with NETA ATS section 7.2 recommendations.
c. Grounding conductor impedance to the building structure shall be measured between two points other than the location of the grounding conductor connections.
d. Ventilation clearance from transformer enclosure to partitions shall be measured and verified with contract documents.

4. Motor Controllers Compliance:

a. Motor Controllers.
b. Visual and Mechanical inspections along with electrical test measurements shall be made in accordance with NETA ATS section 7.16 recommendations.

5. Grounding System Performance:

a. Grounding System.
b. Visual and Mechanical inspections along with electrical tests shall be performed in accordance with NETA ATS Section 7.13.

6. Interior Lighting System Performance:

a. Interior Lighting System.
b. All luminaire/lamp combinations shall be verified by inspection. All incorrectly lamped lights shall be compiled in a list form titled "Incorrect Light Lamping." List shall include room name locations of incorrect lights.
c. Illumination levels shall be performed in random areas (up to 10% of building area) and with the use of an electronic digital read-out type. Illuminance photometer with adjustable scales from 20 fc to 2000 fc minimum.

d. Operational tests shall be performed for all interior lighting control/dimming systems.
e. Interior Lighting Control Performance Including Operation of Occupancy Sensors, Automatic Time Controls, Energy Management Control Override Timers, Manual Dimming Control, Multi-level Switching, etc.
f. Illumination Foot Candle Level Measurement in up to 20% of Building Area.

7. Exterior lighting system performance (random illumination level measurement).

a. Exterior Lighting System.
b. Operational tests shall be performed to verify light control groups and sequence. Manual override control shall also be verified.
c. Random areas of approximately 10,000 sq. ft. (up to 4 such areas) shall be identified for exterior field illumination measurements. The area shall be divided into 10-foot squares and measurements taken and recorded onto an 8-1/2" x 11" sketch of the area.

8. Emergency Generator Performance including Simulation of Actual Power Outage:

a. Stand-by engine generator.
b. Operating performance tests shall be performed and recorded in accordance with NETA-ATS Section 7.22.1.

9. Uninterruptible Power Systems:

a. Uninterruptible Power Supplies.
b. Visual and Mechanical inspections along with electrical tests shall be performed and recorded in accordance with NETA-ATS Section 7.22.2.

10. Bus transfer Equipment Operation:

a. Bus transfer Equipment.
b. Visual and Mechanical inspections along with electrical tests shall be performed and recorded in accordance with NETA-ATS Section 7.22.3.

11. Fire Alarm Systems:

c. Each intended operation of the fire alarm system shall be demonstrated for correct functional performance.
d. Visual and Physical inspections along with functional tests shall be performed and recorded.

3.08 PHASING OF CONSTRUCTION AND COMMISSIONING:

A. The commissioning plan shall take into account the staged start-up of each phase. Commissioning documentation and verification to begin with each phase completion.

3.09 COMMISSIONING DATA SHEETS

A. The Commissioning Data Sheets for various equipment shall be as provided in the Commissioning Plan. They shall be completed as described in Para. 3.07 - Verification of Performance.

3.10 REPORT REQUIREMENTS

A. The Commissioning Authority shall document each commissioning event with meeting minutes or a report. The documents shall separately list deficiencies observed or discovered during the event. The document shall be distributed to Commissioning Team.

B. The Commissioning Authority shall prepare a final formal report to the Owner which will include a narrative in the form of an Executive Summary of the results of program, impressions of the training sessions and the level of operating competence and a certification that the verification of each item is complete and all systems are operating as intended.

C. Transmitted with the report shall be edited Operation and Maintenance Manuals including:

1. Commissioning Data Sheets.

2. Warranties.

3. Permits and Inspection Reports.

END OF SECTION 260800