

BID DOCUMENTS AND TECHNICAL SPECIFICATIONS

FOR

WCU - NORTON INTRAMURAL FIELDS

OWNER:

**WESTERN CAROLINA UNIVERSITY
3476 OLD CULLOWHEE ROAD
CULLOWHEE, NC 28723**

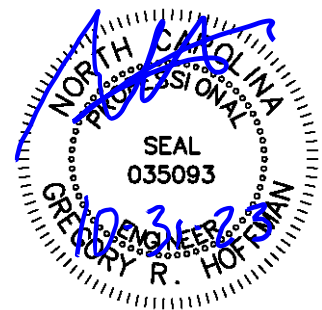
PREPARED BY:



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**CDC JOB NO. 22250
October 31, 2023
SCO-ID # 22-24232-01A**

TABLE OF CONTENTS

DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

NOTICE TO BIDDERS
FORM OF PROPOSAL
BID BOND
MINORITY BUSINESS PARTICIPATION
GEOTECHNICAL REPORT
FORM OF CONSTRUCTION CONTRACT & BONDS
P&P BONDS
POWER OF ATTORNEY SHEET
APPROVAL OF ATTORNEY GENERAL
PROJECT SCHEDULE
INSURANCE CERTIFICATES
NOTICE OF AWARD
NOTICE TO PROCEED
BID SUMMARY
PAYMENT APPLICATION
COUNTY SALES AND USE TAX FORM
CONTRACTORS FINAL AFFIDAVIT / WAIVER OF LIEN AND INDEMNITY
NORTH CAROLINA ONE-CALL NOTICE

TECHNICAL SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

00 72 00	GENERAL CONDITIONS
00 73 00	SUPPLEMENTARY CONDITIONS
01 22 00	UNIT PRICES
01 23 00	ALTERNATES
01 29 00	PAYMENT PROCEDURES
01 31 00	PROJECT MANAGEMENT
01 33 00	SUBMITTAL PROCEDURE
01 51 00	TEMPORARY UTILITIES
01 52 00	CONSTRUCTION FACILITIES
01 78 00	CLOSEOUT PROCEDURE

DIVISION 03 - CONCRETE

03 10 00	CONCRETE FORMING AND ACCESSORIES
03 11 00	CONCRETE FORMWORK
03 20 00	CONCRETE REINFORCEMENT
03 30 00	CAST-IN-PLACE CONCRETE
03 30 00.01	NON-STRUCTURAL CAST-IN PLACE CONCRETE
03 45 00	PRECAST ARCHITECTURAL CONCRETE

DIVISION 04 - MASONRY

04 20 00	UNIT MASONRY
----------	--------------

DIVISION 05 - METALS

05 12 00	STRUCTURAL STEEL FRAMING
05 12 13	ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING
05 50 00	METAL FABRICATION

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 10 00	ROUGH CARPENTRY
06 16 00	SHEATHING
06 16 36	WOOD PANEL PRODUCT SHEATHING
06 17 15	ENGINEERED STRUCTURAL WOOD SECTION
06 17 53	SHOP FABRICATED STRUCTURAL WOOD TRUSSES
06 20 13	EXTERIOR FINISH CARPENTRY

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 19 00	WATER REPELLENTS
07 21 00	THERMAL INSULATION
07 27 13	MODIFIED BITUMINOUS SHEET AIR BARRIERS
07 41 13.16	STANDING-SEAM METAL ROOF PANELS
07 42 13.13	FORMED METAL WALL PANELS
07 42 43.11	HIGH DENSITY TIMBER PANEL
07 62 00	SHEET METAL FLASHING AND TRIM
07 92 00	JOINT SEALANTS

DIVISION 08 - OPENINGS

08 11 13	HOLLOW METAL DOORS AND FRAMES
08 33 23	OVERHEAD COILING DOORS
08 41 13	ALUMINUM FRAMED ENTRANCES AND STOREFRONT
08 71 00	DOOR HARDWARE
08 80 00	GLAZING
08 90 00	LOUVERS AND VENTS

DIVISION 09 - FINISHES

09 29 00	GYPSUM BOARD
09 30 13	CERAMIC TILING
09 65 13	RESILIENT BASE AND ACCESSORIES
09 91 23	INTERIOR PAINTING
09 96 00	HIGH-PERFORMANCE COATINGS

DIVISION 10 - SPECIALTIES

10 21 13	CEILING MOUNTED PLASTIC TOILET COMPARTMENTS
10 28 00	TOILET BATH AND LAUNDRY ACCESSORIES
10 44 16	FIRE EXTINGUISHER
10 73 13	AWNINGS

DIVISION 22 - PLUMBING

22 00 80	RECORD DOCUMENTS
22 01 00	PENETRATION FIRE STOPPING
22 05 00	COMMON WORK RESULTS FOR PLUMBING
22 05 13	COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
22 05 16	EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
22 05 19	METERS AND GAGES FOR PLUMBING PIPING
22 05 23	GENERAL-DUTY VALVES FOR PLUMBING PIPING
22 05 29	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
22 05 48	
22 05 53	IDENTIFICATION FOR PLUMBING AND EQUIPMENT
22 07 00	PLUMBING INSULATION
22 11 13	FACILITY WATER DISTRIBUTION PIPING
22 11 16	DOMESTIC WATER AND COMPRESSED AIR PIPING
22 11 19	DOMESTIC WATER PIPING SPECIALTIES
22 11 23	DOMESTIC WATER PUMPS
22 13 16	DRAIN, WASTE, AND VENT PIPING
22 13 19	SANITARY WASTE PIPING SPECIALTIES
22 33 00	ELECTRIC DOMESTIC WATER HEATERS
22 40 00	PLUMBING FIXTURES
22 47 00	WATER COOLERS

DIVISION 23 - MECHANICAL

23 00 00	GENERAL REQUIREMENTS FOR HVAC WORK
23 00 10	SUBMITTAL PROCEDURES
23 00 20	REFERENCES
23 00 30	PRODUCT REQUIREMENTS
23 00 40	EXECUTION
23 00 60	CLOSEOUT REQUIREMENTS
23 00 80	PROJECT RECORD DOCUMENTATION
23 05 00	COMMON WORK RESULTS FOR HVAC
23 05 29	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 05 93	TESTING, ADJUSTING, AND BALANCING FOR HVAC
23 31 13	METAL DUCTS
23 33 00	AIR DUCT ACCESSORIES
23 34 16	HVAC FANS
23 37 13	DIFFUSERS, REGISTERS, AND GRILLES
23 82 39	UNIT HEATERS
23 90 00	LOUVERS AND VENTS

DIVISION 26 - ELECTRICAL

26 00 50	COMMON WORK RESULTS FOR ELECTRICAL
26 01 00	PENETRATION FIRESTOPPING
26 05 13	MEDIUM-VOLTAGE CALBE
26 05 19	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 33	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
26 05 48	VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 12 13	MEDIUM-VOLTAGE TRANSFORMER
26 22 00	LOW-VOLTAGE TRANSFORMERS
26 24 16	PANELBOARDS
26 27 26	WIRING DEVICES
26 41 13	LIGHTING PROTECTION FOR STRUCTURES
	TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRIC POWER
26 43 13	CIRCUITS
26 51 00	INTERIOR LIGHTING
26 56 68	EXTERIOR ATHLETIC LIGHTING

DIVISION 31 - EARTHWORK

31 05 05	DEMOLITION
31 05 19	ENGINEERING FABRICS
31 10 05	WASTE MATERIAL DISPOSAL
31 11 00	CLEARING AND GRUBBING
31 22 00	GRADING
31 23 00	EXCAVATING, BACKFILLING AND COMPACTING FOR UTILITIES AND STRUCTURES
31 23 13	SUBGRADE
31 25 00	EROSION AND SEDIMENT CONTROL
31 25 13	TEMPORARY SILT FENCE
31 32 00	SITE STABILIZATION
31 37 00	RIP RAP

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 01 17	ASPHALT PAVEMENT REPAIRS
32 05 23	MISCELLANEOUS CONCRETE CONSTRUCTION
32 11 23	AGGREGATE BASE COURSE
32 12 16	ASPHALT PAVING
32 16 13	CONCRETE CURB AND GUTTER
32 16 23	CONCRETE WALKS
32 17 23	PAVEMENT MARKINGS
32 31 13	CHAIN LINK FENCES AND GATES
32 91 19	TOP SOIL
32 92 19	SEEDING AND MULCHING
32 92 23	SODDING

DIVISION 33 - UTILITIES

33 11 00	WATER PIPE AND APPURTENANCES
33 12 00	WATER VALVES AND APPURTENANCES
33 12 13	DOMESTIC WATER SERVICE CONNECTION
33 31 00	SANITARY SEWER PIPE AND APPURTENANCES
33 36 00	PRECAST CONCRETE STRUCTURES
33 41 00	DRAINAGE MATERIALS
33 47 26	BIORETENTION SYSTEM
33 49 00	MINOR DRAINAGE STRUCTURES



Architectural Specifications Seal for WCU Norton
Intramural Field House

Sections:

034500
042000
051200
051213
055000
061000
061600
061715
062013
071900
072100
072713
074113.16
074213.13
074243.11
076200
079200
081113
083323
084113
087100
088000
089000
092900
093013
096513
099123
099600
102113
102800
104415
107313

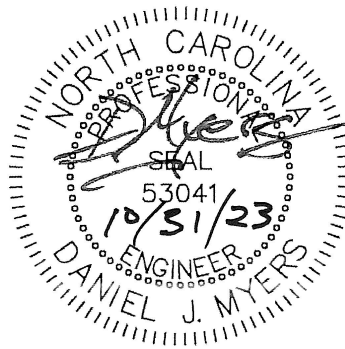


Structural Specification Seal for WCU Norton Fieldhouse

Sections:

031000
032000
033000
061636
061753

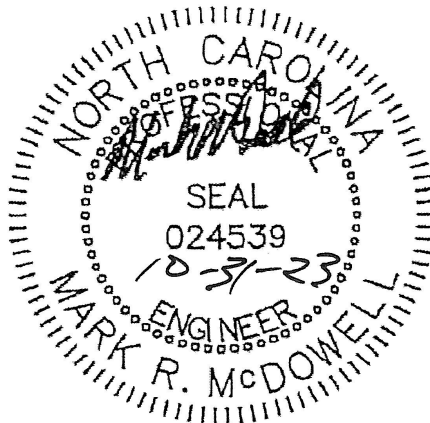




Mechanical Specifications Seal for WCU Norton
Intramural Field House

Sections:

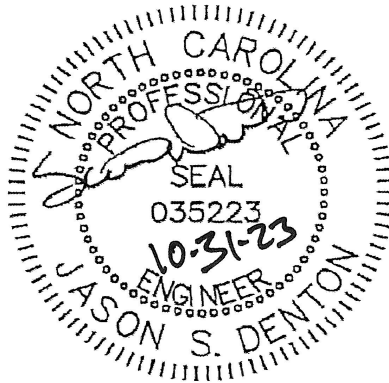
230000
230010
230020
230030
230040
230060
230080
230500
230529
230593
233113
233300
233416
233713
238239
239000



Plumbing Specifications Seal for WCU Norton Intramural
Field House

Sections:

220080
220100
220500
220513
220516
220519
220523
220529
220548
220553
220700
221113
221116
221119
221123
221316
221319
223300
224000
224700



Electrical Specifications Seal for WCU Norton Intramural Field

Sections:

260050
260100
260513
260519
260526
260529
260533
260548
260553
261213
262200
262416
262726
264113
264313
265100
265668

DIVISION 0 CONTRACT REQUIREMENTS



NOTICE TO BIDDERS

Sealed proposals will be received by the Western Carolina University in Cullowhee NC, in the office of Western Carolina University Facilities Management Office at 2:00 pm January 10th, 2024 and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment entering into the construction of

WCU - Norton Intramural Fields

This project consists of installing erosion control, fine grading, storm drainage, installing water and sewer services, sod, constructing new restroom building, and field preparation.

Pre-Bid Meeting

An optional open pre-bid meeting will be held for all interested bidders on December 11th, 2023 at 2:00 PM onsite. The meeting will address project specific questions, issues, bidding procedures and bid forms.

Complete plans, specifications and contract documents are available electronically to interested parties. Interested parties should contact Civil Design Concepts, PA to request electronic copies.

Hard copies of Contract Documents may be obtained at the office of the Engineer, **Civil Design Concepts, P.A.** located at **168 Patton Ave., Asheville, NC** by those qualified as prime bidders, upon deposit of one hundred fifty dollars (\$ 150) in cash or certified check. The full plan deposit will be returned to those bidders provided all documents are returned in good, usable condition within ten (10) days after the bid date.

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

A goal of 10% for small or minority business participation has been established for this project and those qualified firms are encouraged to participate. In addition, Prime Contractor's are required to fulfill specific criteria as noted in the Contract Documents with regard to minority participation.

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

General contractors are notified that Chapter 87, Article 1, General Statutes of North Carolina, will be observed in receiving and awarding general contracts. General contractors submitting bids on this project must have license classification for General Contractors.
(set forth the license classification required by the NC General Contractors Licensing Board under G.S. 87-1)

NOTE--SINGLE PRIME CONTRACTS: Under GS 87-1, a contractor that superintends or manages construction of any building, highway, public utility, grading, structure or improvement shall be deemed a "general contractor" and shall be so licensed. Therefore a single prime project that involves other trades will require the single prime contractor to hold a proper General Contractors license. **EXCEPT:** On public buildings being bid single prime, where the total value of the general construction does not exceed 25% of the total

construction value, contractors under GS87- Arts 2 and 4 (Plumbing, Mechanical & Electrical) may bid and contract directly with the Owner as the SINGLE PRIME CONTRACTOR and may subcontract to other properly licensed trades. [GS87-1.1- Rules .0210](#)

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

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

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

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

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

Designer:

Civil Design Concepts, P.A.

(Name)

168 Patton Ave., Asheville, NC 28801

(Address)

828-252-5388

(Phone)

Owner:

Western Carolina University

(Agency/Institution)

Michael T. Byers

Vice Chancellor Administration and Finance

FORM OF PROPOSAL

(Project) WCU – NORTON INTRAMURAL FIELDS

(Institution) Western Carolina University

(SCO-ID #.) 22-24232-01A

Contract: _____

Bidder: _____

Date: _____

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

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

The State of North Carolina through Western Carolina University

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

WCU – Norton Intramural Fields

in full in complete accordance with the plans, specifications and contract documents, to the full and entire satisfaction of the State of North Carolina, and the

Western Carolina University and Civil Design Concepts

with a definite understanding that no money will be allowed for extra work except as set forth in the General Conditions and the contract documents, for the sum of:

SINGLE PRIME CONTRACT:

Base Bid:

_____ Dollars(\$)

General Subcontractor:

_____ Lic _____

Plumbing Subcontractor:

_____ Lic _____

Mechanical Subcontractor:

_____ Lic _____

Electrical Subcontractor:

_____ Lic _____

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

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

Alternate 1: Proposed Football Fields to be Sodded

_____ Dollars(\$)

Alternate 3: Restroom Building Including Relevant Site Work (Sheets C202, Architectural, M001,M101, M201, P001, and P101).

_____ Dollars(\$)

Alternate 4: Installation of WIFI Conduits Excluding Cabling (E303)

_____ Dollars(\$)

UNIT PRICES

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

GENERAL CONTRACT:

No. 1 <u>Undercut Backfill with Stone</u>	<u>500CY</u>	Unit Price (\$)	_____
No. 2 <u>Undercut Backfill with Soil</u>	<u>500CY</u>	Unit Price (\$)	_____
No.3 <u>Washed Stone</u>	<u>100TON</u>	Unit Price(\$)	_____
No.4 <u>CABC</u>	<u>100TON</u>	Unit Price(\$)	_____
No.5 <u>Rip Rap</u>	<u>100TON</u>	Unit Price(\$)	_____
No.6 <u>Geotextile Fabric</u>	<u>200SY</u>	Unit Price(\$)	_____

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

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

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

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

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

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

*** OR ***

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

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

Proposal Signature Page

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

Respectfully submitted this day of _____

(Name of firm or corporation making bid)

WITNESS:

(Proprietorship or Partnership)

By: _____
Signature

Name: _____
Print or type

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

Address _____

ATTEST:

By: _____

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

License No. _____

Federal I.D. No. _____

Email Address: _____

(CORPORATE SEAL)

Addendum received and used in computing bid:

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

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

FORM OF BID BOND

KNOW ALL MEN BY THESE PRESENTS THAT _____

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

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

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

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

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

*(Community college projects: Delete State of North Carolina as owner and replace with community college name.)

MINORITY BUSINESS SUBCONTRACT GOALS:

The goals for participation by minority firms as subcontractors on this project have been set at 10%. The bidder must identify on its bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit (Affidavit A) listing good faith efforts **or** affidavit (Affidavit B) of self-performance of work, if the bidder will perform work under contract by its own workforce, as required by G.S. 143-128.2(c) and G.S. 143-128.2(f).

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

OR

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

OR

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

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

MINIMUM COMPLIANCE REQUIREMENTS:

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

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

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

Identification of HUB Certified/ Minority Business Participation

(Name of Bidder)

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

[illegible]

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

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

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

State of North Carolina AFFIDAVIT A – Listing of Good Faith Efforts

County of _____

(Name of Bidder)

Affidavit of _____

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

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

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

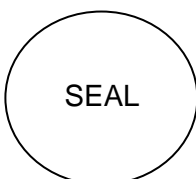
The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure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

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

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

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

Notary Public _____

My commission expires _____

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

County of _____

Affidavit of _____
(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the _____
_____ contract.
(Name of Project)

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

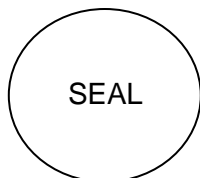
The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement. The Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

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

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

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

Notary Public _____

My commission expires _____

State of North Carolina - AFFIDAVIT C - Portion of the Work to be Performed by HUB Certified/Minority Businesses

County of _____

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

If the portion of the work to be executed by HUB certified/minority businesses as defined in GS143-128.2(g) and 128.4(a),(b),(e) is equal to or greater than 10% of the bidders total contract price, then the bidder must complete this affidavit.

This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being low bidder.

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

(Project Name)
Project ID# _____ Amount of Bid \$ _____

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

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

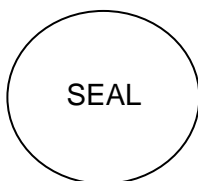
*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

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

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

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

Date: _____ Name of Authorized Officer: _____



Signature: _____

Title: _____

State of _____, County of _____

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

Notary Public _____

My commission expires _____

State of North Carolina AFFIDAVIT D – Good Faith Efforts

County of _____

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

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

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

Project ID# _____ (Project Name) Amount of Bid \$ _____

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

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

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

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

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

- Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.
- Copies of quotes or responses received from each firm responding to the solicitation.
- A telephone log of follow-up calls to each firm sent a solicitation.
- 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.
- Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.
- Copy of pre-bid roster
- Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.
- Letter detailing reasons for rejection of minority business due to lack of qualification.
- Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

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

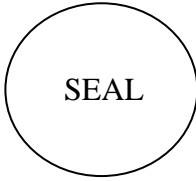
Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

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

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

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

Notary Public _____

My commission expires _____

APPENDIX E

MBE DOCUMENTATION FOR CONTRACT PAYMENTS

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: WCU – Norton Intramural Field

SCO Project ID: 22-24232-01A

Pay Application #: _____ Period: _____

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

MBE FIRM NAME	* TYPE OF MBE	AMOUNT PAID THIS MONTH (With This Pay App)	TOTAL PAYMENTS TO DATE	TOTAL AMOUNT COMMITTED

*Minority categories: Black (B), Hispanic (H), Asian American (AA), American Indian (AI), White Female (WF), Socially and Economically Disadvantaged (SED)

Approved/Certified By:

Name

Title

Date

Signature

SUBMIT WITH EACH PAY REQUEST - FINAL PAYMENT - FINAL REPORT



**BUNNELL
LAMMONS
ENGINEERING**

April 12, 2023

Mr. Curtis B. Monteith
Western Carolina University
Facilities Management
3476 Old Cullowhee Road
Cullowhee, North Carolina 28723

Subject: **Limited Geotechnical Exploration Report**
Norton Intramural Field / Storage and Restroom Facility
Western Carolina University
Cullowhee, North Carolina
BLE Project No. J23-19686-01

Dear Mr. Monteith:

Bunnell-Lammons Engineering, Inc. (BLE) is pleased to present this report of limited geotechnical exploration for the above-referenced project. Our services were provided in accordance with Bunnell-Lammons Engineering (BLE) Proposal No. P23-401 dated March 6, 2023 and verbally authorized by you to proceed with the proposed scope. The purpose of this exploration was to provide a seismic site classification for the proposed structure. This report details the findings of the limited geotechnical exploration performed. This report has been prepared based on our correspondence with Mr. Gregory Hoffman, P.E. with Civil Design Concepts, P.A. Additional project information was obtained from a site visit performed by BLE during the course of the geotechnical exploration.

PROJECT INFORMATION

WCU is planning the construction of a storage and restroom facility as part of the Norton Intramural Field project. We understand that the building will be located to the northwest of the Norton Residence Hall and to the south of parking lot 27B. The building will consist of a single-story structure with a footprint of approximately 2,600 square feet. We understand that building construction is anticipated to be a conventional masonry and wood framed structure with a concrete grade slab and metal roof. The exterior finish is anticipated to be a combination of masonry and architectural metal panels. Shallow foundation support is anticipated for the structure. We understand that as part of the subject project, the proposed area for the subject building has recently had soil fill placed and compacted. A large sheeps foot roller and dozer were noted to be on-site at the time of our site visit. Based on our recent site visit and the soil test borings, it appears that approximately 6 to 8 feet of soil fill have been placed.

FIELD EXPLORATION

The site was explored by performing three (3) soil test borings at the approximate locations shown on the attached Boring Location Plan (reference Figure 1). The soil test borings were performed using a truck-mounted drill rig turning 2-1/4 inch I.D. hollow-stem augers. The soil test borings were performed to depths of between 11 feet and 15 feet (auger refusal depth) below the existing ground surface. Soil samples were obtained in accordance with ASTM D 1586 by driving a 1-3/8 inch I.D. split-spoon sampler with a 140-pound safety hammer. The boring locations were established in the field by referencing the provided drawings and publicly available aerial photography along with the use of a hand-held GPS unit with 3-to-5-meter accuracy. As such, locations reported herein should be considered approximate. The Soil Test Boring Records and a description of our field procedures are attached.



30 Park Ridge Drive, Fletcher, NC 28732 ☎ 828.277.0100 📠 828.277.0110 ✉ info@blecorp.com

BLECORP.COM

AREA GEOLOGY

The project site is located in the Blue Ridge Physiographic Province. The bedrock in this region is a complex crystalline formation that has been faulted and contorted by past tectonic movements. The rock has weathered to residual soils which form the mantle for the hillsides and hilltops. The typical residual soil profile in areas not disturbed by erosion or human activities consists of clayey soils near the surface where weathering is more advanced, underlain by sandy silts and silty sands. The boundary between soil and rock is not sharply defined, and there often is a transitional zone, termed "partially weathered rock," overlying the parent bedrock. Partially weathered rock is defined, for engineering purposes, as residual material with a standard penetration resistance of at least 100 blows per foot (bpf). Weathering is facilitated by fractures, joints, and the presence of less resistant rock types. Consequently, the profile of the partially weathered rock and hard rock is quite irregular and erratic, even over short horizontal distances. Also, it is not unusual to find lenses and boulders of hard rock and/or zones of partially weathered rock within the soil mantle, well above the general bedrock level.

The upper soils along drainage features and in flood plain areas are often water-deposited (alluvial) materials that have been eroded and washed down from adjacent higher ground. These alluvial soils are usually soft and compressible, having never been consolidated by pressures in excess of their present overburden.

SUBSURFACE CONDITIONS

Existing Fill

Soils interpreted as fill soils were encountered at all three soil test boring locations to depths of approximately 8.5 feet below the existing ground surface. The fill soil consisted of very loose and loose very silty and silty sand. Based on our site visit and correspondence, we understand the existing fill soil had been recently placed as part of the project. No compaction testing data or field records of fill placement were available for our review at the time this letter was prepared. However, based on the average standard penetration test (SPT) resistance values that ranged from 5 to 7 blows per foot, the existing fill generally appears to have received some degree of compactive effort during placement. The fill was generally free of organics and deleterious materials, but it should be noted that the content and quality of man-made fills can vary significantly. It was also noted that the fill soil encountered in the borings was damp to moist at the time of our exploration.

Alluvium

Soil interpreted as water-deposited alluvium was encountered below the existing fill at all three soil test borings. The alluvium generally consisted of loose and very firm very silty fine sand with rounded rock fragments typically at the base of the alluvium layer. SPT blow counts in this material ranged from 3 to 50 blows per foot. The rounded rock fragments in the soil matrix are believed to have magnified the blow counts (N-values). The SPT samples of the alluvial soil were moist to wet at the time of drilling.

Auger Refusal

Material sufficiently hard to cause refusal to the power auger drilling equipment was encountered in soil test boring B-1 at a depth of 15 feet below ground surface and in soil test borings B-2 and B-3 at a depth of 11 feet below ground surface. Refusal may result from boulders, lenses, ledges or layers of relatively hard rock underlain by partially weathered rock or residual soil; refusal may also represent the surface of relatively continuous bedrock. However, the refusal that occurred in the soil test borings is thought to have occurred on cobbles or rock fragments within the alluvial soil layer. Core drilling procedures or excavation with a large track hoe are required to penetrate this material and determine their character and continuity. Core drilling or the use of a large excavator was beyond the current scope of this exploration.

Groundwater Conditions

Ground water was encountered in soil test borings at the depths of between 7 feet and 8 feet at the time of drilling. Because the borings were located on a college campus and in areas accessible by the students and staff and for safety concerns, the borings were backfilled shortly after drilling thus precluding 24-hour groundwater level measurements. On completion of checking for the presence of water the bore holes were backfilled with auger cuttings. Groundwater elevations at the site can be expected to fluctuate several feet with seasonal and rainfall variations. Ground water levels may also fluctuate due to construction activity. Normally, the highest groundwater levels occur in late winter and spring and the lowest levels occur in late summer and fall.

The descriptions above provide a general summary of the subsurface conditions encountered. The appended test boring records contain detailed information recorded at each boring location. These represent our interpretation of subsurface conditions based on engineering examination of the field samples. The lines designating the interfaces between various strata represent approximate boundaries and the transition between strata may be gradual. It should be noted that the soil conditions will vary between boring locations.

GEOTECHNICAL RECOMMENDATIONS

The following recommendations have been developed from the obtained boring data, our experience with similar soil conditions, the limited provided project information and the assumed foundation loading. Assuming subsurface conditions encountered at the boring locations are representative of subsurface conditions, the following conclusions and recommendations should generally be applicable for this site.

General Assessment

Based on the boring data collected to date, the soils within the depth of interest generally consist of low to moderate consistency pre-existing fill and alluvial soils. It is anticipated that site grading can generally be accomplished using conventional construction approaches and standard building practices. Provided that the foundation bearing soils are closely evaluated by BLE during construction, it is anticipated that a shallow foundation system or a monolithic foundation slab can be used to support the proposed building. However, field modifications to improve bearing conditions (particular in previously placed fill soil) should be anticipated and included in the construction budget. As such, we recommend that an allowance be budgeted to perform remedial repairs on some of the existing soils. Based on the limited project information provided to date, remedial repair would typically involve the removal of the loose/soft soil and then replacing these soils with crushed stone and possibly a geotextile fabric. Appropriate recommendations would be made at the time of construction. Some subgrade stabilization for slab support should also be anticipated. Based on our understanding that the structure is a lightly loaded building partial undercutting and replacement methods seems to be a practical cost-effective remedial recommendation. Remedial repair and subgrade stabilization measures will also depend heavily on the prevailing weather at the time of construction.

Recommended Bearing Capacity

Foundations bearing in existing fill soils tested and evaluated by BLE may be sized for a uniform allowable bearing pressure of 1,500 psf, subject to the criteria and site preparation recommendations in this report. In areas where foundations bear in loose or soft fill or where bearing materials do not exhibit the design bearing capacity, modifications will be required. These modifications may include increasing the foundation size, lowering the foundation bearing elevation, or over-excavating and replacing soft/loose soils with either compacted aggregate, engineered fill or fill concrete. The need for undercutting should be determined by a BLE representative at the time of construction, as discussed in detail below.

Recommended Minimum Dimensions

We recommend that the minimum widths for individual column and continuous wall footings be 24 and 18 inches, respectively. The minimum widths are considered advisable to provide a margin of safety against a local or punching shear failure of the foundation soils. Exterior/perimeter footings should bear at least 30 inches below final exterior grade for embedment needed to develop the recommended allowable design bearing pressure and to provide frost protection. Interior footings should bear at least 16-inches below the floor grade slab. The same protective embedment recommended for the interior and exterior spread footings should be used for the thickened perimeter and interior portions of a monolithic foundation slab, if such a slab is used in lieu of individual strip and spread footing foundations.

Foundation Evaluations During Construction

To observe that the soils encountered in footing excavations are consistent with those encountered in the soil test borings or in properly compacted soil fill, we recommend that foundation excavations be examined by a representative of Bunnell-Lammons Engineering. Part of this examination should include checking the bearing soils with a dynamic cone penetrometer performed by an experienced engineering technician working under the direction of the geotechnical engineer. This testing will document that the design bearing conditions are present and allow recommendations for any needed adjustments in foundation size or bearing elevation to be made at specific locations. Recommendations would most likely include that the foundation excavation be undercut below the foundation bearing level and extended laterally beyond the foundation perimeter a distance equal to at least one-half the depth of undercut beneath the footing bearing level. The undercut excavation then would be backfilled with engineered fill/compacted aggregate or washed stone.

Surface Protection

Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for long periods of time. Therefore, we recommend that, once each footing excavation is extended to final grade, the footing be constructed as soon as possible thereafter to minimize the potential for damage to the bearing soils. The foundation bearing area should be level or benched and free of loose soil, ponded water, and debris. Foundation concrete should not be placed on soils that have been disturbed by seepage. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom prior to placement of concrete. If the excavation must remain open overnight or if rainfall becomes imminent while the bearing soils are exposed, we recommend placement of a 2 to 4-inch thick "mud-mat" of "lean" (2,000 psi) concrete on the bearing soils before the placement of reinforcing steel for protection against softening.

Grade Slab Subgrade

A conventional grade slab or a thickened grade slab may be supported on properly compacted and evaluated fill assuming that the site is prepared in accordance with the recommendations in this report. Lightly loaded grade slabs should generally be underlain by a 6-inch-thick layer of aggregate base course (ABC stone), as specified in the North Carolina Department of Transportation Standard Specifications for Roads and Structures. The aggregate base course layer should be compacted to at least 98 percent of its standard Proctor compaction test. Based on previous experience with similar soils, a maximum modulus of subgrade reaction (k) equal to 100 pounds per cubic inch should be used for design. Requirements for support of moderate to heavily loaded grade slabs will be evaluated on a case-by-case basis, but are anticipated to not be required. Grade slab areas are typically evaluated during construction by proofrolling with a loaded dump truck or similar rubber-tired equipment. Any soft areas can be repaired by partial undercutting and replacement or other subgrade stabilization measures. A vapor barrier should be included below the slab if vapor penetration is not acceptable. The need for a vapor barrier is also dependent on the floor covering type and applicable building codes. Completed slabs should be protected from excessive surface moisture prior to and during periods of prolonged, below-freezing temperatures to prevent subgrade freezing and resulting heave. The slab subgrade area should be evaluated by BLE prior to placement of crushed stone.

Seismic Site Classification

Based on the definitions provided in the 2018 North Carolina Building Code, which references the International Building Code (IBC 2015), the collected SPT data and our experience in this area, we recommend a seismic site classification of "D" for the proposed building. It is important to note that SPT data generally provides a conservative assessment of the seismic site classification. Occasionally, a higher site classification is obtained by directly measuring the seismic shear wave velocity of the soil profile. This is often performed where significant cost savings in the structure can be realized. BLE can provide this additional service, if desired. However, a review of the boring data indicates the likelihood of an increased site classification in this particular case is low.

SPECIFICATION REVIEW

It is recommended that Bunnell-Lammons Engineering be provided the opportunity to make a general review of the foundation and earthwork plans and specifications prepared from the limited recommendations presented in this report. We would then suggest any modifications so that our recommendations are properly interpreted and implemented.

BASIS OF RECOMMENDATIONS

The general subsurface conditions utilized in our evaluation have been based on interpolation of the subsurface data between the widely spaced borings. Subsurface conditions between the borings will differ. If the project information is incorrect or the structure location (horizontal or vertical) and/or dimensions are changed, please contact us so that our recommendations can be reviewed. The discovery of any site or subsurface conditions during construction which deviate from the data obtained in this exploration should be reported to us for our evaluation. The assessment of site environmental conditions for presence of pollutants in the soil, rock and ground water of the site was beyond the scope of this exploration.

CLOSING

We appreciate the opportunity to provide our professional geotechnical services on this project. If you have any questions regarding this report, please do not hesitate to call us.

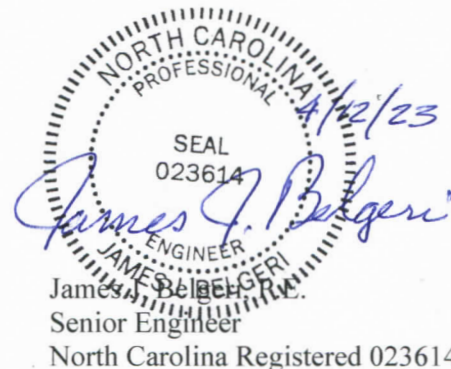
Sincerely,

BUNNELL-LAMMONS ENGINEERING, INC.

BLE NC License No. C-1538

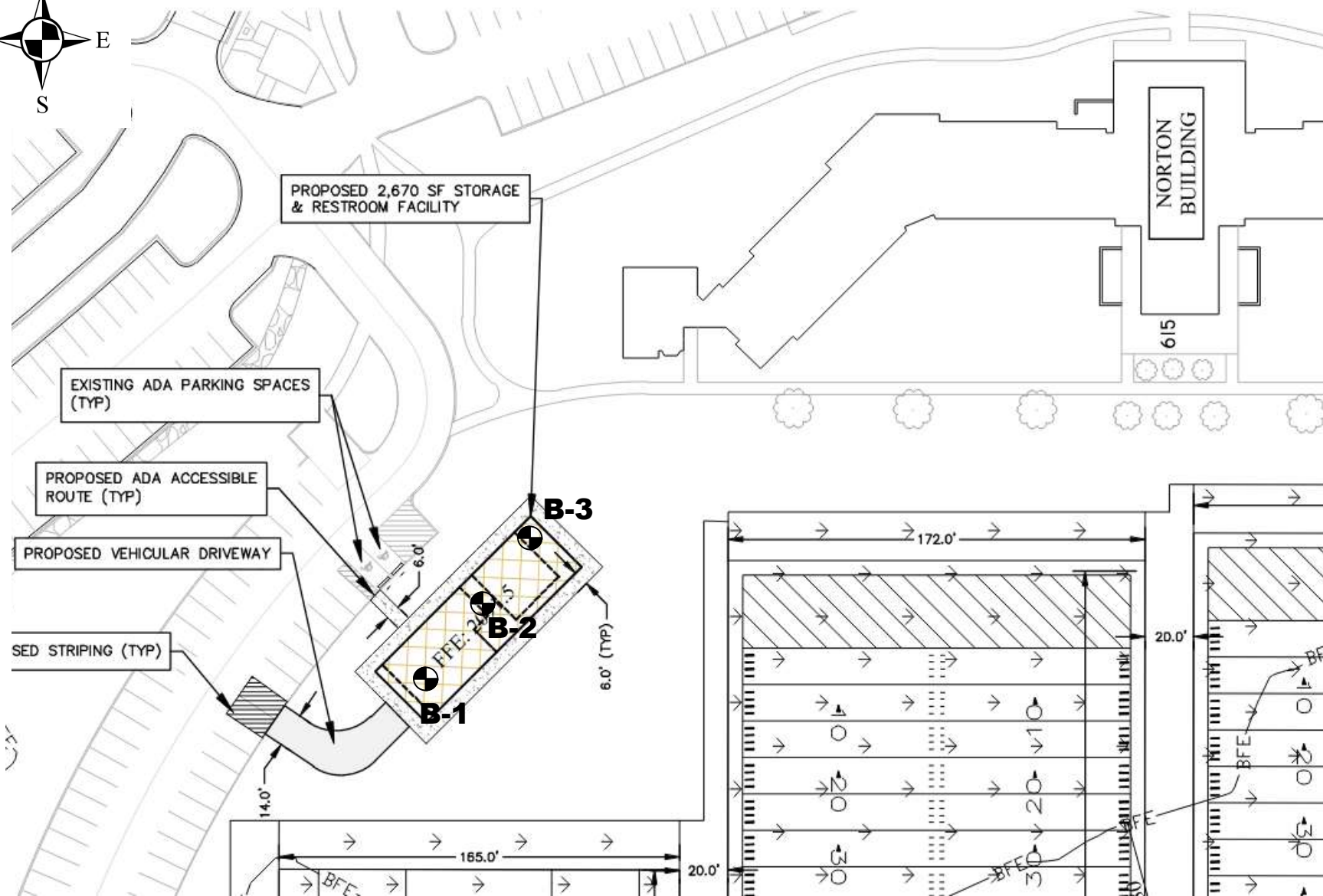
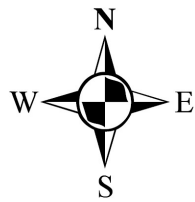


Sam C. Interlicchia
Senior Project Manager



James J. Belcher, P.E.
Senior Engineer
North Carolina Registered 023614

Attachments:



Approximate Soil Test Boring Location

No Scale

Reference: Portion of Site Plan C201 prepared by CDC



BUNNELL
LAMMONS
ENGINEERING

Drawn By: SCI

Date: April 2023

Norton Intramural Field
Storage & Restroom Building
Western Carolina University
BLE Project No. J23-19686-01

Boring
Location Plan

Figure No.
1



PROJECT: Norton Field House PROJECT NO.: J23-19686-01
 CLIENT: WCU START: 3/7/23 END: 3/7/23
 LOCATION: Cullowhee, NC ELEVATION: _____
 DRILLER: Metro Drill, Inc., H. Wessinger LOGGED BY: S. Interlicchia
 DRILLING METHOD: CME - 45; 2 - 1/4 inch Hollow Stem Auger
 DEPTH TO - WATER> INITIAL: ▽ 8 AFTER 24 HOURS: ▼ _____ CAVING> ☒

SOIL TEST BORING NO. B-1
Sheet 1 of 1



**BUNNELL-LAMMONS
ENGINEERING, INC.**
GEOTECHNICAL AND ENVIRONMENTAL
CONSULTANTS

SOIL TEST BORING NO. B-2

PROJECT: Norton Field House

PROJECT NO.: J23-19686-01

CLIENT: WCU

START: 3/7/23 END: 3/7/23

LOCATION: Cullowhee, NC

ELEVATION:

DRILLER: Metro Drill, Inc., H. Wessinger

LOGGED BY: S. Interlicchia

DRILLING METHOD: CME - 45; 2 - 1/4 inch Hollow Stem Auger

DEPTH TO - WATER> INITIAL: 7.5 AFTER 24 HOURS: CAVING>

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT										
				2	5	10	20	30	40	50	70	90		
5 														



**BUNNELL-LAMMONS
ENGINEERING, INC.**
GEOTECHNICAL AND ENVIRONMENTAL
CONSULTANTS

SOIL TEST BORING NO. B-3

PROJECT: Norton Field House

PROJECT NO.: J23-19686-01

CLIENT: WCU

START: 3/7/23 END: 3/7/23

LOCATION: Cullowhee, NC

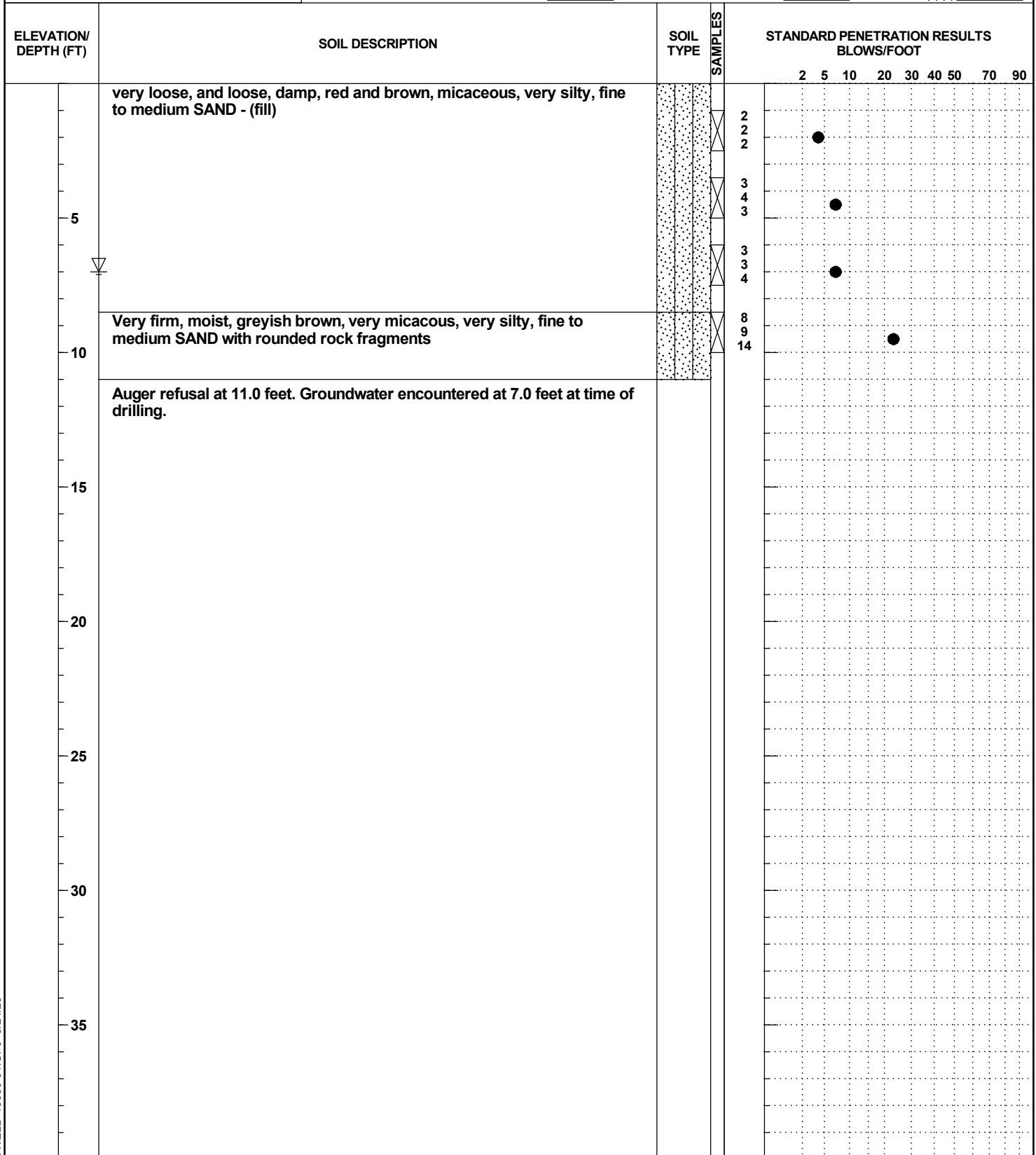
ELEVATION:

DRILLER: Metro Drill, Inc., H. Wessinger

LOGGED BY: S. Interlicchia

DRILLING METHOD: CME - 45; 2 - 1/4 inch Hollow Stem Auger

DEPTH TO - WATER> INITIAL: 7 AFTER 24 HOURS: CAVING>



KEY TO SOIL CLASSIFICATIONS AND CONSISTENCY DESCRIPTIONS

BUNNELL-LAMMONS ENGINEERING, INC.
ASHEVILLE, NORTH CAROLINA

Penetration Resistance* Blows per Foot

SANDS

0 to 4
 5 to 10
 11 to 20
 21 to 30
 31 to 50
 over 50

Relative Density

Very Loose
 Loose
 Firm
 Very Firm
 Dense
 Very Dense

Particle Size Identification

Boulder: Greater than 300 mm
 Cobble: 75 to 300 mm
 Gravel:
 Coarse - 19 to 75 mm
 Fine - 4.75 to 19 mm
 Sand:
 Coarse - 2 to 4.75 mm
 Medium - 0.425 to 2 mm
 Fine - 0.075 to 0.425 mm
 Silt & Clay: Less than 0.075 mm

Penetration Resistance* Blows per Foot

SILTS and CLAYS

0 to 2
 3 to 4
 5 to 8
 9 to 15
 16 to 30
 31 to 50
 over 50

Consistency

Very Soft
 Soft
 Firm
 Stiff
 Very Stiff
 Hard
 Very Hard

12 Number of blows in first 6-inches
 15 Number of blows in second 6-inches
 16 Number of blows in third 6-inches

*ASTM D 1586

KEY TO DRILLING SYMBOLS



Grab Sample



Split Spoon Sample



Undisturbed Sample



Groundwater Table at Time of Drilling

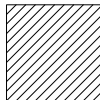


Groundwater Table 24 Hours after Completion of Drilling

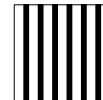
KEY TO SOIL CLASSIFICATIONS



Well-graded Gravel
 GW



Low Plasticity Clay
 CL



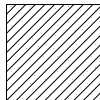
Clayey Silt
 MH



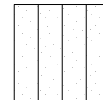
Silty Sand
 SM



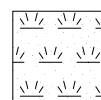
Poorly-graded Gravel
 GP



Sandy Clay
 CLS



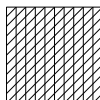
Sandy Silt
 MLS



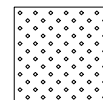
Topsoil
 TOPSOIL



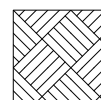
Partially Weathered Rock
 BLDRCBBL



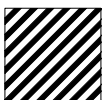
Silty Clay
 CL-ML



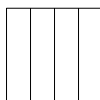
Sand
 SW



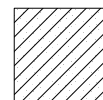
Bedrock
 BEDROCK



High Plasticity Clay
 CH



Silt
 ML



Clayey Sand
 SC



Concrete
 A5

Field Exploration Procedures

SOIL TEST BORINGS

The borings were made by mechanically twisting a continuous flight steel auger into the soil. Soil sampling and penetration testing were performed in accordance with ASTM D-1586. At assigned intervals, soil samples were obtained with a standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings, and then driven an additional 12 inches with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12 inches was recorded and is designated the “standard penetration resistance.” The penetration resistance, once properly evaluated, is an index to the strength of the soil and foundation supporting capability. Representative portions of the soil samples, thus obtained, were placed in glass jars and transported to the laboratory. In the laboratory, the samples were examined by a geotechnical engineer and visually classified. Soil Test Boring Records are attached showing the soil descriptions and penetration resistance.

FORM OF CONSTRUCTION CONTRACT

(ALL PRIME CONTRACTS)

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

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

_____ hereinafter called
the Party of the Second Part.

WITNESSETH:

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

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

WCU NORTON INTRAMURAL FIELDS

Consisting of the following sheets: C000, G003, C101, C201, C301, C501, C601, C921,
C931, C932, C951, C952, C961, C962, C998; G110; M001, M101, M201, E001, E102, E200,
E202, P001, P101, (If Alternates are excepted, more sheets will be added).

Dated: _____ and the following addenda:

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

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

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

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

2. That the Party of the First Part shall commence work to be performed under this
agreement on a date to be specified in a written order of the Party of the Second Part and
shall fully complete all work hereunder within _____ consecutive calendar days
from said date. For each day in excess thereof, liquidated damages shall be as stated in
Supplementary General Conditions. The Party of the First Part, as one of the
considerations for the awarding of this contract, shall furnish to the Party of the Second
Part a construction schedule setting forth planned progress of the project broken down by

the various divisions or part of the work and by calendar days as outlined in Article 14 of the General Conditions of the Contract.

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

(\$ _____).

Summary of Contract Award:

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

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

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

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

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

Witness:

Contractor: (Trade or Corporate Name)

(Proprietorship or Partnership)

By: _____

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

Attest: (Corporation)

By: _____

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

The State of North Carolina through*

(CORPORATE SEAL)

(Agency, Department or Institution)

Witness:

By: _____

Title: _____

FORM OF PERFORMANCE BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal
(Contractor) _____

Name of Surety: _____

Name of Contracting
Body: _____

Amount of Bond: _____

Project _____

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

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

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

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

Executed in _____ counterparts.

Witness:

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

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

(Corporate Seal)

Witness:

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

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

Contractor: (Trade or Corporate Name)

By: _____

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

(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

(Surety Corporate Seal)

FORM OF PAYMENT BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal
(Contractor) _____

Name of Surety: _____

Name of Contracting
Body: _____

Amount of Bond: _____

Project _____

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

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

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

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

Executed in _____ counterparts.

Witness:

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

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

(Corporate Seal)

Witness:

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

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

Contractor: (Trade or Corporate Name)

By: _____

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

(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

(Surety Corporate Seal)

Sheet for Attaching Power of Attorney

Sheet for Attaching Insurance Certificates

APPROVAL OF THE ATTORNEY GENERAL

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

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

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

This _____ day of _____ 20____.

Signed _____
Budget Officer

INSERT PROPOSED SCHEDULE HERE

INSERT INSURANCE CERTIFICATES HERE

NOTICE OF AWARD

TO: _____

Project Description: This project consists of installing erosion control, fine grading, storm drainage, installing water and sewer services, sod, constructing new restroom building, and field preparation.

The Owner has considered the Bid Proposal submitted by you for the above-described Project in response to its receipt of Bids on DATE

You are hereby notified that your Bid Proposal has been accepted in the amount of

(words) (numbers)

If you fail to execute said Agreement and to furnish said Bonds with ten (10) days from the date of this Notice, said Owner will be entitled to consider all your rights arising out of the Owner's acceptance of your Bid Proposal as abandoned and as a forfeiture of your Bid Proposal. The Owner will be entitled to such other rights as may be granted by law.

Civil Design Concepts, PA

Engineer

BY: _____

TITLE: _____

NOTICE TO PROCEED

TO:

DATE:

PROJECT: WCU – Norton Intramural Fields

You are hereby notified to commence WORK in accordance with the Agreement for _____, dated _____, on or before _____, and you are to complete the Work within _____ consecutive calendar days thereafter. The date of completion of all Work is therefore _____

Civil Design Concepts, PA

Engineer

BY: _____

TITLE: _____

STATE CONSTRUCTION OFFICE

BID SUMMARY SHEET

DESIGNER: Civil Design Concepts, PA

OWNER/AGENCY: Western Carolina University

PROJECT NAME: WCU – Norton Intramural Fields

CODE & ITEM _____

SCO FILE#: _____

DATE BIDS RECEIVED: _____

PROJECT SIZE: (Sq Ft., Etc.) _____

COUNTY OF PROJECT: _____

<u>GENERAL CONSTRUCTION</u>	<u>LOW BID</u>	<u>\$/UNIT COST</u>
------------------------------------	-----------------------	----------------------------

AVERAGE OF 3 LOWEST BIDS	_____	_____
ESTIMATED BID	_____	_____
OVER/ (UNDER) BUDGET	_____	_____

<u>MECHANICAL</u>	<u>LOW BID</u>	<u>\$/UNIT COST</u>
--------------------------	-----------------------	----------------------------

AVERAGE OF 3 LOWEST BIDS	_____	_____
ESTIMATED BID	_____	_____
OVER/ (UNDER) BUDGET	_____	_____

<u>ELECTRICAL</u>	<u>LOW BID</u>	<u>\$/UNIT COST</u>
--------------------------	-----------------------	----------------------------

AVERAGE OF 3 LOWEST BIDS	_____	_____
ESTIMATED BID	_____	_____
OVER/ (UNDER) BUDGET	_____	_____

<u>PLUMBING</u>	<u>LOW BID</u>	<u>\$/UNIT COST</u>
------------------------	-----------------------	----------------------------

AVERAGE OF 3 LOWEST BIDS	_____	_____
ESTIMATED BID	_____	_____
OVER/ (UNDER) BUDGET	_____	_____

<u>OTHER</u>	<u>LOW BID</u>	<u>\$/UNIT COST</u>
---------------------	-----------------------	----------------------------

AVERAGE OF 3 LOWEST BIDS	_____	_____
ESTIMATED BID	_____	_____
OVER/ (UNDER) BUDGET	_____	_____

<u>OTHER</u>	<u>LOW BID</u>	<u>\$/UNIT COST</u>
---------------------	-----------------------	----------------------------

AVERAGE OF 3 LOWEST BIDS	_____	_____
ESTIMATED BID	_____	_____
OVER/ (UNDER) BUDGET	_____	_____

PROJECT NAME: _____

<u>ALTERNATES</u>	<u>LOW BID</u>	<u>\$/UNIT COST</u>
-------------------	----------------	---------------------

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

OTHER UNIT PRICES

REMARKS *and brief description of project (Attach extra sheets as necessary.)*

6/2008 _____

Contractor's Application For Payment No. _____

	Application Period:	Application Date:
To (Owner): Western Carolina University	From (Contractor):	Via (Engineer) Civil Design Concepts, PA
Project: WCU – Norton Intramural Field	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.: 22250

APPLICATION FOR PAYMENT

Change Order Summary

Approved Change Orders				
Number	Additions	Deductions		
			1. ORIGINAL CONTRACT PRICE.....	\$ _____
			2. Net change by Change Orders.....	\$ _____
			3. CURRENT CONTRACT PRICE (Line 1 ± 2)	\$ _____
			4. TOTAL COMPLETED AND STORED TO DATE	
			(Column F on Progress Estimate)	\$ _____
			5. RETAINAGE:	
			a. _____ % x \$ _____ Work Completed	\$ _____
			b. _____ % x \$ _____ Stored Material.....	\$ _____
			c. Total Retainage (Line 5a + Line 5b)	\$ _____
			6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5c)	\$ _____
			7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application).....	\$ _____
			8. AMOUNT DUE THIS APPLICATION.....	\$ _____
			9. BALANCE TO FINISH, PLUS RETAINAGE	
			(Column G on Progress Estimate + Line 5 above)	\$ _____
TOTALS				
NET CHANGE BY CHANGE ORDERS				

CONTRACTOR'S CERTIFICATION

The undersigned Contractor certifies that: (1) all previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with Work covered by prior Applications for Payment; (2) title of all Work, materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to Owner at time of payment free and clear of all Liens, security interests and encumbrances (except such as are covered by a Bond acceptable to Owner indemnifying Owner against any such Liens, security interest or encumbrances); and (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

By:	Date:
-----	-------

Payment of:	\$ _____	(Line 8 or other - attach explanation of other amount)
is recommended by:	_____	_____
	(Engineer)	(Date)
Payment of:	\$ _____	(Line 8 or other - attach explanation of other amount)
is approved by:	_____	_____
	(Owner)	(Date)
Approved by:	_____	_____
	Funding Agency (if applicable)	(Date)

Progress Estimate

Contractor's Application

For (contract):						Application Number:		
Application Period:						Application Date:		
A		B	Work Completed		E	F		G
Item		Scheduled Value	C	D	Materials Presently Stored (not in C or D)	Total Completed and Stored to Date (C + D + E)	% (E) B	Balance to Finish (B - F)
Specification Section No.	Description		From Previous Application (C + D)	This Period				
	Totals							

Progress Estimate

Contractor's Application

For (contract):						Application Number:				
Application Period:						Application Date:				
A				B	C	D	E	F		G
Item		Bid Quantity	Unit Price	Bid Value	Estimated Quantity Installed	Value	Materials Presently Stored (not in C)	Total Completed and Stored to Date (D + E)	% (F) B	Balance to Finish (B - F)
Bid Item No.	Description									
	Totals									

Stored Material Summary

Contractor's Application

For (contract):						Application Number:			
Application Period:						Application Date:			
A	B	C	D		E		F		G
Invoice No.	Shop Drawing Transmittal No.	Materials Description	Stored Previously		Stored this Month		Incorporated in Work		Materials Remaining in Storage (\$) (D + E - F)
			Date (Month/Year)	Amount (\$)	Amount (\$)	Subtotal	Date (Month/Year)	Amount (\$)	
		Totals							

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

CONTRACTOR: _____

Page 1 of _____

PROJECT: WCU – Norton Intramural Field

FOR PERIOD: _____

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

* Attach subcontractor(s) report(s)

** Must balance with Detail Sheet(s)

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

Sworn to and subscribed before me,

This the _____ day of _____, 20____

Signed

Notary Public

My Commission Expires: _____

Print or Type Name of Above

Seal

NOTE:

This certified statement may be subject to audit.

STATE OF NORTH CAROLINA SALES AND USE TAX REPORT DETAIL

CONTRACTOR: _____

Page 2 of

SUBCONTRACTOR _____

FOR PERIOD: _____

PROJECT: WCU – Norton Intramural Field

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

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

CONTRACTORS AFFIDAVIT / WAIVER OF LIEN & INDEMNITY

STATE OF NORTH CAROLINA

COUNTY OF _____

On this day _____, being duly sworn, deposes and says that he is the
_____ of _____ (Contractor) who entered into a contract for
_____ dated _____, with
_____(Owner) for furnishing materials and labor in the
erection and construction of facilities defined in the contract Documents, such erection and
construction having been completed.

Further, that in accordance with the Contract Documents and applicable Statutes of the State of
North Carolina, the undersigned hereby declares that the claims of all sub-contractors, material
men, laborers and all other persons and parties furnishing labor and materials with respect to the
above mentioned Contract have been paid in full except as follows:

_____	_____
_____	_____
_____	_____
_____	_____

Affiant further states that by execution of this affidavit he agrees to indemnify and save harmless
the Owner from any liability for payment of said deficiencies in the stated amounts or any part
thereof.

(Contractor)

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

Notary Public

My Commision Expires _____

MEET NORTH CAROLINA ONE-CALL CENTER

North Carolina One-Call is a Corporation formed and funded by participating utility companies and municipalities in the interest of community and job safety and improved service through damage reduction to the utilities.

A one call toll free number, **1-800-632-4949**, provides an avenue to all of the participating members from any point within the State of North Carolina.

Anyone proposing to excavate, dig, bore, tunnel, blast or disturb the earth in any manner in which buried utilities may be damaged is requested to call the toll-free number between the hours of 7:00 a.m. and 5:00 p.m., Monday through Friday, forty-eight hours before starting the proposed work.

Within minutes of your telephone call, the participating members will be made aware of your plans and will be given pertinent information that has been provided by you about your planned work. You will be told the names of the participating members from whom you can expect a response. If there are buried facilities in the path of your activity, the route of the utilities will be staked and/or marked at no expense to you. If there are no facilities in the area of the planned work, you will be called or notified by a representative of the participating company accordingly.

Should a non-participating utility operator be serving your area, we recommend that you call them on an individual basis. All utility operators, whether company or municipality, will be provided an opportunity to become a member of North Carolina One-Call.

Naturally, knowing the route of the utilities, the excavator is expected to exercise caution and to avoid damage as the project progresses.

Damage prevention doesn't just happen - it is a planned and orderly process through which each of us can participate - **Yes, we can and will dramatically reduce damages to the utilities in the State of North Carolina! Thanks for your help.**

BEFORE YOU DIG

IN THE INTEREST OF COMMUNITY AND JOB SAFETY

AND IMPROVED SERVICE

CALL NORTH CAROLINA ONE-CALL

1-800-632-4949

DIVISION 01

GENERAL REQUIREMENTS



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

STANDARD FORM FOR CONSTRUCTION PROJECTS

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

Form OC-15

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

Twenty Fourth Edition January 2013

INSTRUCTIONS TO BIDDERS

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

1. PROPOSALS

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

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

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

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

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

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

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

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

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

2. EXAMINATION OF CONDITIONS

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

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

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

3. BULLETINS AND ADDENDA

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

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

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

4. BID SECURITY

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

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

5. RECEIPT OF BIDS

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

6. OPENING OF BIDS

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

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

7. BID EVALUATION

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

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

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

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

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

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

8. PERFORMANCE BOND

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

9. PAYMENT BOND

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

10. PAYMENTS

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

11. PRE-BID CONFERENCE

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

12. SUBSTITUTIONS

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

Submittals for proposed substitutions shall include the following information:

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

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

GENERAL CONDITIONS OF THE CONTRACT

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

TABLE OF CONTENTS

ARTICLE	TITLE	PAGE
1	Definitions	9
2	Intent and Execution of Documents	11
3	Clarifications and Detail Drawings	12
4	Copies of Drawings and Specifications	12
5	Shop Drawings, Submittals, Samples, Data	13
6	Working Drawings and Specifications at the Job Site	13
7	Ownership of Drawings and Specifications	14
8	Materials, Equipment, Employees	14
9	Royalties, Licenses and Patent	15
10	Permits, Inspections, Fees, Regulations	15
11	Protection of Work, Property and the Public	16
12	Sedimentation Pollution Control Act of 1973	17
13	Inspection of the Work	17
14	Construction Supervision and Schedule	18
15	Separate Contracts and Contractor Relationships	22
16	Subcontracts and Subcontractors	23
17	Contractor and Subcontractor Relationships	23
18	Designer's Status	24
19	Changes in the Work	25
20	Claims for Extra Cost	27
21	Minor Changes in the Work	29
22	Uncorrected Faulty Work	29
23	Time of Completion, Delays, Extension of Time	29
24	Partial Utilization: Beneficial Occupancy	30
25	Final Inspection, Acceptance, and Project Closeout	31
26	Correction of Work Before Final Payment	31
27	Correction of Work After Final Payment	32
28	Owner's Right to Do Work	32
29	Annulment of Contract	32
30	Contractor's Right to Stop Work or Terminate the Contract	33
31	Requests for Payments	33
32	Certificates of Payment and Final Payment	34
33	Payments Withheld	36
34	Minimum Insurance Requirements	36
35	Performance Bond and Payment Bond	37
36	Contractor's Affidavit	38
37	Assignments	38
38	Use of Premises	38
39	Cutting, Patching and Digging	38
40	Utilities, Structures, Signs	38
41	Cleaning Up	40
42	Guarantee	41

43	Codes and Standards	41
44	Indemnification	41
45	Taxes	41
46	Equal Opportunity Clause	42
47	Employment of the Handicapped	42
48	Asbestos-Containing Materials (ACM)	43
49	Minority Business Participation	43
50	Contractor Evaluation	43
51	Gifts	43
52	Auditing Access to Persons and Records	44
53	North Carolina False Claims Act.....	44
54	Termination for Convenience.....	45

ARTICLE 1 - DEFINITIONS

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

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

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

ARTICLE 2 - INTENT AND EXECUTION OF DOCUMENTS

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

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

ARTICLE 3 - CLARIFICATIONS AND DETAIL DRAWINGS

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

ARTICLE 4 - COPIES OF DRAWINGS AND SPECIFICATIONS

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

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

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

ARTICLE 5 - SHOP DRAWINGS, SUBMITTALS, SAMPLES, DATA

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

ARTICLE 6 - WORKING DRAWINGS AND SPECIFICATIONS AT THE JOB SITE

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

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

ARTICLE 7 - OWNERSHIP OF DRAWINGS AND SPECIFICATIONS

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

ARTICLE 8 - MATERIALS, EQUIPMENT, EMPLOYEES

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

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

ARTICLE 9 - ROYALTIES, LICENSES AND PATENTS

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

ARTICLE 10 - PERMITS, INSPECTIONS, FEES, REGULATIONS

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

ARTICLE 11 - PROTECTION OF WORK, PROPERTY AND THE PUBLIC

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

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

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

ARTICLE 12 - SEDIMENTATION POLLUTION CONTROL ACT OF 1973

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

ARTICLE 13 - INSPECTION OF THE WORK

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

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

ARTICLE 14 - CONSTRUCTION SUPERVISION AND SCHEDULE

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

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

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

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

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

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

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

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

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

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

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

ARTICLE 15 - SEPARATE CONTRACTS AND CONTRACTOR RELATIONSHIPS

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

ARTICLE 16 - SUBCONTRACTS AND SUBCONTRACTORS

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

ARTICLE 17 - CONTRACTOR AND SUBCONTRACTOR RELATIONSHIPS

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

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

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

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

ARTICLE 18 - DESIGNER'S STATUS

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

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

ARTICLE 19 - CHANGES IN THE WORK

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

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

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

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

- d. Under Paragraph "b" and Methods "c(2)" above, the allowances for overhead and profit combined shall be as follows: all contractors (the single contracting entity (prime), his subcontractors (1st tier subs), or their sub-subcontractors (2nd tier subs, 3rd tier subs, etc)) shall be allowed a maximum of 10% on work they each self-perform; the prime contractor shall be allowed a maximum of 5% on contracted work of his 1st tier sub; 1st tier, 2nd tier, 3rd tier, etc contractors shall be allowed a maximum of 2.5% on the contracted work of their subs. ; Under Method "c(1)", no additional allowances shall be made for overhead and profit. In the case of deductible change orders, under Method "c(2)" and Paragraph (b) above, the contractor shall include no less than five percent (5%) profit, but no allowances for overhead.
- e. The term "net cost" as used herein shall mean the difference between all proper cost additions and deductions. The "cost" as used herein shall be limited to the following:
1. The actual costs of materials and supplies incorporated or consumed as part of the work;
 2. The actual costs of labor expended on the project site; labor expended in coordination, change order negotiation, record document maintenance, shop drawing revision or other tasks necessary to the administration of the project are considered overhead whether they take place in an office or on the project site.
 3. The actual costs of labor burden, limited to the costs of social security (FICA) and Medicare/Medicaid taxes; unemployment insurance costs; health/dental/vision insurance premiums; paid employee leave for holidays, vacation, sick leave, and/or petty leave, not to exceed a total of 30 days per year; retirement contributions; worker's compensation insurance premiums; and the costs of general liability insurance when premiums are computed based on payroll amounts; the total of which shall not exceed thirty percent (30%) of the actual costs of labor;
 4. The actual costs of rental for tools, excluding hand tools; equipment; machinery; and temporary facilities required for the work;
 5. The actual costs of premiums for bonds, insurance, permit fees, and sales or use taxes related to the work.
- Overtime and extra pay for holidays and weekends may be a cost item only to the extent approved by the owner.
- f. Should concealed conditions be encountered in the performance of the work below grade, or should concealed or unknown conditions in an existing structure be at variance with the conditions indicated by the contract documents, the contract sum and time for completion may be equitably adjusted by change order upon claim by either party made within thirty (30) days after the condition has been identified. The cost of such change shall be arrived at by one of the foregoing methods. All change orders shall be supported by a unit cost breakdown showing method of arriving at net cost as defined above.
- g. In all change orders, the procedure will be for the designer to request proposals for the change order work in writing. The contractor will provide such proposal and supporting data in suitable format. The designer shall verify correctness. Delay in the processing of the change order due to lack of proper submittal by the contractor of all required supporting data shall not constitute grounds for a time extension or basis of a claim. Within fourteen (14) days after receipt of the contractor's accepted proposal including all supporting documentation required by the designer, the designer shall prepare the change order and forward to the contractor for his signature or otherwise respond, in writing, to

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

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

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

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

ARTICLE 20 - CLAIMS FOR EXTRA COST

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

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

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

ARTICLE 21 - MINOR CHANGES IN THE WORK

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

ARTICLE 22 - UNCORRECTED FAULTY WORK

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

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

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

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

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

ARTICLE 24 - PARTIAL UTILIZATION/BENEFICIAL OCCUPANCY

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

ARTICLE 25 - FINAL INSPECTION, ACCEPTANCE, AND PROJECT CLOSEOUT

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

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

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

ARTICLE 26 - CORRECTION OF WORK BEFORE FINAL PAYMENT

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

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

ARTICLE 27 - CORRECTION OF WORK AFTER FINAL PAYMENT

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

ARTICLE 28 - OWNER'S RIGHT TO DO WORK

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

ARTICLE 29 - ANNULMENT OF CONTRACT

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

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

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

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

ARTICLE 31 - REQUEST FOR PAYMENT

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

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

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

ARTICLE 32 - CERTIFICATES OF PAYMENT AND FINAL PAYMENT

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

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

ARTICLE 33 - PAYMENTS WITHHELD

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

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

ARTICLE 34 - MINIMUM INSURANCE REQUIREMENTS

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

a. Worker's Compensation and Employer's Liability

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

b. Public Liability and Property Damage

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

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

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

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

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

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

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

d. Deductible

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

e. Other Insurance

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

f. Proof of Carriage

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

ARTICLE 35 - PERFORMANCE BOND AND PAYMENT BOND

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

ARTICLE 36 - CONTRACTOR'S AFFIDAVIT

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

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

ARTICLE 37 - ASSIGNMENTS

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

ARTICLE 38 - USE OF PREMISES

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

ARTICLE 39 - CUTTING, PATCHING AND DIGGING

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

ARTICLE 40 - UTILITIES, STRUCTURES, SIGNS

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

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

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

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

ARTICLE 41 - CLEANING UP

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

ARTICLE 42 - GUARANTEE

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

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

ARTICLE 43 - CODES AND STANDARDS

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

ARTICLE 44 - INDEMNIFICATION

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

ARTICLE 45 - TAXES

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

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

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

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

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

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

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

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

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

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

ARTICLE 46 - EQUAL OPPORTUNITY CLAUSE

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

ARTICLE 47 - EMPLOYMENT OF INDIVIDUALS WITH DISABILITIES

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

ARTICLE 48 - ASBESTOS-CONTAINING MATERIALS (ACM)

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

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

ARTICLE 49 - MINORITY BUSINESS PARTICIPATION

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

ARTICLE 50 – CONTRACTOR EVALUATION

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

ARTICLE 51 – GIFTS

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

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

ARTICLE 52 – AUDITING-ACCESS TO PERSONS AND RECORDS

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

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

ARTICLE 53 – NORTH CAROLINA FALSE CLAIMS ACT

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

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

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

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

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

ARTICLE 54 – TERMINATION FOR CONVENIENCE

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

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

**SUPPLEMENTARY GENERAL CONDITIONS
OF THE CONTRACT**

STANDARD FORM FOR CONSTRUCTION CONTRACTS

WESTERN CAROLINA UNIVERSITY

SUPPLEMENTARY GENERAL CONDITIONS (SGC's) OF THE CONTRACT

This document supplements but does not alter in any way the requirements of the General Conditions of the Contract.

1. **DEFINITIONS**

As defined in Article 1 of the General Conditions, the Supplementary General Conditions as well as the WCU General Requirements are considered part of the contract documents.

The Owner is the State of North Carolina through Western Carolina University.

Provide shall mean purchase, deliver, install, new, clean, completely operational, fully tested and ready for use.

2. **SCOPE OF WORK**

See attached Technical Specifications and Drawings for scope of work including WCU General Requirements.

3. **ALTERNATES**

See Section 012300, "Alternates" for listing.

4. **SHOP DRAWINGS, SUBMITTALS, SAMPLES, DATA**

The submittal requirements are described in Article 5 of the General Conditions. Items for which submittals are required are listed below:

Pre-Submittals:

- The contractor shall provide the Owner a complete list of contact information for the Contractor, his key personnel, and all Subcontractors. This list shall be provided to the Owner prior to beginning the Work and shall be updated regularly with the updated provided to the Owner.
- All items referenced in Technical Specifications

Post-Submittals:

- All previously submitted documents revised to show as-built condition.
- O&M Manuals for any equipment requiring a submittal.

Data on the following items shall be sent to the Designer for review and approval. The submittal process is described in Article 5 of the General Terms and Conditions. Refer to "Technical Specifications" for required submittals. All Pre-Submittals shall be delivered to the Designer and Owner no later than the Preconstruction Meeting. All Post Submittals shall be delivered to the

Designer and Owner within thirty (30) days of work completion. The final pay request shall be included with Post-Submittals.

5. WORKING DRAWINGS AND SPECIFICATIONS AT THE JOB SITE

The Contractor shall maintain at the job site a readable set of the complete set of working drawings and specifications for his work, including all shop drawings. The Contractor shall maintain at the job site an up-to-date, readable set of the As-Built drawings.

6. MATERIALS, EQUIPMENT, EMPLOYEES

Should an accident or disruption occur on the project work site, the Contractor shall notify the WCU Project Manager and WCU Safety and Risk Management Office as soon as possible and no less than 24 hours of occurrence.

7. PERMITS, INSPECTIONS, FEES, REGULATIONS

The Contractor shall request and obtain permission from the WCU Project Manager for an interruption of utility or services a minimum of seven (7) days in advance. Failure of the Contractor to obtain Owner permission shall not be grounds for an extension of time.

Prior to performing any "hot work" or any work above ceiling in existing buildings, the Contractor shall obtain a permit for such from the WCU Safety and Risk Management Office.

The Contractor shall comply with Owner's Interim Life Safety Plan requirements to maintain egress from all occupied buildings.

8. CONSTRUCTION SUPERVISION and SCHEDULE

The Contractor shall start work within two (2) weeks upon receipt of Notice to Proceed. The Contractor shall submit a project work schedule before beginning work. The starting date and work schedule shall be adhered to, and the work shall be performed during the Owner's normal working hours, 8:00 AM to 5:00 PM. Requests by the Contractor to work outside normal working hours shall be made a minimum of one (1) week in advance to the WCU Project Manager on site. The Contractor's bid shall include all costs associated with workers working outside of normal business hours and/or costs associated with workers working overtime as required to meet the specified project schedule. The Owner reserves the right to request work to be performed outside normal working hours and to limit Contractor activities when they conflict with Owner operations. Any increased costs due to Owner requirements for work outside normal hours not specified in the Contract Documents will be negotiated.

The Contractor shall maintain a daily field report including, but not limited to, listing of all personnel on site (including all Subcontractors), weather conditions, major scopes of work under construction, material deliveries, safety incidents, progress photographs, and inspections.

9. SUBCONTRACTS and SUBCONTRACTORS

- All Subcontractors shall be identified in writing and approved by the Owner prior to the start of work
10. **TIME OF COMPLETION, DELAYS, EXTENSION OF TIME, LIQUIDATED DAMAGES**

The Contractor shall commence work to be performed under this Contract on the date to be specified in the Notice to Proceed from the Contract Administrator and shall fully complete all work hereunder within 180 consecutive calendar days from the date specified in the Notice to Proceed. The following are the critical dates for the project: Anticipated Notice to Proceed: _____ Site available for Work: _____; Construction Completion: _____. No increase in contract time will be allotted for the addition of Bid Alternate work.

If the Contractor should fail to complete the work within the time specified (including approved Change Orders) and this failure directly prevents the Owner from utilizing and/or occupying the building premises or results in other direct costs to the Owner, Liquidated Damages in the amount of \$500.00 (Five-Hundred Dollars) per consecutive calendar day will be assessed for each day the schedule of the Work exceeds the contractual duration set forth in the contract or therefore extended by approved change order. Other reduction/restrictions to work hours, site use, and other construction general conditions may occur if the contract time extends beyond the contract time specified (including approved Change Orders).

If the Contractor is delayed at any time in the progress of the Contractor's work by any act or negligence of the Owner, the Owner's employees or the Owner's separate Contractor; by changes ordered in the work; by abnormal weather conditions; by any causes beyond the Contractor's control; or by other causes deemed justifiable by Owner, then the contract time may be reasonably extended in a written order from the Owner upon written request from the Contractor within ten (10) days following the cause for delay.

Non-compensable weather delays affecting the critical path shall be tracked during the period leading up to the building being dried-in, and calculated and awarded via Change Order if warranted, at the end of the construction period.

11. **USE OF PREMISES**

Work under this contract shall be performed in such a manner as to avoid interruption or interference with the operation of any existing activity on the premises or at the location of the work. The Owner may enforce extra restrictions during certain periods of the year. During examination periods, the Contractor shall restrict noise-making activities. If the project involves work in or near a building in which an exam is being conducted, the Contractor shall be required to restrict operations which are disturbing to students during the hours of the exam(s). Work will not be permitted on Graduation Day, or the day preceding it.

While on campus, Contractor's and Sub-Contractor's personnel shall be identifiable at all times, for example, by wearing company names or logos on garments or hard hats.

Damage done to the University premises that are under the control of the Contractor, or damage caused by the contractor to premises used by the contractor, shall be corrected at the Contractor's expense.

The contractor shall schedule deliveries between 7:00 am and 4:00 pm. The contractor shall have adequate personnel and any necessary equipment onsite to receive deliveries. The contractor shall notify the WCU Project Manager of any deliveries of equipment, material or road work that will impede the flow of vehicular or pedestrian traffic. The contractor shall provide traffic control by certified traffic control personnel (vehicular and pedestrian) during these deliveries. Staging for multiple concrete / steel / other large material deliveries, crane and other large pieces of equipment

must be coordinated with the WCU Project Manager. Walks, streets, and drives are most congested with pedestrians at the top of the hour, when making deliveries the carrier should be made aware of this and plan his deliveries accordingly.

A minimum five working days' notice must be given to the WCU Project Manager to block parking spaces, drives, roads, streets and pedestrian walks.

Roads, streets, drives, fire lanes must remain open at all times. Adequate clearance must be maintained for emergency vehicles to negotiate the drive. Maintain a minimum of 20 feet for fire lanes. Construction vehicles are not allowed to block, park, or stage in a fire lanes. Vehicles blocking fire lanes will be ticketed and towed at the Contractor's expense.

Construction fences should be covered with fabric screening unless it blocks the view of oncoming traffic. Construction gates will swing into the construction area. The construction fences shall not obstruct pedestrian or vehicle traffic unless alternate ways were designed in the site drawings and approved by the WCU Project Manager.

The Contractor will provide additional cleanup, warning signs, and barricades if deemed necessary by the Owner.

The Contractor's scheduling and staging requirements must be coordinated with, and approved by, the WCU Project Manager.

Contractors working for the University are required to comply with Western Carolina University's policies, which are provided herein and hereby incorporated and made a part of this contract.

- Smoking and Vaping Policies
<https://www.wcu.edu/discover/leadership/office-of-the-chancellor/legal-counsel-office/university-policies/numerical-index/university-policy-45.aspx>
- Alcoholic Beverages
<https://www.wcu.edu/discover/leadership/office-of-the-chancellor/legal-counsel-office/university-policies/numerical-index/university-policy-81.aspx>
- Weapons on Campus
<https://www.wcu.edu/discover/leadership/office-of-the-chancellor/legal-counsel-office/university-policies/numerical-index/university-policy-91.aspx>
- Campus/Workplace Violence Prevention and Management
<https://www.wcu.edu/discover/leadership/office-of-the-chancellor/legal-counsel-office/university-policies/numerical-index/university-policy-109.aspx>
- Title IX Sexual Harassment Policy
<https://www.wcu.edu/discover/leadership/office-of-the-chancellor/legal-counsel-office/university-policies/numerical-index/university-policy-129.aspx>

12. UTILITIES, STRUCTURES, SIGNS

The Owner will provide water and electricity to the extent they are available at the project site. The Contractor shall be responsible for making connections to provided utilities.

The Contractor shall provide restroom facilities. The Contractor's personnel shall not use toilet or washroom facilities in the existing building.

The Contractor shall be responsible for procedures to make temporary disruptions to existing utilities serving the building(s) as well as disruptions to roads and pedestrian walks and any disruptions shall be planned well in advance of the work. The work shall be executed in a manner to provide reasonably continuous service throughout the construction period. Any and all disruptions and interruptions of service shall be coordinated with the WCU Project Manager a minimum of seven (7) days in advance. Failure of the Contractor to obtain Owner permission shall not be grounds for an extension of time.

13. **SECURITY**

The Contractor and Subcontractors shall be responsible for security to their equipment and the site-stored materials under their jurisdiction, whether paid for by the Owner or not, until acceptance of the project. The Contractor shall coordinate security requirements with the WCU Project Manager.

010000 OWNER REQUIREMENTS

for Western Carolina University Construction Projects

Items noted below are part of the Contract Documents

1. Project Identification:

All correspondence, reports, schedules, applications of payment, fax documents, etc., must contain proper name of project, code and item number, and ID number if applicable.

2. Project Schedule:

Provide graphic chart from beginning to end of construction.

A. Schedule line items must directly relate to Pay Application line items.

B. Each line item must include 2 lines:

a. Planned Schedule through contract completion

b. Actual work completed, adjacent to Planned Schedule in contrasting color or gray tone.

C. Note current completion percentage for each line item.

3. Pay Applications:

Submit only two (2) signed and designer approved copies to WCU Project Manager.

A. Sales Tax Forms:

Submit with each Pay Application Invoices are not required, with the exception of invoices for stored materials.

B. MBE/HUB Forms:

MBE payment documentation is required with each pay application in order for payment to be processed.

4. Change Orders:

Submittals should pay particular attention to 3 issues:

A. Correct Project Title as given by SCO.

B. Correct math.

C. Complete backup info for all Change Order items with detailed cost breakdown including materials, labor, or unit cost, Subcontractor and Contractor overhead and profit.

D. Cost will be rounded to the nearest whole dollar.

5. Project Coordination:

General coordination will occur during design process, but during construction, date specific coordination by Contractor[s] may be required with WCU University Police, IT Services, and WCU phone system, Facilities Management [FM] for steamline work, domestic water, stormwater and electrical service. All of this coordination will be through FM Project Manager.

6. Work or Equipment by Owner:

Construction Documents must identify which work or equipment will be provided by Owner for Contractor installation or provided and installed by Owner. Utility connection coordination is Contractor's responsibility. State of North Carolina procurement system may require equivalent equipment bidding, so exact model and corresponding exact utility connection dimensions may not be known until later into project. Contractor is responsible for adequate notification to Owner for scheduled installation of Owner supplied work or equipment. This is not

limited to installation date, but includes lead time required for ordering and delivery. Project Specifications must include "Work by Owner" or "Equipment by Owner" in Supplemental Conditions portion, even if to say "there is no work by Owner in this project" if there is none.

7. Campus Environment:

A. Student, Faculty and Staff Contacts:

Contractors and Contractor's personnel, Subcontractors and Subcontractor's personnel, material delivery personnel are on campus to perform contract work. Contact with students, faculty, staff or University visitors is not permitted. In these litigious times, "contact is defined as verbal, offensive gestures, discriminatory signs or clothes." Project personnel are expected to behave properly on campus. Indecent behavior, language or non-verbal communication will not be tolerated. Refer to University Policies issued by the Chancellor's office:

www.wcu.edu/chancellor/index/universitypolicy/policy53.html

For the purposes of Policy #53, Contractor's, Subcontractor's and material delivery personnel are considered to be "employees" during their time on campus performing construction related activities. Contractors, Subcontractors and material supply companies must agree to remove personnel or groups who violate this Policy.

B. Radios, personal electronic music devices:

For Safety purposes, portable or vehicular radios and electronic music devices are not permitted to be played while on campus.

C. University Facilities:

University Food Service facilities exist for the use of WCU students, faculty and staff. Contractors must either bring their own food to jobsite or use community food service establishments.

D. WCU buildings are tobacco free. This includes smoke or chew tobacco forms. No smoking within 50 feet of building perimeter.

E. It is illegal for any person to bring firearms, any type of alcoholic beverage, or drugs other than prescription pharmaceuticals onto campus property.

F. Working Hours: Work hours 7:00 am – 7:00 pm Coordinate work outside those hours with WCU Project Manager. Emergency repair work can be performed at any hour, by coordinating with WCU Project Manager.

8. Protection of existing materials:

All existing materials to remain must be adequately protected throughout construction period. If damage occurs, the Contractor shall repair damage to original condition to the Owner's satisfaction or replace damaged materials.

9. Transportation:

A. Parking

i. Contractor may park limited number of vehicles within construction fence. This is typically limited to one (1) truck per Subcontractor.

ii. Parking for additional personnel is to be coordinated with WCU Project Manager. Contractor's personnel who park outside construction fence in student, faculty or staff parking areas will be subject to fines and or towing.

B. Deliveries:

i. Contractors are responsible for insuring that material deliveries arrive safely at jobsite. At a minimum Supplier transportation drivers should know the name of Contractor, name of Project and driving directions. It is astounding the number of jobsite deliveries where this basic

information is unknown by drivers. Contractor representatives are to be available to receive deliveries. **WCU will not receive deliveries on behalf of the contractor. Contractor deliveries to WCU Warehouse will be rejected.**

C. Speed Limit:

i. Note that campus wide speed limit is 20 miles per hour or per displayed speed limit. Construction personnel must obey speed limit. Crosswalks throughout campus establish areas where pedestrians have right-of-way. Vehicular traffic must yield at cross-walks. This includes students, faculty and staff when contractor's personnel are using cross-walks. Keep in mind that pedestrians occasionally are distracted and may not be attentive to task at hand, i.e. driving. Exercise caution.

D. Parking Permits:

- i. Parking permits can be obtained from the Office of Facilities Management.
- ii. Parking permits not required for company vehicles parked within fenced staging area (are required if ever parked outside of staging area).

10. Material Storage:

A. Construction fencing is required for most projects to protect WCU students, faculty and staff from injury and personal property from damage. Comply with all OSHA rules and regulations. No signage is permitted on fence unless approved by WCU.

B. Jobsite storage within project Construction Fence: Coordinate "lay down" material storage area required within construction fence with Designer and WCU PM. When project is complete and materials removed, repair any damage to asphalt or striping.

C. Remote Storage Trailer Storage:

Containerized or enclosed trailer storage that exceeds project fence area must be located at area designated by WCU Project Manager. Trailers must be coordinated with other project trailers and location approved by FM Director of Design and Construction. If miss-located, trailer[s] will be relocated to approved location at Contractor or Subcontractor's expense. No open trailers or flatbed trailers are permitted, unless otherwise authorized.

Each trailer must be identified with two 8" x 8" wood or metal signs painted yellow, 1 mounted on rear door and 1 mounted on side of trailer. Signage lettering must be contrasting color and minimum 1" high. Signage must identify Contractor or Subcontractor, with phone number and Project title. If more than 1 trailer is used, trailers must be numbered on sign. Company logos may be used, but lettering height should not be reduced for larger logo.

D. Remote Palletized Storage:

Note that this staging area is not the equivalent of a "bonded warehouse". Loose stored materials are still the property and responsibility of the Contractor or Subcontractor. Layout of palletized storage area must be approved by FM Director of Design and Construction. Coordinate storage for this project with other WCU projects storage.

- E. Storage Containers are to be removed from campus prior to completion of construction contract. Final Payment will be withheld until container(s) are removed from campus.

11. Utilities:

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

All interruption of campus services for service connections will be coordinated through the WCU Project Manager. Contractor will not interrupt existing services without prior approval from Owner. The Contractor, under the supervision of the Owner, will throw switches, turn valves, etc. WCU requires seven (7) days notice minimum for major utility outages. WCU

requires a forty-eight (48) hour notice minimum in minor outages such as sprinkler, fire alarm, water, etc.

i. Electric power for construction use:

Electricity source at temporary electrical service location. Voltage and amperage meters as required for project. WCU is the Electric Utility Company on campus and a portion of surrounding area. Coordinate with WCU Resale Electric Power.

ii. Water source:

Contractor is responsible to extend water from source to project location[s] where needed.

iii. Permanent steam heat.

B. Utilities paid for by Contractor:

i. Telephone; local land line company: Verizon

ii. Temporary heat required for concrete curing, drywall joint compound, plaster, paint, etc. Exercise caution that heating device matches use and is compatible with surrounding finishes. Prevent excess heat danger of ignition of wood or flammable finishes.

iii. Sanitary facilities:

Small scope projects may allow contractor's personnel to use existing toilet room facilities within existing building[s]. Contractor is responsible for keeping clean and repairs to damage incurred during use. Refer to project Specifications or Preconstruction meeting. For exterior or significant renovations projects, Contractor must provide and maintain Port-A-John type units.

12. Photographic Documentation:

WCU has contracted with Multivista to provide photographic documentation during all phases of construction. The building and site has been completely recorded to document the condition prior to start of construction. Project team members can be permitted to access the Multivista project site. Coordinate with WCU project manager.

13. Site Management:

A. Contractor is responsible for maintaining a safe site. Well organized sites are usually safer sites. Grass must be mowed or trimmed to keep height below 6" maximum length for entire project period. Cutting is Contractor's responsibility within construction fence and 24" outside construction limits. When project is completed and project fence is removed, cut grass height to match adjacent grass height.

B. Storm water runoff cannot adversely affect adjacent areas throughout length of project. Install NCDENR required erosion protection measures before beginning earth moving or trenching operations. NCDENR permits must be secured by designer before start of construction. Erosion control measures must be maintained throughout duration of project until final ground cover is established. If silt fence or hay bails have retained silt materials as a result of rainstorm, contractor must insure that erosion control measures have adequate capacity for next rainstorm.

C. No construction or directional signage is allowed on campus. No project signs are required. WCU Printshop will produce and erect any project banner signage on jobsite. Jobsite trailer may display Contractor's logo sign 4' x 6' maximum size.

14. Construction Debris:

A. Debris must be removed from campus. All debris must be transported off campus to regulated landfill or recycling center. Secure debris in trucks so that material cannot fall or be blown from trucks during transportation through campus.

B. Demolition debris is not to remain on project site. Contractors or Subcontractors must provide their own dumpsters and for periodic emptying. WCU dumpsters shall not be used for any construction debris.

C. Stockpiling of excess material is not permitted. Materials such as topsoil may be stockpiled in an organized manner for later use. If material will not be reused in finished work, it is expected to be removed from the site.

D. Adjacent roadways must be cleaned daily if required to prevent mud or dust from coating existing roadway.

E. In the rare event that another project site can use excess soil material, WCU will transmit corresponding contractor's contact information.

15. Earthwork:

A. Control any air pollution caused by dust and dirt. Comply with governing regulations.

B. Any fill materials shall be free of organic material.

C. Protect existing trees and vegetation to remain against unnecessary cutting, breaking, skinning of roots or bark, smothering trees by stockpiling building materials or soil materials within drip line.

D. Utility Lines:

i. Trenching or any fill materials under utility lines are frequently subjected to subsidence from inadequate compaction. Fully compact any subgrade materials to provide adequate utility line bearing.

ii. Fill lifts depth: 8" maximum depth for fill lifts performed by heavy equipment. 4" maximum depth for hand operated tamper compaction.

iii. Refer to Contract Documents for specific compaction requirements.

iv. No frozen material or frozen subgrade may be used under utility lines.

16. Landscape Bed Prep:

A. Planting Bed depth of 12" required. Organic topsoil, free of roots, stones larger than 1/2", debris and weeds.

17. Building Demolition:

A. Structure:

i. No demolition is to be performed until Contractor has a perfect understanding of existing building structural system. Install any temporary bracing required to prevent movement of existing building elements scheduled to remain.

B. Protection of materials or finishes to remain:

i. Contractor is responsible to provide adequate protection for any material to remain.

C. Dust Protection:

i. Contractor must erect Dust Curtains before beginning demolition work at areas where dust will enter existing spaces or rooms. Curtains must prevent dust from billowing into adjacent spaces. Seal curtains against finishes. Curtains shall be minimum 0.004" [4 mils.] thick sheets. Maintain throughout demolition work. Construction personnel shall not track dust or dirt into any occupied portion of building.

D. Salvage Materials:

i. Contractors must coordinate salvage schedule in advance with WCU Project Manager.

END OF SECTION

SECTION 01 14 00

WORK RESTRICTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 USE OF PREMISES

- A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
 - 1. Limits: Confine constructions operations to areas indicated on Construction Drawings as within the Limits of Disturbance.
 - 2. Owner Occupancy: Allow for Owner occupancy of site.
 - 3. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.3 OCCUPANCY REQUIREMENTS

- A. Full Owner Occupancy: Owner will occupy areas surrounding site and existing 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 Owner's operations.
- B. Contractor shall have restricted use of the existing structure is limited by the Owner's continued occupancy and use of the existing structure as outlined in Section 01 10 00 – "Summary", Article 1.4 WORK SEQUENCE.

- C. Partial Owner Occupancy: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Beneficial Occupancy, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
1. The engineer will prepare a Certificate of Beneficial Occupancy for each specific portion of the Work to be occupied before Owner occupancy.
 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
 3. Before Beneficial Occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will provide, operate, and maintain mechanical and electrical systems serving occupied portions of building.
 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 22 00

UNIT PRICES

012200.1 SCOPE

This section covers the method of measurement and payment for items of work included in the lump sum bid as well as work that is outside of the lump sum price. The work items that will be considered outside the lump sum bid price shall include changes from the bid set due to the permitting process, owner requests, additions/deletions by governing officials onsite, and by Engineer due to adverse field conditions.

012200.2 GENERAL

The total lump sum price of the contract shall cover all work required by the Contract Documents. All costs in connection with the proper and successful completion of the work including furnishing all materials, equipment, supplies and appurtenances; providing all construction, equipment and tools; and performing all necessary labor and supervision to fully complete the work, shall be included in the lump sum bid. All work not specifically set forth as a pay item in the Bid shall be considered a subsidiary obligation of the contractor and all costs in connection therewith shall be considered a subsidiary obligation of the Contractor and all costs in connection therewith shall be included in the bid.

012200.3 ESTIMATED QUANTITIES

All estimated quantities stipulated in the Bid or other Contract Documents are approximate and are to be used only (a) as a basis for estimating the probable cost of the work and (b) for the purpose of comparing bids submitted for the work. No guarantee is expressed or implied that the quantities shown in the Bid shall be required to fulfill the contract. The basis of payment for work and materials shall be the percentage complete of the lump sum contract. The contractor agrees that he will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts thereof.

012200.4 WORK ITEMS OUTSIDE OF THE LUMP SUM SCOPE

The following describes the method of measurement and payment for the bid items that fall outside work covered on the Bid. The Engineer prior to performance of work must approve work items outside the scope of the lump sum bid and their quantities. Work items completed outside of the scope of work prior to Engineer approval will be deemed a subsidiary obligation of the contract, and therefore compensation will not be given for any work not pre-approved.

012200.5 ADDITIONAL WORK AS DIRECTED AND APPROVED BY ENGINEER

UNDERCUT UNSUITABLE MATERIAL, REMOVE OFFSITE, BACKFILL WITH STONE

The quantity of “undercut unsuitable material, remove offsite, backfill with stone” To be paid for will be by cubic yard measured in place by the average end area method, based on measurements made prior to and following excavation. The quantity measured will be paid for at the Contract price for “undercut unsuitable material, remove offsite, backfill with stone” Work associated with this line item shall consist of the removal and disposal of unsuitable materials and providing and placement of stone to replace the unsuitable material removed, as determined by the Engineer. The unit price bid per cubic yard of “undercut unsuitable material, remove offsite, backfill with stone” installed in place shall include all costs for excavation disposal, and providing the stone backfill including all installation, excavation and hauling costs as well as all cost for the disposal of unsuitable material.

UNDERCUT UNSUITABLE MATERIAL, REMOVE OFFSITE, BACKFILL WITH COMPACTED SOIL

The quantity of “undercut unsuitable material, remove offsite, backfill with compacted soil” to be paid for will be by cubic yard measured in place by the average end area method, based on measurements made prior to and following excavation. The quantity measured will be paid for at the Contract price for “undercut unsuitable material, remove offsite, backfill with compacted soil” Work associated with this line item shall consist of the removal and disposal of unsuitable materials and providing and placement of compacted soil fill to replace the unsuitable material removed, as determined by the Engineer. The unit price bid per cubic yard of “undercut unsuitable material, remove offsite, backfill with compacted soil” installed in place shall include all costs for excavation disposal, and providing the stone backfill including all installation, excavation and hauling costs as well as all cost for the disposal of unsuitable material.

WASHED STONE

Work associated with this line item shall consist of providing Washed stone for additional backfill, or permanent dewatering as determined by the engineer. The unit price bid shall include all excavation, and material cost. Washed stone used for PVC or HDPE pipe bedding per the plans will not be paid for under this item, as it shall be included in the lump sum price for the project.

Washed stone shall be paid for at the unit bid price for the total number tons used as backfill, and/or permanent means of dewatering. The contractor shall provide the engineer haul tickets for each load of Washed stone utilized on the project.

CABC STONE

Work associated with this line item shall consist of providing CABC stone for additional backfill, or permanent dewatering as determined by the engineer. The unit price bid shall include all excavation, and material cost. CABC stone used for PVC or HDPE pipe bedding per the plans will not be paid for under this item, as it shall be included in the lump sum price for the project.

CABC stone shall be paid for at the unit bid price for the total number tons used as backfill, and/or permanent means of dewatering. The contractor shall provide the engineer haul tickets for each load of CABC stone utilized on the project.

CLASS II RIP RAP

This item of work shall include furnishing and installing Class II rip rap as shown on the drawings. The unit price shall include the stone, non woven filter fabric and placement according to the plan detail.

Payment for rip rap will be by the actual number of tons of Class II rip rap properly installed. The Contractor shall furnish certified weight tickets of materials

MIRAFI HP 370

The quantity of “Mirafi HP 370” to be paid for will be by the square yard measured in place. The quantity measured will be paid for at the Contract price under “Mirafi HP 370”. Work associated with this line item shall consist of the complete installation of this woven geotextile fabric in accordance with the manufacturer’s recommendation. The areas for installation of this fabric will be determined by the Engineer.

END OF SECTION

SECTION 01 23 00

ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 PROCEDURES

- A. Alternates will be reviewed and accepted at Owner's option. Owner-Contractor Agreement will identify accepted alternates.
- B. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
- C. Execute accepted alternates under the same conditions as other Work of the Contract.
- D. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Proposed Football Fields to be sodded.
- B. Alternate No. 2: Restroom Building with Relevant site work.
 - 1. Refer to C202, Architectural, M001, M101, M201, P001 and P101
- C. Alternate No. 3: Installation of Wi-Fi conduits excluding cabling.
 - 1. Refer to E305.

END OF SECTION

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1: GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Engineer at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Engineer.
 - c. Engineer's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Submit draft of EJCDC Document No. C-620.

3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Change Orders (numbers) that affect value.
 - c. Dollar value:
 - 1) The percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of 1 percent of the Contract Sum.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing.
7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.
 1. Initial Application for Payment, and final Application for Payment involve additional requirements.
 2. Contractors must include a waste management report with each application for payment.

- B. Payment Application Times: Submit Application for Payment to Engineer by the 25th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month. Provide a "pencil copy" to the Engineer no later than the 23rd of the month.
- C. Application for Payment Forms: EJCDC Document No. C-620 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on the form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts of Change Orders and Construction Change Directives issued before the last day of construction period covered by application.
 - 3. Transmittal: Submit 2 signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt. Include copies of minority business participation forms and sales tax certificates. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- E. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. Contractor's construction schedule (preliminary if not final).
 - 4. Submittal schedule (preliminary if not final).
 - 5. List of Contractor's staff assignments.
 - 6. List of Contractor's principal consultants.
 - 7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 8. Initial progress report.
- F. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Evidence of completion of Project closeout requirements.
 - 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 - 3. Updated final statement, accounting for final changes to the Contract Sum.
 - 4. EJCDC Document C-620, "Contractor's Affidavit of Payment of Debts and Claims."
 - 5. EJCDC Document C-620, "Contractor's Affidavit of Release of Liens."
 - 6. EJCDC Document C-620, "Consent of Surety to Final Payment."

7. Evidence that claims have been settled – Lien Waiver.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Preliminary Final Inspection or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

PART 2- PRODUCTS (Not Used)

PART 3- EXECUTION (Not Used)

END OF SECTION

SECTION 01 31 00 PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination drawings.
 - 2. Administrative and supervisory personnel
 - 3. Project meetings
 - 4. Request for Interpretation (RFIs)
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

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

1.4 COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
 - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 1. Salvage materials and equipment involved in the performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 SUBMITTALS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of Engineering, structural, civil, mechanical, and electrical systems.
 - b. Indicate required installation sequences.
 - c. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
 2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 42 inches.
 3. Number of Copies: Submit two opaque copies of each submittal. Engineer will return 1 copy.
 - a. Submit five copies where Coordination Drawings are required for operation

and maintenance manuals. Engineer will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing.

- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

- 1. Post copies of the list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1.7 REQUESTS FOR INFORMATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.

- 1. RFIs shall originate with Contractor. Engineer will return RFIs submitted to Engineer by other entities controlled by Contractor with no response.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:

- 1. Project name.
 - 2. Date.
 - 3. Name of Contractor.
 - 4. Name of Engineer
 - 5. RFI number, numbered sequentially.
 - 6. Specification Section number and title and related paragraphs, as appropriate.
 - 7. Drawing number and detail references, as appropriate.
 - 8. Field dimensions and conditions, as appropriate.
 - 9. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 10. Contractor's signature.
 - 11. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials,

assemblies, and attachments.

- C. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
 - 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow 5 working days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
 - 1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Engineer's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 - 2. Engineer's action may include a request for additional information, in which case Engineer's time for response will start again.
 - 3. Engineer's action on RFIs that may result in a change to the Contract Time, or the Contract Sum may be eligible for Contractor to submit Change Proposal.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Use software log with not less than the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Engineer.
 - 4. RFI number including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Engineer's response was received.
- F. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of the date and time of each meeting. Notify Owner and Contractor of scheduled meeting dates and times.
 2. Agenda: Engineer will prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Engineer will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, and Contractor, within three days of the meeting.
- B. Preconstruction Conference: The Engineer will schedule a preconstruction conference before starting construction, at a time convenient to Owner and Contractor.
1. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Schedule of values
 - c. List of subcontractors and suppliers
 - d. Weather days
 - e. Liquidated Damages
 - f. General and Supplemental Conditions of the Contract
 - g. Monthly Meetings
 - h. Change Orders
 - i. Payment Procedures
 - j. Decorum on the construction site
 - k. Restroom facilities
 - l. Parking facilities
 - m. Working hours
 - n. Owner requirements
 - o. Preliminary and Final inspections
 - p. Record Drawings
 - q. Safety Regulations
 - r. Minority Business Contractors
 - s. SCO Requirements
 - t. Permits and Inspections
 - u. Temporary Power
 - v. Tax forms
 2. Minutes: Engineer will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at the Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Engineer of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Related RFIs.
 - c. Related Change Orders.
 - d. Purchases.
 - e. Deliveries.
 - f. Submittals.
 - g. Review of mockups.
 - h. Possible conflicts.
 - i. Compatibility requirements.
 - j. Time schedules.
 - k. Weather limitations.
 - l. Manufacturer's written instructions.
 - m. Warranty requirements.
 - n. Compatibility of materials.
 - o. Acceptability of substrates.
 - p. Temporary facilities and controls.
 - q. Space and access limitations.
 - r. Testing and inspecting requirements.
 - s. Installation procedures.
 - t. Coordination with other work.
 - u. Required performance results.
 - v. Protection of adjacent work.
 - w. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to the performance of the Work and reconvene the conference at the earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at bi-weekly intervals with Owner and monthly intervals with Owner and Engineer.

1. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Progress cleaning.
 - 9) Quality and work standards.
 - 10) Status of correction of deficient items.
 - 11) Field observations.
 - 12) Status of RFIs.
 - 13) Status of proposal requests.
 - 14) Pending changes.
 - 15) Status of Change Orders.
 - 16) Pending claims and disputes.
 - 17) Documentation of information for payment requests.
3. Minutes: Contractor will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

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PART 2 PRODUCTS (Not Used)

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer responsive action.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

- A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Engineer for Contractor's use in preparing submittals.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Engineers reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 5 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 5 working days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Engineer consultants, Owner, or other parties is indicated, allow 5 working days for initial review of each submittal.
- E. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Engineer.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Other necessary identification.
- F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- G. Additional Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
1. Submit one copy of the submittal to concurrent reviewer in addition to specified number of copies to Engineer.
 2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineers will return

submittals, without review, received from sources other than Contractor.

1. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractors, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Specification Section number and title.
 - i. Drawing number and detail references, as appropriate.
 - j. Transmittal number numbered consecutively.
 - k. Submittal and transmittal distribution record.
 - l. Remarks.
 - m. Signature of transmitter.
 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.
- I. Resubmittals: Make resubmittals in the same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked "Approved or approved as noted."
- J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- K. Use for Construction: Use only final submittals with mark indicating "Approved or approved as noted" taken by Engineer.

1.5 CONTRACTOR'S USE OF ENGINEER CAD FILES

- A. General: At Contractor's written request, copies of Engineer CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
1. Release of liability associated with the utilization of the files and submission of Engineer form for release.
 2. Payment for administrative time associated with production of the files at \$50/sheet.

3. Utilization of the files in the format provided by the Engineer without conversion to multiple file types. File type provided will be .dwg, AutoCAD version 2006 or later.
4. No adjustments for layering or formatting.
5. The availability of Engineer consultant's files is limited and subject to their individual company policy.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
 1. Submit electronic submittals directly to an Engineer by email.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Standard product operation and maintenance manuals.
 - h. Compliance with specified referenced standards.
 - i. Testing by recognized testing agency.
 - j. Application of testing agency labels and seals.
 - k. Notation of coordination requirements.
 - l. Product Cleaning Instructions
 4. Submit Product Data before or concurrent with Samples.
 5. Number of Copies: Submit three copies of Product Data, unless otherwise indicated. Engineer will return two copies. Mark up and retain one returned copy as a Project Record Document.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.
 - m. Relationship to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer if specified.
 - o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.
 3. Number of Copies: Submit three opaque copies of each submittal, unless copies are required for operation and maintenance manuals. Submit five copies where copies are required for operation and maintenance manuals. Engineer will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality- control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 4. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 5. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.
 7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured, and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - 1) Number of Samples: Submit three sets of Samples. Engineer will retain one Sample set; remainder will be returned.
 - 2) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 3) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product.
 2. Number and name of room or space.
 3. Location within room or space.
 4. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. Engineer will return two copies.
 - a. Mark up and retain one returned copy as a Project Record Document.
- F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation" for Construction Manager's action.

- G. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- H. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- J. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
 - 4. Number of Copies: Submit three copies of the subcontractor list, unless otherwise indicated. Engineer will return two copies.
 - a. Mark up and retain one returned copy as a Project Record Document.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Engineer will not return copies.
 - 2. Certificates and Certifications: Provide a notarized statement that includes the signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - 3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates the capabilities and experience of a firm or person. Include lists of completed projects with project names and addresses, names, and addresses of Engineers and owners, and other information specified.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- M. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- N. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- O. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during

installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

- R. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- S. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
 - 1. Preparation of substrates.
 - 2. Required substrate tolerances.
 - 3. Sequence of installation or erection.
 - 4. Required installation tolerances.
 - 5. Required adjustments.
 - 6. Recommendations for cleaning and protection.
- T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement whether conditions, products, and installation will affect warranty.
 - 7. Other required items indicated in individual Specification Sections.
- U. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit it to Engineer.
 - 1. Engineer will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

2.3 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If the criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to the Engineer.
 - 2. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and

other required submittals, submit three copies of a statement, signed, and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

3. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Shop drawings received by the Engineer that do not bear the Contractor's stamp of approval will be immediately returned to the Contractor without review by the Engineer. Delay caused by shop drawings being returned because of incomplete or inaccurate information or for lack of Contractor's approval stamp will not be grounds for an extension of time.

3.2 ENGINEER ACTION

- A. General: Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
- C. Informational Submittals: Engineer will review each submittal and will not return it or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION

SECTION 01 51 00

TEMPORARY UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Temporary utilities and services, including:
 - 1. Heating and cooling during construction
 - 2. Ventilation during construction
 - 3. Temporary water service
 - 4. Temporary sanitary facilities
 - 5. Temporary power and lighting
 - 6. Construction telephone service.
 - 7. Contractor metering and payment of Electrical and Water service usage
- B. Removal of temporary utilities.

1.3 RELATED SECTIONS

- A. Section 01 11 00 - Summary of the Work: Contractor's use of site and premises.
- B. Section 01 33 00 – Submittal Procedures

1.4 SUBMITTALS

- A. Temporary Utilities: Submit reports of tests, inspections, applicable meter readings and similar procedures performed on temporary utilities.

1.5 TEMPORARY UTILITIES AND SERVICES

- A. Temporary Utilities and Services, General: All utilities and other services necessary for proper performance of the Work shall be provided by Contractor, unless specifically noted “Work by Owner” or “Equipment by Owner”. Refer to Contract General Conditions, Article 4.11. Temporary utilities and services shall conform to all applicable requirements of

authorities having jurisdiction and serving utility companies and agencies, including the following:

1. Requirements of authorities having jurisdiction, including:
 - a. NC OSHA
 - b. North Carolina Building Code requirements
 - c. Health and safety regulations
 - d. Utility agency and company regulations
 - e. Police, Fire Department and Rescue Squad rules
 - f. Environmental protection regulations
 2. Standards:
 - a. NFPA Document 241 - Building Construction and Demolition Activities.
 - b. ANSI A10 Series - Safety Requirements for Construction and Demolition.
 - c. NECA Electrical Design Library - Temporary Electrical Facilities.
 - d. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service in compliance with North Carolina Electrical Code.
 - e. Piped or Plumbed systems – Install service in accordance with North Carolina Plumbing Code.
- B. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.
- C. Temporary Connections and Fees: Contractor shall arrange for services and pay all fees and service charges for temporary power, water, sewer, gas and other utility services necessary for the Work.
1. Contractor shall apply for and obtain permits for temporary utilities, including permits for temporary generators, from authorities having jurisdiction.
 2. All costs for temporary connections, including fees charged by serving utilities, shall be included in Contract Sum.
- D. Permanent Connections and Fees: Contractor shall arrange for utility agencies and companies to make permanent connections. University will arrange for permanent utility account and pay permanent connection fees. After Contract Completion review and determination that Work is acceptable, University will pay utility service charges for services delivered through permanent connections, for normal quantities.
- E. Use of Temporary Utilities: Enforce strict discipline in use of temporary utilities to conserve on consumption. Limit use of temporary utilities to essential and intended uses to minimize waste and abuse.

1.6 PROJECT CONDITIONS

- A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous,

dangerous, or unsanitary conditions, or public nuisances to develop or persist on the site.

1.7 HEATING AND COOLING

- A. Temporary Heating and Cooling: Provide and pay for temporary heating and cooling devices, fuel and related service charges to provide ambient temperatures as required to maintain conditions necessary for proper performance of construction activities.
- B. Use of Permanent Heating and Cooling Systems: Permanent heating and cooling equipment may be used after completion, testing and inspection of systems and approval of code authorities having jurisdiction.
 - 1. Prior to operation of permanent heating equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place.
 - 2. Contractor shall provide and pay for operation, maintenance and regular replacement of filters and worn or consumed parts.
 - 3. Immediately prior to Contract Completion review, change disposable filters and clean permanent filters of equipment used during construction.
- C. Temperature Criteria: Maintain interior ambient temperature of minimum 50 degrees F and maximum 80 degrees F, unless otherwise specified or approved by University's Representative.

1.8 VENTILATION DURING CONSTRUCTION

- A. Ventilation During Construction: Provide and pay for temporary ventilation devices, energy and related service charges.
- B. Use of Permanent Ventilation Systems: The Contractor may use permanent ventilation equipment after completion, testing and inspection of systems and approval by University's Representative and authorities having jurisdiction.
 - 1. Prior to operation of permanent ventilation equipment for ventilation purposes during construction, Contractor shall verify that equipment is lubricated and filters are in place.
 - 2. Contractor shall provide and pay for maintenance and regular replacement of filters and worn or consumed parts of permanent ventilation system using for ventilation during construction.
 - 3. Immediately prior to Contract Completion review, Contractor shall change disposable filters and clean permanent filters of equipment used during construction.
- C. Ventilation Criteria: Ventilate enclosed areas to assist cure of materials, to dissipate humidity and to prevent accumulation of dust, fumes, vapors and gases, as necessary for proper performance of the Work.

1.9 TEMPORARY WATER SERVICE

- A. Temporary Water Service: Contractor shall locate, with the assistance of the University, and connect to existing water source for temporary construction water service. Contractor shall comply with the following:
 - 1. Locate and connect to existing water source for temporary construction water service, as acceptable to University's Representative.
 - 2. Extend branch piping with outlets located, so that water is available by use of hoses.
 - 3. Temporary water service piping, valves, fittings and meters shall comply with requirements of the serving water utility and California Plumbing Code (CPC).
 - 4. All costs to establish temporary construction water system shall be included in the Contract Sum.
- B. Use of Permanent Water System: Permanent water system may be used for construction water after completion, sterilization, testing and inspection of system and approval by University's Representative and authorities having jurisdiction.

1.10 TEMPORARY SANITARY FACILITIES

- A. Temporary Sanitary Facilities: Provide and maintain adequate temporary sanitary facilities and enclosures for use by construction personnel.
 - 1. Number of temporary toilets shall be suitable for number of workers.
 - 2. Provide wash-up sink with soap, towels and waste disposal.
- B. Use of Permanent Sanitary Facilities: Do not use permanent sanitary facilities unless approved by University's Representative. Immediately prior to Contract Completion review, thoroughly clean and sanitize permanent sanitary facilities used during construction.

1.11 TEMPORARY POWER AND LIGHTING

- A. Temporary Power and Lighting, General: Comply with NECA Electrical Design Library - Temporary Electrical Facilities.
- B. Temporary Power: Provide electric service as required for construction operations, with branch wiring and distribution boxes located to provide electrical service for performance of the Work.
 - 1. Provide temporary electric feeder connected to University operated electric utility service at location determined by the Contractor and as approved by the University electric utility.

2. Temporary power conduit, raceways, fittings, conductors, panels, connections, disconnects, overcurrent protection, outlets and meters shall comply with requirements of the serving electric utility, North Carolina Electrical Code and requirements of authorities having jurisdiction.
 3. Contractor shall pay all costs to establish temporary electric service unless otherwise specified.
 4. As necessary in order to maintain construction progress, Contractor shall provide and pay all costs associated with generators used for temporary power.
- C. Temporary Lighting: Provide temporary lighting as necessary for proper performance of construction activities and for inspection of the Work.
1. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
 2. Maintain lighting and provide routine repairs.
- D. Protection: Provide weatherproof enclosures for power and lighting components as necessary. Provide overcurrent and ground-fault circuit protection, branch wiring and distribution boxes located to allow convenient and safe service about site of the Work. Provide flexible power cords as required.
- E. Use of Permanent Power and Lighting Systems: Permanent power and lighting systems may be used after completion, testing and inspection of systems and approval by University's Representative and authorities having jurisdiction.
1. Contractor shall maintain lighting and make routine repairs and replacements as necessary.
 2. Contractor shall pay for electricity consumed after permanent power system is operational and approved by authorities having jurisdiction.
- F. Service Disruptions: When necessary for energizing and de-energizing temporary electric power systems, minimize disruption of service to those served by public mains. Schedule transfers at times convenient to University and to occupants.
- G. Relamping: For permanent lighting used during construction, relamp all fixtures immediately prior to Contract Completion (punch list) review.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials: Contractor shall provide new materials. If acceptable to the Architect, undamaged previously used materials in serviceable condition may be used. Provide materials that are suitable for the use intended. Their use and methods of installation shall not create unsafe conditions or violate requirements of applicable codes and standards.
- B. Equipment: Contractor shall provide new equipment; or, if acceptable in writing by the Trustees, Contractor may provide undamaged, previously used equipment in serviceable condition. Provide equipment that is suitable for use intended.

PART 3 - EXECUTION

3.1 TEMPORARY UTILITIES INSTALLATION

- A. Temporary Utilities Installation, General: Contractor shall engage the appropriate local utility company or personnel to install temporary service or connect to existing service.
 - 1. Use Charges: Cost or use charges for temporary facilities are the Contractor's responsibility.
 - 2. Allowance for Utilities Charges: When Contract includes an allowance for metering of utility services, whether through temporary or permanent facilities, unused amount shall be returned to the Trustees by deductive change order.
- B. Water Service: Contractor may take water from the University's systems in such quantities and at such times as they are available. If this is done, Contractor shall provide all temporary materials necessary to extending the utility to where they will be used. Contractor shall install a meter and reimburse the University for any water used.
- C. Temporary Electric Power Service: Contractor may take electricity from the University's system if available. If this is done, Contractor shall provide all equipment, including connections, and other materials necessary for extending the utility lines to where they will be used. Contractor shall coordinate the installation with the University's Representative. Contractor shall install a meter and reimburse the University for any power used. Where sub-metering is not possible or practical, a flat fee may be established and paid to the University.
 - 1. When not available from the University, the Contractor must arrange and pay for electric service through the local utility or furnish his own portable power.
 - 2. All permanent power used by the Contractor prior to Occupancy by the Trustees shall be metered and paid for by the Contractor.
- D. Temporary Telephones: Contractor shall have telephone facility available at its business office for the duration of contract where the Contractor and its superintendent may be contacted. A pay phone for use of subcontractors is recommended.
- E. Temporary Fire Protection: Until fire protection needs are supplied by permanent facilities, Contractor shall install and maintain temporary fire protection facilities of the types needed to

protect against reasonably predictable and controllable fire losses. Contractor shall comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations." Contractor shall:

1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
 2. Store combustible materials in containers in fire-safe locations.
 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.
 4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.
- F. Maintenance of Temporary Utilities and Services: Contractor shall maintain temporary utilities and services in good operating condition until removal. Contractor shall protect from utilities and services from environmental and physical damage.

3.2 TERMINATION AND REMOVAL OF TEMPORARY UTILITIES AND SERVICES

- A. Termination and Removal of Temporary Utilities and Services: Unless the Trustees require that it be maintained longer, Contractor shall remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Completion. Contractor shall complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. At Completion, Contractor shall clean and renovate permanent facilities that have been used during the construction period.
- B. Removal of Temporary Underground Utilities and Restoration: Remove temporary underground utility installations to a minimum depth of two-feet below utility services. Contractor shall:
1. Backfill, compact and regrade site as necessary to restore areas or to prepare for indicated paving and landscaping.
 2. Restore paving damaged by temporary utilities. Refer to requirements specified in Section 01732 - Cutting and Patching Requirements.
- C. Cleaning and Repairs: Contractor shall clean exposed surfaces and repair damage caused by installation and use of temporary utilities and services. Where determined by University's Representative that repair of damage is unsatisfactory, Work, Contractor shall replace construction with matching finishes.

END OF SECTION

SECTION 01 52 00

CONSTRUCTION FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Portable Toilet(s)
- B. Removal of construction facilities.

1.3 RELATED SECTIONS

- A. Section 01 11 00 - Summary of the Work: Contractor's use of site and premises.
- B. Section 01 51 00 - Temporary Utilities: Water, power and telephone services to construction facilities.

1.4 MAINTENANCE OF CONSTRUCTION FACILITIES CONTROLS

- A. Maintenance: Contractor shall maintain construction facilities in proper and safe condition throughout the progress of the Work.
- B. Replacement: In the event of loss or damage, Contractor shall promptly restore temporary construction facilities by repair or replacement at no change in the Contract Sum or Contract Time.

1.5 CONTRACTOR'S FIELD OFFICES AND SHEDS

- A. Not applicable to this section.

1.6 UNIVERSITY'S CONSTRUCTION MANAGEMENT FIELD OFFICE

- A. Not applicable to this section.

PART 2 - PRODUCTS

Not applicable to this Section.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONSTRUCTION FACILITIES

- A. Not applicable to this section.

3.2 REMOVAL OF CONSTRUCTION FACILITIES

- A. Removal of Construction Facilities: Unless otherwise mutually agreed by University's Representative and Contractor, remove temporary materials, equipment, services, and construction prior to Contract Completion review.
1. Completely remove in-ground construction facilities upon completion of contract. Backfill, compact, and regrade site as necessary to restore areas or to prepare for indicated paving and landscaping.
- B. Cleaning and Repairs: Clean and repair damage caused by installation or use of temporary construction facilities on public and private rights-of-way.

END OF SECTION

SECTION 01 78 00

CLOSEOUT PROCEDURES

PART ONE: GENERAL

1.1 Summary

- A.** Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Project Record Documents and Samples.
 - 2. Operation and Maintenance Manuals.
 - 3. Instruction of Owner's personnel.
 - 4. Warranties and bonds.
 - 5. Spare parts and overages
 - 6. LEED documentation
- B.** Related Sections
 - 1.1.2.1** Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
 - 1.1.2.2** A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
 - 1.1.2.3** Section 01 77 00 - Closeout Procedures: Contract closeout procedures.
 - 1.1.2.4** Individual Product Sections: Specific requirements for operation and maintenance data.
 - 1.1.2.5** Individual Product Sections: Warranties required for specific products or Work.

1.2 Related Documents

- A.** Construction Documents and general provisions of the Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction and Supplementary Conditions and other Division 01 Specification Sections, applicable to this Section. All methods herein are to follow all applicable state and local code as well as installation standards.
- B.** Comply with the requirements of the various specifications and standards referred to in the contract Plans and Specifications, except where they conflict with the specific requirements of these contract Plans and Specifications. Such reference specifications and standards.

C. Definitions

As-Built Drawings: As-built drawings are developed and maintained by the Contractor and depict actual conditions, including deviations from the Contract Documents. These

deviations and additions may result from coordination required by, but not limited to: contract modifications; official responses to Contractor submitted Requests for Information; direction from the Contracting Officer; designs which are the responsibility of the Contractor, and differing site conditions. Maintain the as-builts throughout construction as red-lined hard copies on site and red-lined PDF files. These files serve as the basis for the creation of the record drawings. Maintaining current as-built drawings is hereby expressly defined as a field and office supervision activity and therefore included in the contractor's overhead and/or fee percentage as defined in the provisions of contract.

D. Submittals

At time of substantial completion, contractor shall furnish physical and digital copies of Record Drawings, Record Specifications, Operation and Maintenance Manuals and Warranties and Bonds as required by Owner. All submitted records and files shall clearly identify the Owner, project name, drawing name, specification section and date.

PART TWO: PRODUCTS (NOT USED)

PART THREE: EXECUTION

3.1 Project Record Documents

- A.** In addition to requirements in General Conditions, maintain on site for Owner one record set of the following documents: record actual revisions to the Work:
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and Construction Change Directives.
 - 5. ASI's and responses to RFI's.
 - 6. Reviewed shop drawings, product data, and samples.
 - 7. Field Test Records
 - 8. Inspection Certificates
 - 9. Manufacturer's instruction for assembly, installation, and adjusting.
- B.** The record documents shall include all disciplines of work whether changes occur or not. These documents, as well as the approved permit set of plans, shall be available to the Architect and Owner at the site and reviewed with them on a monthly basis. Satisfactory maintenance of up-to-date record drawings on a monthly basis will be a requirement for approval of progress payments.
- C.** Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

D. Record Drawings:

Content: Types of items requiring marking include, but are not limited to, the following:

1. Dimensional changes to Contract Drawings.
2. Revisions to details shown on Drawings.
3. Field changes of dimensions and details.
4. Actual equipment locations.
5. Changes made by Addenda.
6. Changes made by Change Order or Construction Change Directive.
7. Changes made following Engineer's written orders, including ASI's and responses to RFI's.
8. Details not on the original Contract Drawings.
9. Field records for variable and concealed conditions.
10. Record information on the Work that is shown only schematically.

Record drawings shall include, as a minimum, the location and performance data on each piece of equipment.

Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.

Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

Mark important additional information that was either shown schematically or omitted from original Drawings.

Mark revisions and/or clarifications issued by Addenda, ASI, Construction Change Directive, Change Orders or responses to RFI's to reflect the change. Each such revision shall be graphically depicted to represent physical construction and clearly noted with the applicable Addenda, ASI, Change Order or RFI number. Notation of the Addenda, RFI, ASI, Construction Change Directive or Change Order number alone will not be acceptable.

Ensure entries are complete and accurate, enabling future reference by Owner.

- E.** Specifications: Legibly mark and record at each product section a description of actual products installed, including the following:
1. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 2. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 3. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals.
 4. Mark revisions and/or clarifications issued by Addenda, ASI, Construction Change Directive, Change Orders or responses to RFI's to reflect the change. Each such revision shall be graphically depicted to represent physical construction and clearly noted with the applicable Addenda, ASI, Change Order or RFI number. Notation of the Addenda, RFI, ASI, Construction Change Directive or Change Order number alone will not be acceptable.
- 3.1.5.6** Maintain one complete copy of the Project Manual, including addenda, and one 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 on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and Product Data.
- F.** Other Documents: Maintain manufacturer's certifications, inspection certifications, field test records, and other documents required by individual Specifications sections.
- G.** At completion of project, transfer all Project Record Data to one complete set of colored electronic document. Deliver one complete set electronic Record Documents to the Architect for the Owner's records.

3.2 Operation and Maintenance Data

- A.** For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B.** Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C.** Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.3 Operation and Maintenance Data for Materials and Finishes

- A. A. For Each Product, Applied Material, and Finish include:
Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
Product data, with catalog number, size, composition, and color and texture designations.
Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- D. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- E. Additional information as specified in individual product specification sections.
- F. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

3.4 Operation and Maintenance Data for Equipment and Systems

- A. For Each Item of Equipment and Each System:
Description of unit or system, and component parts.
Identify function, normal operating characteristics, and limiting conditions.
Include performance curves, with engineering data and tests.
Complete nomenclature and model number of replaceable parts.
- B. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- C. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

- D.** Provide servicing and lubrication schedule, and list of lubricants required.
- E.** Include manufacturer's printed operation and maintenance instructions.
- F.** Include sequence of operation by controls manufacturer.
- G.** Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- H.** Provide control diagrams by controls manufacturer as installed.
- I.** Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- J.** Provide a list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- K.** Include test and balancing reports.
- L.** Additional Requirements: As specified in individual product specification sections.

3.5 Operation and Maintenance Manuals

- A.** A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- B.** Prepare data in the form of an instructional manual.
- C.** Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
 - Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
 - Part 2: Operation and maintenance instructions, arranged by system 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. Operating instructions.
 - 5. Maintenance instructions for equipment and systems.
 - 6. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

Part 3: Project documents and certificates, including the following:

7. Shop drawings and product data.
8. Certificates.
9. Photocopies of warranties and bonds.

- D.** Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.
- E.** Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- F.** PDF Electronic File: After review of draft manuals, assemble each manual into a composite electronically-indexed file.
Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
Enable inserted reviewer comments on draft submittals.
File Names and Bookmarks: Enable bookmarking of individual documents based upon file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree.
Configure electronic manual to display bookmark panel upon opening file.

3.6 Instruction of Owner Personnel

- A.** The Owner and/or Hotel personnel are to provide their own Operations and Maintenance records for any products provided by Owner and/or Hotel furnished products if stipulated as such on contractual agreement.
- B.** Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times. For equipment requiring seasonal operation, perform instructions for other seasons within 6 months.

3.7 Warranties and Bonds

- A.** Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within ten (10) days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Completion is determined.

- B.** Verify that documents are in proper form and contain full information.
- C.** Co-execute submittals when required.
- D.** Retain warranties and bonds until time specified for submittal.
- E.** Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- F.** Schedule of Warranties: Provide a summary schedule of the start and end date of each warranty.
- G.** Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets, as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

3.8 Spare Parts, Overages and Maintenance Materials

- A.** Products Required:
Provide quantities of products, spare parts, maintenance tools, and maintenance materials specified in individual sections or as requested by Owner, in addition to that required for completion of Work.
Products: Identical to those installed in the Work. Include quantities in original purchase from manufacturer to avoid variations in manufacture.
- B.** Storage, Maintenance:
Store products with products to be installed in the Work, under provisions of Section Product Requirements.
When adequate, secure storage facilities are available at site, capable of maintaining conditions required for storage and not required for Contract work or storage, or for Owner's needs, spare products may be stored in available space.
Maintain spare products in original containers with labels intact and legible, until delivery to Owner.
- C.** Delivery:
Coordinate with Owner: Deliver and unload spare products to Owner at AProject site as stipulated in contract agreement. For portions of Project accepted and occupied by Owner prior to Substantial Completion, deliver a proportional part of spare products to Owner.

3.9 LEED Documentation Submittals

- A.** Provide all documentation required by Section Sustainable Design Requirements
– LEED Certification and to LEED online.

END OF SECTION

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22-24232-01A

DIVISION 03

CONCRETE



SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. The scope of this specification section covers the Field House Building Structure only. Refer to Civil concrete specs for concrete work beyond the Field House Building footprint.
- B. Section Includes:
 - 1. Form-facing material for cast-in-place concrete.
 - 2. Shoring, bracing, and anchoring.
- C. Related Requirements:
 - 1. Section 32 13 13 "Concrete Paving" for formwork related to concrete pavement and walks.

1.03 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.04 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Exposed surface form-facing material.
 - 2. Concealed surface form-facing material.
 - 3. Form ties.
 - 4. Form-release agent.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.02 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
 - 1. Provide continuous, true, and smooth concrete surfaces.
 - 2. Furnish in largest practicable sizes to minimize number of joints.
 - 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
 - 1. Provide lumber dressed on at least two edges and one side for tight fit.
 - 2.

2.03 RELATED MATERIALS

- A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - 2. Form release agent for form liners shall be acceptable to form liner manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 - 1. Provide and secure units to support screed strips
 - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 - 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 - 1. Determine sizes and locations from trades providing such items.

2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 3. Place joints perpendicular to main reinforcement.
 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 3. Clean embedded items immediately prior to concrete placement.

3.03 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less

than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
1. Align and secure joints to avoid offsets.
 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.04 FIELD QUALITY CONTROL

- A. Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION

SECTION 03 11 00

CONCRETE FORMWORK

PART 1: GENERAL

1.01 DESCRIPTION OF WORK

Extent of formwork is indicated by the concrete structures shown on the drawings. Work shall include (except as specified elsewhere in the Contract Documents) providing formwork and shoring for all cast-in-place concrete; and installation into the formwork, items furnished by others, such as anchors, plates, inserts, frames, nosings, and any other items embedded in concrete.

1.02 STANDARDS

A. REFERENCES

Some products and execution are specified in this section by reference to published specifications or standards of the following with respective abbreviations used:

1. American Concrete InstituteACI
2. The American Society for Testing and MaterialsASTM
3. U. S. Products Standards.....PS

B. STANDARD SPECIFICATIONS AND CODES

The following Publications of the American Concrete Institute form a part of this Specification:

1. ACI 347-78 "Recommended Practice for Concrete Formwork".
2. ACI 301-72 "Specifications for Structural Concrete".

PART 2: PRODUCTS

2.01 MATERIALS

Materials used for formwork shall be selected by the Contractor, subject to approval by the Engineer. All materials shall be high quality and standard for the industry.

PART 3: EXECUTION

3.01 FORMWORK DESIGN

- A. The Contractor shall be responsible for the design of all concrete formwork. Formwork shall be designed in accordance with ACI 347 unless noted. Design, erect, support, brace and maintain formwork so that it will safely support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by formwork system and in-place construction that has attained adequate strength for that purpose. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation and position.
- B. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressure, stresses, lateral stability, and other factors pertinent to safety of structure during construction. Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof. Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide back-up material at joints as required to prevent leakage and fins.
- C. Formwork for foundation systems may be omitted when workmanship and soil conditions permit accurate excavation and the omission is approved by the Engineer. Provide temporary openings in wall forms, column forms, and other locations necessary to permit inspection and cleanout.
- D. Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be a commercially manufactured type. Non-fabricated wire shall be used. Form ties shall be constructed so that the end fasteners can be removed without causing appreciable spalling at the faces of the concrete. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than two diameters or twice the minimum dimensions of the tie from the formed faces of concrete to be permanently exposed to view except that in no case shall this distance be less than 3/4". When the formed face of the concrete is not to be permanently exposed to view, form ties may be cut off flush with the formed surfaces.
- E. At construction joints, contact surface of the form for sheeting for flush surfaces exposed to view shall overlap the hardened concrete in the previous placement by more than one foot. The forms shall be held against the hardened concrete to

prevent offsets or loss of mortar at the construction joint and to maintain a true surface. Wood forms for wall openings shall be constructed to facilitate loosening, if necessary, to counteract swelling of the forms. Wedges used for final adjustment of the forms prior to concrete placement shall be fastened in position after the final check. Formwork shall be so anchored to shores or other supporting surfaces or members that upward or lateral movement of any parts of the formwork system during concrete placement will be prevented. Runways for moving equipment or pump lines shall be provided with struts or legs and shall be supported directly on the formwork or structural member without resting on the reinforcing steel. When mudsills are to be placed for supporting concrete forms, a reasonably level and sufficiently compacted surface will be required. Shores shall be plumb within acceptable tolerances.

3.02 TOLERANCES

- A. Unless otherwise specified by the Engineer, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits listed in Table 4.3.1 of ACI 301-72.
- B. The Contractor shall establish and maintain in an undisturbed condition and until final completion and acceptance of the project, sufficient control points and bench marks to be used for reference purposes to check tolerances.

3.03 PREPARATION OF FORM SURFACES AND FORM COATINGS

- A. All surfaces of forms and embedded materials shall be cleaned of any accumulated mortar or grout from previous concreting and of all other foreign materials before concrete is placed in the forms. Coat form contact surfaces with form-coating compound before reinforcement is placed. Provide form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion or impede the wetting of surfaces to be cured with water or curing compounds. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.04 REMOVAL OF FORMS

- A. Formwork for columns, walls, sides of beams, and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations provided surfaces are cured and protected from cold weather as specified in other sections of this specification.

Forms and shoring in the formwork used to support the weight of concrete in beams, slabs and other structural members, shall remain in place until the concrete has reached the minimum strength specified of 75% of the specified 28-day

design strength. Strength of concrete must be verified by concrete test cylinders molded and cured in the field under the same conditions that the concrete represented by these cylinders are cured and/or maturity meters connected to thermo-couples embedded in the concrete. It shall be the responsibility of the concrete technician, employed by the Owner, to inform the General Contractor when the strength of concrete cured in the field has attained the minimum specified strength required for removal of the forms.

Bottom forms of slabs shall not be removed in less time than is indicated below unless otherwise approved by the Engineer.

Above 60° F.	50° F.	40° to 50° F.
8 days	10 days	18 days

When temperature is below 40° F., the shores shall remain in place for an additional time equal to the lower temperature.

- B. When shores and other vertical supports are so arranged that the non-load-carrying form-facing material may be removed without loosening or disturbing the shores and supports, the facing material may be removed at an earlier age as specified or permitted. Wood forms for wall openings shall be loosened as soon as this can be accomplished without damage to the concrete.

When repair of surface defects or finishing is required at an early age, forms shall be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.

3.05 RESHORING

- A. When reshoring is permitted or required, the operations shall be planned in advance and shall be subject to approval. While reshoring is under way, no live load shall be permitted on the new construction.

In no case during reshoring shall concrete in beam, slabs, column or any other structural member be subjected to combined dead and construction loads in excess of the loads permitted by the Engineer for the developed concrete strength at the time of reshoring. Reshores shall be placed as soon as practicable after stripping operations are complete but in no case later than the end of the working day on which stripping occurs.

3.06 INSPECTION

The Engineer shall always be notified of the pouring schedule in advance and in ample time prior to placement of concrete to inspect the formwork. Inspection of formwork will be made only after each section to be poured is complete.

3.07 RECORDS

- A. The Contractor shall maintain an accurate log showing the following information:
1. Date of pour
 2. Area poured
 3. Average ambient temperature during curing period
 4. Date forms scheduled for removal
 5. Date form removal completed
 6. Method of reshoring (number of floor, etc.)
 7. Test cylinder serial numbers
 8. Strength of test cylinders at 7 and 28 days.

3.08 QUALITY CONTROL & TESTING

- A. All sampling and testing services shall be performed, at the Owners expense, by a testing agency which operates in accordance to ASTM D 3740 and E 329 latest edition and accepted by the Engineer.
- B. The Contractor shall submit for review a design mix for each class of concrete proposed for use. An approved testing laboratory shall prepare the mix. Compressive strength of at least four (4) specimens of the design mix shall indicate 15% higher than 28 days strengths specified. During the work, the Contractor shall make 3 test cylinders for each 50 cubic yards, or fraction thereof, of concrete placed each day. One cylinder shall be tested at 7 days and the other two at 28 days in accordance with ASTM C 39. Copies of all test reports shall be furnished to the Engineer.

3.09 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 03 20 00 -

CONCRETE REINFORCING

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of this specification section covers the Field House Building Structure only. Refer to Civil concrete specs for concrete work beyond the Field House Building footprint.
- B. Section Includes:
 - 1. Steel reinforcement bars.
 - 2. Welded-wire reinforcement.
- C. Related Requirements:
 - 1. Section 32 13 13 "Concrete Paving" for reinforcing related to concrete pavement and walks.

1.02 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of steel reinforcement.
 - 2. Bar supports.
- B. Shop Drawings: Comply with ACI SP-066:
 - 1. Include placing drawings that detail fabrication, bending, and placement.
 - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
 - 1. Location of construction joints is subject to approval of Architect.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.01 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.02 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Plain.

2.03 FABRICATING REINFORCEMENT

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

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.02 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
 - 2. Stagger splices in accordance with ACI 318.
- G. Install welded-wire reinforcement in longest practicable lengths.
 - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
 - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
 - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 - 4. Lace overlaps with wire.

3.03 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement.
 - 2. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.

3.04 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

3.05 FIELD QUALITY CONTROL

- A. Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Steel-reinforcement placement.

END OF SECTION

SECTION 03 30 00 -

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of this specification section covers the Field House Building Structure only. Refer to Civil concrete specs for concrete work beyond the Field House Building footprint.
- B. Section Includes:
 - 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
- C. Related Requirements:
 - 1. Section 03 10 00 "Concrete Forming and Accessories" for form-facing materials.
 - 2. Section 03 20 00 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
 - 3. Section 31 20 00 "Earth Moving" for drainage fill under slabs-on-ground.
 - 4. Section 32 13 13 "Concrete Paving" for concrete pavement and walks.

1.02 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.03 ACTION SUBMITTALS

- A. Product Data: For each of the following.
 - 1. Portland cement.
 - 2. Fly ash.
 - 3. Aggregates.
 - 4. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
 - 5. Vapor retarders.
 - 6. Liquid floor treatments.

7. Curing materials.
 8. Joint fillers.
 9. Repair materials.
- B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
 2. Minimum 28-day compressive strength.
 3. Durability exposure class.
 4. Maximum w/cm.
 5. Slump limit.
 6. Air content.
 7. Nominal maximum aggregate size.
 8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
 9. Intended placement method.
 10. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
- D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
1. Concrete Class designation.
 2. Location within Project.
 3. Exposure Class designation.
 4. Formed Surface Finish designation and final finish.
 5. Final finish for floors.
 6. Curing process.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
1. Installer: Include copies of applicable ACI certificates.
 2. Ready-mixed concrete manufacturer.
- B. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
 2. Admixtures.
 3. Curing compounds.
 4. Bonding agents.
 5. Vapor retarders.
 6. Semirigid joint filler.

7. Joint-filler strips.
 8. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
1. Portland cement.
 2. Fly ash.
 3. Aggregates.
 4. Admixtures:
- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Research Reports:
1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
- F. Preconstruction Test Reports: For each mix design.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.
1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1.06 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.

- e. 28-day compressive strength.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

1.08 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 3. Do not use frozen materials or materials containing ice or snow.
 - 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
 - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
 - 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.01 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.02 CONCRETE MATERIALS

- A. Source Limitations:
 - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
 - 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
 - 3. Obtain aggregate from single source.
 - 4. Obtain each type of admixture from single source from single manufacturer.

- B. Cementitious Materials:
1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
 2. Fly Ash: ASTM C618, Class C or F.
 3. Retain class of aggregate from options in "Normal-Weight Aggregates" Paragraph below or revise to suit Project. ASTM C33/C33M limits deleterious substances in coarse aggregate, depending on climate severity and in-service location of concrete. Classes in first set of options are ASTM C33/C33M default classes for concrete exposed to weather for Severe (S), Moderate (M), and Negligible (N) weathering regions, respectively. Revise first two options to "Class 4S" or "4M" if concrete is exposed to frequent wetting.
- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S coarse aggregate or better, graded. Provide aggregates from a single source.
1. Alkali-Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
 - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
 2. Maximum Coarse-Aggregate Size: as indicated.
 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do 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 C494/C494M, Type A.
 2. Retarding Admixture: ASTM C494/C494M, Type B.
 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- F. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments, color
- G. Water and Water Used to Make Ice: ASTM C94/C94M, potable

2.03 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A, except with maximum water-vapor permeance of 0.01 perms after conditioning; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.04 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.05 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 - 1. Color:
 - a. Ambient Temperature Below 50 deg F: Black.
 - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
 - c. Ambient Temperature Above 85 deg F: White.
- D. Curing Paper: 8-feet-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
 - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- E. Water: Potable or complying with ASTM C1602/C1602M.
- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

2.06 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.

- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
 - 1.

2.07 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.08 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.
 - 4. ,
 - 5. ,
- D. ,

2.09 CONCRETE MIXTURES

- A. Class A: Normal-weight concrete used for footings.

1. Exposure Class: ACI 318 F0 S0 W0 C1.
 2. Minimum Compressive Strength: 3000 psi at 28 days.
 3. Maximum w/cm: 0.55.
 4. Slump Limit: 5 inches, plus or minus 1 inch.
 5. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- B. Class B: Normal-weight concrete used for interior slabs-on-ground.
1. Exposure Class: ACI 318 F0 W0 C0 C1.
 2. Minimum Compressive Strength: 4000 psi at 28 days.
 3. Maximum w/cm: 0.48.
 4. Minimum Cementitious Materials Content: 520 lb/cu. yd..
 5. Slump Limit: 5 inches, plus or minus 1 inch.
 6. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 7. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- C. Class C: Normal-weight concrete used for exterior slabs-on-ground.
1. Exposure Class: ACI 318 F2 W0 C0 C1.
 2. Minimum Compressive Strength: 4500 psi at 28 days.
 3. Maximum w/cm: 0.45.
 4. Slump Limit: 5 inches, plus or minus 1 inch.
 5. Air Content:
 - a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing $\frac{3}{4}$ -inch or larger nominal maximum aggregate size. 7.5 percent, plus or minus 1.5 percent at point of delivery for concrete with nominal maximum aggregate size less than $\frac{3}{4}$ -inch.
 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of ceme

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 1. Daily access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.03 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.04 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 2. Face laps away from exposed direction of concrete pour.
 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.05 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 07 92 00 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.06 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.07 FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:
 - 1. ACI 301 Surface Finish SF-3.0:
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/8 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class A.
 - e. Locations: Apply to concrete surfaces exposed to public view, or to receive a rubbed finish,.
- B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:
 - 1. Grout-Cleaned Rubbed Finish:
 - a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
 - b. Do not clean concrete surfaces as Work progresses.
 - c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
 - d. Wet concrete surfaces.
 - e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.
- C. Related Unformed Surfaces:
 - 1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
 - 2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.08 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish:
 - 1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.

2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
 3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- C. Trowel Finish:
1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 4. Do not add water to concrete surface.
 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
 6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - 1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch and also no more than 1/16 inch in 2 feet.
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings or where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
1. Coordinate required final finish with Architect before application.
 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 2. Coordinate required final finish with Architect before application.

3.09 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 4000 psi at 28 days.
 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 substrate.
 6. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.10 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. If forms remain during curing period, moist cure after loosening forms.
 3. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

- a. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - b. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
- 1. Begin curing immediately after finishing concrete.
 - 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.

3.11 TOLERANCES

- A. Conform to ACI 117.

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than days' old.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
 - 4. Rinse with water; remove excess material until surface is dry.
 - 5. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least [**one**] [**six**] month(s).
 - 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces:
 - 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 3. After concrete has cured at least 14 days, correct high areas by grinding.
 - 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
 - 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

- b. Feather edges to match adjacent floor elevations.
- 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
- 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 - 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.

- 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- C. Inspections:
1. Headed bolts and studs.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure four 6-inch by 12-inch cylinder specimens for each composite sample.
 - ***** [OR] *****
 - b. Cast and laboratory cure six 4-inch by 8-inch cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C39/C39M.
 - a. For 6x12 cylinders test one laboratory-cured specimen at seven days and one set of two specimens at 28 days. Retain 1 cylinder as a spare.
 - b. For 4x8 cylinders, test one laboratory-cured specimen at seven days and one set of three specimens at 28 days. Retain 2 cylinders as spares.
 - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
 8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 9. Additional Tests:
 - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
 10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.16 PROTECTION

- A. Protect concrete surfaces as follows:

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1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 03 30 00.01 NON-STRUCTURAL CAST-IN-PLACE CONCRETE

PART 1: GENERAL

1.01 SCOPE OF WORK

This section includes cast-in-place concrete as shown on Drawings, and as specified herein. In general, this work includes providing cast-in-place concrete consisting of Portland Cement, fine and course aggregate, selected admixtures, mixing, transporting, placing, finishing, and curing as herein specified. This section further includes related items of quality control, testing, and evaluation of concrete strength.

1.02 STANDARDS

A. Some products and execution are specified in this section by reference to published specifications or standards of the following with respect abbreviations used.

1. American Concrete Institute.....ACI
2. The American Society for Testing and Materials.....ASTM

B. The current edition of the following standard references shall apply to the work of this Section as indicated. Suffixes indicating issue date are omitted from reference numerals elsewhere in the text. Concrete work shall comply with the following standards and codes except as indicated otherwise on the Drawings or herein.

1. ACI 301 "Specifications for Structural Concrete"
2. ACI 304 "Recommended Practice for Measuring, Mixing Transporting, and Placing Concrete"
3. ACI 305 "Recommended Practice for Hot Weather Concreting"
4. ACI 306 "Recommended Practice for Cold Weather Concreting"
5. ACI 308 "Recommended Practice for Curing Concrete"
6. ACI 309 "Recommended Practice for Consolidation of Concrete"
7. ACI 311 "Recommended Practice for Concrete Inspection"
8. ACI 214 "Recommended Practice for Evaluation of Compressive Test Results of Field Concrete"

9. ACI 211.1 "Recommended Practice for Selecting Proportions 70 for Normal Weight Concrete"
10. ACI 211.2 "Recommended Practice for Selecting Proportions for Structural light-weight Concrete"
11. ACI 212 "Guide for Use of Admixtures in Concrete"
12. ACI 214 "Recommended Practice for Evaluation of Compression Test Results of Field Concrete"

1.03 QUALITY ASSURANCE

- A. If the average strength of the laboratory control cylinders shows the concrete to be below the specified design strength, the aggregate proportions and water content may be changed by the Engineer, who, in addition to such changes, may require core tests. Tests confirming concrete strengths on hardened concrete, which was poured without testing, shall be paid for by the Contractor.
- B. Prepare design mixes for each class of concrete used in accordance with ACI 311.1. The Contractor shall pay for all design mix costs. Submit written reports to the Engineer for each proposed mix for each class of concrete prior to start of work. Do not begin concrete production until mixes have been reviewed by the Engineer.
- C. Strength data for establishing standard deviation and required overstrength factor will be considered suitable if the concrete production facility has certified records consisting of at least 30 consecutive tests in one group or the statistical average for two groups totaling 30 or more tests representing similar materials and project conditions. Records of these tests shall be submitted with the proposed design mix.
- D. If standard deviation exceeds 800 psi or if no suitable records are available, selected proportions to produce an average strength of at least 1200 psi greater than the required compressive strength of concrete. If standard deviations are less than 600 psi, the minimum overstrength factor required in the design mix shall be in accordance with ACI 318, Section 4.3.1.
- E. Design mixes shall be proportioned using the maximum specified slump and temperature. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by the Engineer before using in the work. Admixtures shall be used in strict accordance with the manufacturer's written instructions. Design mix shall be proportioned using the proposed admixtures at optimum recommended dosages. The manufacturer of the mixture shall prepare and submit test data used to determine the optimum dosage.

1.04 SUBMITTALS

The Contractor shall submit four copies of the proposed design mix for each class of concrete specified herein in accordance with the requirements herein. Design mixes shall be submitted two weeks prior to placement of concrete. The cost of the design mix shall be paid for by the contractor. Submit records of all concrete pours showing exact location of pour, date of pour, quantity of pour, and class of concrete poured to the Engineer each month. Temperature at time of pour should also be recorded. Submit to the Engineer chemical and physical analysis of all cement and fly ash delivered to the batch plant seven (7) days prior to use of the cement or fly ash.

PART 2: PRODUCTS

2.01 MATERIALS

- A. PORTLAND CEMENT shall be fresh stock of an approved standard brand meeting the requirements of ASTM C-150, of Type II and shall be 4000 PSI unless otherwise specified. Only one brand of cement shall be used except when otherwise approved by the Engineer, and the Contractor shall inform the Engineer of the brand name of the cement proposed for use. The Contractor shall submit a copy of mill test reports on all cement delivered to the job 7 days prior to use of the cement. Cube strength from mill tests shall have a tolerance of ± 600 psi. The fineness of cement used shall not have more than 10% retained on a #325 mesh screen when tested in accordance with ASTM C-430.
- B. FLY ASH shall have a high fineness and low carbon content and shall exceed the requirements of ASTM C-618. Specifications for Fly Ash and Raw or Calcined Natural for use in Portland Cement Concretes for Class 7, except that the loss of ignition shall be less than 3%, and all fly ash shall be a classified processed material. Fly ash shall be obtained from one source for the concrete delivered to the project. Complete chemical and physical analysis of each carload of fly ash shall be submitted to the Engineer ten (10) days prior to use of each carload delivered. Concrete mixes proportioned with fly ash shall contain not less than 10% nor more than 20% by weight of cement of fly ash.
- C. CONCRETE AGGREGATE for stone concrete shall consist of clean crushed stone or gravel having hard, strong, uncoated particles free from injurious amounts of soft, thin, elongated or laminated pieces, alkali, organic or other deleterious matter. Maximum aggregate size shall be 3/4" of slabs, columns, etc. The maximum permissible percentage of elongated particles shall not exceed 5% by weight. Elongated particles are those defined as having a length equal to or greater than 5 times the width. Samples of coarse aggregate shall be submitted to the testing laboratory for testing and approval prior to use. The fineness modulus of the coarse aggregate shall not vary for more than $\pm 0.3\%$.
- D. FINE AGGREGATE shall consist of sand, stone screening, or other inert materials with similar characteristics having clean, strong, durable, uncoated grains and free from lumps, soft or flaky particles, clay, shale, alkali, organic

matter or other deleterious substances. Fine aggregate shall be submitted for testing and approval to the testing laboratory. The laboratory shall verify that fine aggregate conforms to ASTM standards by making standard colormetric, sediment, and comparative tensile tests, and by sieve analysis. The fineness modules of the sand shall not vary by more than $\pm 0.2\%$. Color shall be standard as determined from colormetric tests.

- E. CONCRETE ADMIXTURES, when required or permitted shall conform to the appropriate specification listed. Do not use admixtures, which have not been incorporated and tested in the accepted mixes unless otherwise authorized in writing by the Engineer. Air-entraining admixtures shall exceed the requirements of ASTM C-260, "Specifications for Air-Entraining Admixtures for Concrete". Water reducing admixtures shall be hydroxolated polymer type exceeding the requirements of ASTM C-494, Type A.
- F. PREMOLDED EXPANSION JOINT FILLERS shall conform to ASTM D1751.
- G. LIQUID CURING MATERIAL for concrete shall exceed the requirements of ASTM C-309, Type I. Products acceptable shall provide water retention not exceeding a loss of 0.020 grams per sq. cm. when tested at a coverage of 200 sq. ft. per gallon and tested in accordance with ASTM C-156. Submit test data verifying these requirements for approval.
- H. BURLAP shall be free of sizing or any substance that is injurious to cement or can cause discoloration. Burlap shall be rinsed in water prior to use. Burlap shall be sufficient thickness to retain water without requiring wetting.
- I. STEEL FOR EMBEDDED ANGLES AND PLATE CAST IN CONCRETE shall conform to ASTM A-36. Plates and angles shall receive a commercial sand blast and be painted with an inorganic zinc base paint equal to Carbomastic #11, or an approved equal.
- J. CRUSHED STONE FILL, 4" in depth, shall be placed under all concrete floors in contact with the ground. Stone shall be uniform 3/4" stone, no fines, compacted as thoroughly as possible by tamping and rolling. Stone fill shall conform to ASTM C-33.
- K. VAPOR BARRIER shall be a minimum of a 6 mil polyethylene.
- L. WATERSTOPS shall be Sealtight PVC waterstrips as manufactured by the W.R. Meadows Co., or an approved equal. All waterstops shall be Type 6316. Water bars shall be located in all expansive joints in the concrete and in all construction joints in concrete walls.
- M. JOINT SEALING COMPOUND shall be a two-part mineral filled epoxy polyurethane, and shall be used for all exposed joints in exterior paving slabs,

sidewalks, where concrete slabs abut concrete walls, and in exposed joints in slabs on grade.

- N. SURFACE COATING for all exposed concrete except where otherwise shown shall be a masonry water proofer or sealer.
- O. AIR ENTRAINMENT: Air-entraining admixtures shall be used for all concrete exposed to freezing and thawing or subjected to hydraulic pressure. Entrained air shall conform to the air control limits of Table 3.4.1 of ACI 301. The water-cement ratio for all air-entrained concrete exposed to freezing and thawing shall not exceed 0.53.
- P. SLUMPS: All concrete shall be proportioned and produced to have a maximum slump of 4" and a minimum slump of 2" as per ASTM C143. A tolerance of up to but not exceeding 1" above the indicated maximum shall be allowed for individual batches in any one day's pour provided the average of the most recent ten batches within the same pour does not exceed the maximum limits. No tolerance will be permitted for individual batches when less than ten (10) batches are delivered for one day's pour.

Q. CONCRETE MIXING

- 1. Concrete shall be mixed at batch plants or it may be transit mixed as specified herein. Concrete batch plants must comply with the requirements of ASTM C-94 for ready-mixed concrete, ASTM C33 for aggregates and ACI-304 with sufficient capacity of producing concrete of the quantity and quality as specified herein. All plant facilities are subject to inspection by the Engineer. Ready-mix concrete shall comply with requirements of ASTM C-94, and as specified herein, unless otherwise noted. During hot weather or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C-94 will be required as follows:
 - a. When air temperatures are between 80°F. and 90°F., reduce the mixing and delivery time from 1-1/2 hours to 1 hour
 - b. When outside air temperatures are above 90°F, reduce the mixing and delivery time from 1-1/2 hours to 45 minutes.
- 2. Addition of water at the site for concrete mix with insufficient slumps, slumps less than the maximum specified herein, will not be permitted. Concrete delivered to the project with slump less than the minimum or greater than the maximum specified shall be rejected and discarded off site.
- 3. Batch tickets for each load of concrete shall be submitted to the Engineer. The following information shall be provided on each batch ticket:

- a. Design mix designation
 - b. Exact time cement, water and aggregate were discharged into the mix
 - c. Compressive strength of mix
 - d. Amount of water added to the mix
4. Maintain equipment in proper operating condition, with drums cleaned before charging of each batch. Schedule delivery of trucks in order to prevent delay of placing after mixing.

5. CONCRETE TYPE AND STRENGTHS

Location	Maximum Size Aggregate	*28 Day Compressive Strength
Slabs on Grade	3/4"	4000 psi
Walls	3/4"	4000 psi
Walks and Steps	3/4"	4000 psi

*Twenty-eight day strength shall be as determined from concrete sampled in accordance with ASTM C-172 and standard 6" x 12" molded cylinders tested in accordance with ASTM C-31 and C-39.

**See notes on plans for required concrete strengths.

PART 3: EXECUTION

3.01 PREPARATION

Before placing concrete, all equipment for mixing and transporting and placing concrete shall be cleaned, all debris and ice removed from spaces to be occupied by the concrete, forms thoroughly cleaned of soil, ice, or other coatings which will prevent proper bond, reinforcement shall be securely tied in place and expansion joint material, anchors, and other embedded items shall be securely positioned. Hardened concrete and foreign materials shall be removed from the conveying equipment.

3.02 CONCRETE PLACEMENT

- A. Place concrete in compliance with the practices and recommendations of ACI 304 or as herein specified. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practical by methods, which will prevent separation or loss of ingredients and in a manner, which will assure that the required quality concrete, is obtained. Conveying equipment shall be of size and design to insure a continuous flow of concrete at the delivery end.

- B. Concrete shall be deposited continuous, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located at points as provided for in the drawings or as approved. Placing shall be carried on at such a rate that the concrete, which is being integrated, with fresh concrete is still plastic. Deposit concrete as nearly as possible to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure, which will cause segregation.
- C. Concrete shall not be allowed to "freefall" a distance greater than 3'-0". All concrete placed in columns and walls shall be placed through a tremie with the bottom or outlet of the tremie being held at maximum of 3'-0" above the surface where concrete is being placed.
- D. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.
- E. Do not use concrete which has become non-plastic and unworkable or does not meet the required quality control limits, or which has become contaminated by foreign material. Remove rejected concrete from the project site and dispose of in an acceptable location. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding, and tamping. Vibration of forms and reinforcing steel will not be permitted.
- F. Do not use vibrators to transport concrete inside forms. Insert and withdraw vertically at uniformly spaced locations not further than the visible effectiveness of the vibrator. Do not insert vibrators into lower levels of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcing and other embedded items without causing segregation of the mix.
- G. Deposit and consolidate concrete in slabs in a continuous operation, within the limits of construction joints until the placing of the entire section is complete.
- H. Bring surface of slabs to the correct elevations with a straight edge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of lumps and hollows. Do not sprinkle water on the plastic surface. Do not disturb the surface prior to beginning the finish operation.
- I. Concrete placed by plumbing shall conform to the recommendations of ACI Publication, "Placing Concrete by Pumping Methods."

3.03 CONSTRUCTION JOINTS

Joints not shown on the drawings shall be made at locations that will least impair the strength of the structure and shall be approved by the Engineer. In general, they shall be located near the middle of the span of members. Joints in walls and columns shall be located at the underside of floors or slabs, and the tops of foundation walls. Roughen surfaces of hardened concrete at all vertical construction joints. Clean surface of laitance, coatings, loose particles, and foreign matter to expose aggregate. Prepare for bonding of fresh concrete to new concrete that has hardened; at joints between foundation systems and walls dampen, but do not saturate, the roughened and cleaned surface of set concrete immediately before placing fresh concrete. In lieu of neat cement grout, bonding grout may be a commercial bonding agent. Apply to cleaned concrete surfaces in accordance with the printed instruction of this bonding material manufacturer. Provide keyways at least 1-1/2" deep in all construction joints in walls, slabs, and between walls, and foundation systems. Provide PVC Waterstops in all construction joints in concrete walls and in concrete beams and slabs. PVC waterstops shall also be provided between concrete beams and slabs at all expansion joints.

3.04 COLD WEATHER PLACING AND CURING REQUIREMENTS

- A. No concrete is to be placed when the air temperature is 40° F or below and the predicted low temperature for the succeeding 24-hour period is less than 32° F.
- B. All Concrete when placed in the forms shall have a temperature of between 50° and 90° F and shall be maintained at a temperature of not less than 50° F for at least 72 hours for normal concrete and 24 hours for high early strength concrete, or for as much time as is necessary to secure proper rate of curing and designed compressive strength.

3.05 HOT WEATHER PLACING

An approved admixture designed to retard the rate of set shall be used for all concrete placed when temperatures exceed 75°F. Set retarding admixtures shall conform to ASTM C-494, Type D, water reducing and retarding. Wet forms thoroughly before placing. Cool reinforcing by wetting sufficiently so that steel temperatures will be nearly equal to the ambient air temperature. Provide windbreaks around the perimeter of the area where concrete is being placed. Fresh concrete with temperatures of 90°F. or above shall be discarded off site. The amount of cement used in the job is computed for the temperature indicated on the approved design mix. For higher concrete mix temperature, the weight of the cement shall be increased at the rate of 12 lbs. per cubic yard for each 10°F. above the concrete mix temperature.

3.06 CURING AND PROTECTION

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.

- B. Curing for all horizontal slab surfaces, except those to receive a bonded finish material, during periods when the outside air temperature does not exceed 60°F. shall be provided by applying a membrane-forming curing compound to concrete surfaces as soon as the final troweling or floating operation has been completed. Apply uniformly with a roller brush at a rate not to exceed 200 sq. ft. per gallon. Maintain the continuity of the coating and repair damage to the coat during the entire curing period. Curing for surfaces to receive a bonded finish material shall be as noted below. Curing for all horizontal surfaces during period when the outside air temperature will exceed 60°F. shall be provided by covering the entire surface with burlap. The burlap shall be lapped 1/2 width in order to provide a double thickness of burlap. Immediately following the placement of the burlap, the entire surface shall be maintained continuously wet for a period of 7 days. Do not permit surfaces to dry at any period during the required curing period.
- C. Cure formed surfaces by moist curing with the forms in place for the full curing period, or until forms are removed. If forms are removed before the curing period is complete, apply a membrane-forming curing compound to damp surfaces as soon as the water film has disappeared. Apply uniformly in continuous operation by roller brushes in accordance with the manufacturer's directions.
- D. Do not use membrane curing compounds on surfaces which are to be covered with a coating material applied directly to the concrete or with any other cover or finish material which shall be bonded to the concrete. These surfaces must be watercured with a full coverage of burlap kept continuously moist for a period of 7 days.
- E. During the curing period, protect concrete from damaging mechanical disturbances, including load stresses, shocks, excessive vibration and from change caused by subsequent construction operations.

3.07 SURFACE REPAIRS

- A. Repair and patch defective areas immediately after removal of forms as directed by the Engineer. Cut out honeycombs, rock pockets, voids over 1/2" in diameter and holes left by tie rods and bolts down to solid concrete, but in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surfaces. Exposed reinforcing steel with at least 3/4" clearance all around. Dampen all concrete surfaces in contact with patching concrete, and brush with a neat cement grout coating or concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials to provide concrete of the same type or class as the original adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
- B. Fill holes extending through concrete by means of a plunger type gun or other suitable device from the least exposed face to insure complete filling. Remove stains and other discolorations that cannot be removed by cleaning for all exposed

surfaces. Repair isolated random cracks and single holes not over 1" in diameter by the dry-pack method. Groove the top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with a neat cement grout coating. Place dry-pack, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a #16 mesh sieve using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match the existing surface.

- C. Fill in holes and openings left in concrete structures for the passage of work by other trades, unless otherwise shown or directed, after the work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete work.
- D. Correct high areas in unformed surfaces by grinding, after the concrete has cured at least 14 days. Correct low areas in unformed surfaces during, or immediately after, completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Engineer.

3.08 SLABS ON GRADE

A. PREPARATION OF SUBGRADE

The subgrade shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required in the specifications. The bottom of an undrained granular base course shall not be lower than the adjacent finished grade. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing, it shall be raised and maintained above 50°F. long enough to remove all frost from the subgrade. The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.

B. JOINTS

Joints in slabs on grade shall be located as to divide the slab in areas not in excess of 800 sq. ft. The maximum distance between joints in slabs on grade at all points of contact between slabs on grade and vertical surfaces such as foundation walls and elsewhere as indicated. At exposed joints, recess the premolded fill on a minimum of 1/2", and fill the remaining section with a joint seal and as specified herein. All exposed construction joints in the slabs on grade shall have the edges tooled and the crack and groove formed by the edging tool filled with a polyurethane joint sealant. No cold-key or metal form joints will be permitted.

3.09 SIDEWALKS

- A. Brooming of the concrete surface shall be done transverse to the direction of traffic. Joint spacing shall not be less than 5'-0". Where existing sidewalks are being widened, transverse joints shall be located so as to line up with existing joints in the adjacent sidewalk. Joints shall not be sealed.
- B. All sidewalks shall contain 6"x6" / 1.4x1.4 WWF. Chairs shall be installed or WWF lifted during placement to allow WWF to be within middle 1/3 of sidewalk cross section.
- C. Backfill shall be compacted to a degree comparable to the adjacent undisturbed material.

3.10 CURB AND GUTTER

- A. Concrete curb/curb and gutter shall meet the requirements of Section 846-3 of the NCDOT Standard Specifications for Roads and Structures (latest edition).
- B. The concrete shall be given a light broom finish with the brush marks parallel to the curb line or gutter line.
- C. No earth backfill or pavement shall be placed adjacent to the curb and gutter until at least three curing days have elapsed. Backfill shall be compacted to a degree satisfactory to the Engineer.

3.11 FINISHES

A. STANDARD ROUGH FORM FINISH

Provide a standard rough form finish to all concrete formed surfaces that are to be concealed in the finish work or other construction. (**NOTE:** Interior faces of walls of water retaining structures are not considered to be concealed.) Standard rough form finish shall consist of all defective areas repaired as specified and all holes or voids larger than 3/8" filled with cement grout.

B. STANDARD FINISH FOR EXPOSED SURFACES

Provide an applied surface finish of Masonry Water proofer or Sealer to all exposed interior and exterior concrete finishes unless otherwise noted. Interior faces of walls of water retaining structures, including areas which are normally submerged, are considered to be exposed surfaces and shall receive the specified standard finish for exposed surfaces. The surface finish shall consist of chopping and/or grinding down all high spots removing grinding of all burrs and/or other projections, filling all voids 3/8" and larger, and cutting out all unsound concrete and patching as specified herein. Before applying the finish, wet and clean the surface of all grease, oils, efflorescence, and other foreign material. Dampen surface immediately ahead of application. Apply the finish coat with a tampico

fiber brush by laying the finish coat on the wall in a thick coat of a minimum of 2 lbs. per sq. yard, and brush to a uniform level surface. Do not apply in temperatures 40°F or below, or when temperatures are likely to fall below 40°F within 24 hours after application. The finish coat shall be mixed in strict accordance with the manufacturer's written instructions. After the finish coat has cured, apply a finish coat of masonry water proofer or sealer at a minimum of 12 lb. per sq. yd. Trained technicians shall apply the masonry water proofer or sealer.

C. SMOOTH FORM FINISH

Provide a smooth form finish for all exposed interior concrete walls inside buildings, in pipe gallery areas, or as noted on the Drawings. Standard form finish shall produce a smooth, hard, uniform texture on the concrete. The arrangement of the forms and the number of seams and joints shall be kept to a minimum. Immediately after forms are removed, cut out all unsound concrete and patch as specified herein, and fill all pinholes and other voids larger than 1/4" with a cement grout. Compress mortar into voids with a firm rubber trowel or float. After mortar dries, wipe off surface with burlap.

D. SLAB FINISHES

1. Scratched Finish

After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance, the surface shall be roughened with stiff brushes or rakes before a final set. A scratched finish shall be applied to all surfaces which are to receive a bonded surface finish.

2. Floated Finish

After the concrete has been placed, consolidated, struck off, and leveled, the concrete shall not be worked further until ready for floating. Floating shall begin when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after the first floating, planeness of surface shall be checked with a 10'-0" straight edge applied at not less than two different angles. All high spots shall be cut down and all low spots filled during this procedure to produce a surface with Class B tolerance throughout. This slab shall then be floated immediately to a uniform sandy texture. A float finish shall be applied to all slab surfaces, which are to receive a waterproofing membrane.

3. Troweled Finish

The surface shall first be float-finished as specified. It shall next be power troweled, and finally hand troweled. The first troweling after power floating shall produce a smooth surface, which may still show some

trowel, marks. Additional troweling shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be essentially free of trowel marks, uniform in texture, and appearance, and shall be planed to a Class tolerance. On surfaces intended to support floor coverings, any defects of sufficient magnitude to show through the floor covering shall be removed by grinding. A trowel finish shall be applied to all surfaces, which are exposed to view or are to receive a floor covering of carpet, vinyl, asbestos, tiles, etc.

4. Broom Finish

Immediately after the concrete has received a float finish as specified in Section B, it shall be given a coarse transverse scored texture by drawing a broom or burlap belt across the surface. A broom finish shall be applied to all parking surfaces, exterior concrete walks, and concrete paving slabs.

3.12 FINISHING TOLERANCES

Finishes with a Class C tolerance shall be true planes within 1/4" in 2'-0" as determined by a 2'-0" straight edge placed elsewhere on the slab in any direction. Variation from level for Class A. tolerance shall not exceed 1/4" in 10'-0" or 1/2" maximum in any one bay between columns. Variation from level for a Class B and Class C finish shall not exceed 1/4" in 10'-0" or 3/4" in any one bay between columns.

3.13 RELATED UNFORMED SURFACES

As tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surface unless otherwise shown.

3.14 MISCELLANEOUS CONCRETE ITEMS

- A. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.
- B. Provide machine and equipment bases and foundations, as shown on the drawings. Set anchor bolts for machines and equipment to template at correct elevations prior to placement of the concrete, complying with certified diagrams or templates of the manufacturer finishing machines and equipment.

3.15 INSPECTION

Before placing concrete, the formwork installation, reinforcing steel, and items to be embedded or cast-in must be complete. Notify other crafts involved in ample time to permit the installation of their work; co-operate with other trades in setting such work, as required. Notify Engineer upon completion of installation of all reinforcing and other items in ample time to permit inspection of the work before concrete is poured. Soil bottoms at foundation systems are subject to testing laboratory as directed by the Engineer. Place concrete immediately after approval of foundation excavations.

3.16 TESTING AND QUALITY CONTROL

- A. The Owner shall employ a concrete testing laboratory to provide all laboratory testing services on the project and a concrete technician to perform all quality control tests on concrete and materials used to batch concrete. The testing agency employed shall meet the requirement of "Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction", (ASTM E-329).
- B. The Contractor shall provide and maintain adequate facilities on the project for the testing laboratory to locate the required testing equipment and for safe storage area for test cylinders. The general contractor shall provide at his own expense all casual labor needed to assist the concrete technician in obtaining samples of concrete and concrete materials and moving and transporting cylinders and materials which are being tested.
- C. The following services shall be performed by the designated testing agency:
 - 1. Review and/or check-test the Contractor's proposed materials for compliance with the specifications.
 - 2. Review and/or check-test the Contractor's proposed mix design as required by the Engineer.
 - 3. Secure production samples of materials at plants or stock-piles during the course of the work and test for compliance with the specifications as required by the Engineer.
 - 4. Conduct strength tests of the concrete during construction in accordance with the following procedures:
 - a. Secure composite samples in accordance with "Method of Sampling Fresh Concrete" (ASTM C-172). Each sample shall be obtained from a different batch of concrete on a random basis, avoiding any selection of the test batch other than by a number selected at random before commencement of concrete placement.
 - b. Mold and cure three specimens from each sample in accordance with "Method of Making and Curing Concrete Compression and

Flexural Specimens in the Field" (ASTM C-31). Any deviations from the requirements of this Standard shall be recorded in the test report.

- c. Test specimens in accordance with "Method of Test for Compression Strength of Molded Concrete Cylinders" (ASTM C-39). Two specimens shall be tested at 28 days for acceptance and one shall be the average of the strengths of the two specimens tested at 28 days. If one specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded and the strength of the remaining cylinder shall be considered the test result. Should both specimens in the test show any of the above defects, the entire test shall be discarded. When high early strength concrete is used, the specimens shall be tested at the ages indicated in the Contract Documents.
 - d. Make at least one strength test for each 50 cu. yd., or fraction thereof, of each mix design of concrete placed in any 1 day. When the total quantity of concrete with a given mix design is less than 50 cu. yd., the strength test may be waived by the Engineer if, in his judgment, adequate evidence of satisfactory strength is provided, such as strength test results for the same kind of concrete supplied on the same day and under comparable conditions to other work or other projects.
5. Determine slump of the concrete sample for each strength test and whenever consistency of concrete appears to vary, using "Method of Test for Slump of Portland Cement Concrete" (ASTM C-143). Slump is to be 4" with a +/- 1" tolerance. Anything not in this range is to be approved by the engineer prior to placement.
 6. Determine air content of normal weight concrete sample for each strength test in accordance with either "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" (ASTM C-231), "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method" (ASTM C-173), or "Method of Test for Weight per Cubic Foot, Yield and Air Content (Gravimetric) of Concrete", (ASTM C-138). Concrete shall be air entrained with 5-7% air.
 7. Determine unit weight of concrete sample for each strength test.
 8. Determine temperature of concrete sample for each strength test. If temperature is 90° or above, concrete is not to be used.
 9. Determine in-place strength of concrete by curing cylinders under the same field conditions that the concrete representing these field cylinders is

cured and additionally by determining the degree/hours of curing required for the concrete to develop the required strength for form removal.

10. Inspect concrete batching, mixing and delivery operations to the extent deemed necessary by the Engineer.

3.17 EVALUATION AND ACCEPTANCE OF CONCRETE STRUCTURES

- A. The concrete quality control testing as specified will be evaluated by the following criteria:
 1. Compressive strength tests for laboratory-cured cylinders will be considered satisfactory if the averages of all sets of three consecutive compressive strength test results equal or exceed the 28-day design compressive strength of the type of class of concrete; and, no individual strength test falls below the required compressive strength by more than 500 psi. If compressive strength tests fail to meet these requirements, the concrete represented by these tests will be considered deficient and subject to additional testing and/or removal.
 2. Concrete work, which does not conform to the specified requirements, including strength, tolerance and finishes, shall be corrected as directed at the Contractors expense, without extension of time therefor. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from correction to the concrete work. Core tests, if required, shall be evaluated in accordance with the requirements of ACI 318-77.

3.18 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 03 45 00 PRECAST ARCHITECTURAL CONCRETE

PART 1 : GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Architectural precast concrete cladding coping, column caps and sill units.
- B. Related Sections include the following:
 - 1. Section 04 2000 "Unit Masonry" for thin brick setting materials and installation after precast concrete panel production.
 - 2. Section 05 5000 "Metal Fabrications" for loose lintels miscellaneous steel shapes.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
 - 1. Indicate separate face and backup mixture locations and thicknesses.
 - 2. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 3. Include plans and elevations showing unit location and sequence of erection for special conditions.
 - 4. Indicate relationship of architectural precast concrete units to adjacent materials.
- D. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.
 - 1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.

2. INFORMATIONAL SUBMITTALS
 3. Qualification Data: For Installer and fabricator.
 4. Installer to provide 10 examples of similar installations, five General Contractor and 5 Owner references.
- E. Material Certificates: For the following items, signed by manufacturers:
1. Cementitious materials.
 2. Reinforcing materials and prestressing tendons.
 3. Admixtures.
- F. Material Test Reports: For aggregates.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: A precast concrete erector with a minimum of 10 years of continuous experience setting precast..
- B. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements.
- C. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- D. Sample Units: After sample approval and before fabricating architectural precast concrete units, produce a minimum of 2 sample panels approximately 2 foot lengths, one of a coping profiles to be included in masonry sample panel in area for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.
 1. Locate panels where indicated or, if not indicated, as directed by Architect.
 2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
 3. After acceptance of repair technique, maintain one sample panel at manufacturer's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
 4. Demolish and remove sample panels when directed.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground.
 - 1. Support units during shipment on nonstaining shock-absorbing material.
 - 2. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
 - 3. Place stored units so identification marks are clearly visible, and units can be inspected.
 - 4. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage.
 - 5. Lift and support units only at designated points shown on Shop Drawings.

A. SEQUENCING

- 1. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

2. PRODUCTS

PART 2 : MANUFACTURERS

2.01 Available Fabricators:

- A. Subject to compliance with requirements, fabricators offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Lucas Concrete, Charlotte N.C.
 - 2. PRC Precast, Greenville, S.C.
 - 3. Miller-Mize Precast, Inc.
 - 4. P&D Architectural Precast Inc., LaGrange, NC

2.02 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

- B. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

2.03 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.04 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
- B. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
- D. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - 1. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.
- E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

2.05 STAINLESS-STEEL CONNECTION MATERIALS

- A. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers.
- B. Lubricate threaded parts of stainless-steel bolts with an antiseize thread lubricant during assembly.
- C. Stainless-Steel-Headed Studs: ASTM A 276, with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

2.06 ACCESSORIES

- A. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.07 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion full-depth mixture by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi minimum.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- F. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.08 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
- B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
- C. Form joints are not permitted on faces exposed to view in the finished work.

1. Edge and Corner Treatment: Uniformly chamfered.

2.09 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
- B. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- C. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- D. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.
- E. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.
- F. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 3. Place reinforcement to maintain at least 3/4-inch minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 4. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar

supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

5. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- G. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- H. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
- I. Place backup concrete mixture to ensure bond with face-mixture concrete.
- J. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
- K. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- L. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- M. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.
- N. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- O. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.10 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

- B. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.
- C. Weld Plates: Plus or minus 1 inch.
 - 1. Inserts: Plus or minus 1/2 inch.
 - 2. Handling Devices: Plus or minus 3 inches.
 - 3. Reinforcing Steel and Welded Wire Fabric: Plus or minus 1/4 inch where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch.
 - 4. Reinforcing Steel Extending out of Member: Plus or minus 1/2 inch of plan dimensions.
 - 5. Location of Rustication Joints: Plus or minus 1/8 inch.
 - 6. Location of Opening within Panel: Plus or minus 1/4 inch.
 - 7. Electrical Outlets, Hose Bibs: Plus or minus 1/2 inch.
 - 8. Location of Bearing Surface from End of Member: Plus or minus 1/4 inch.
 - 9. Allowable Rotation of Plate, Channel Inserts, and Electrical Boxes: 2-degree rotation or 1/4 inch maximum over the full dimension of unit.
 - 10. Position of Sleeve: Plus or minus 1/2 inch.

2.11 FINISHES

- A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved sample panels and as follows:
- B. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.
- C. 110: Color - Limestone (Buff)
 - a. Concrete Color - White
 - b. Texture - Sandblasted; Exposure: Light
 - c. Description: Fine Aggregate: Crushed buff limestone; Pigment: White to buff as selected by Architect.
- D. Finish exposed top bottom and back surfaces of architectural precast concrete units to match face-surface finish where exposed.

- E. Finish exposed bottom surfaces of architectural precast concrete units by smooth, steel-trowel finish at sill and coping overhangs where exposed.
- F. Finish unexposed surfaces of architectural precast concrete units by float finish.

2.12 SOURCE QUALITY CONTROL

- A. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 requirements for concrete strength.
- B. Testing: If there is evidence that strength of precast concrete units may be deficient evidenced but not limited to fractures, deflection, chipping or breakage; or may not comply with ACI 318 requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
- C. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
 - 1. Cores will be tested in an air-dry condition.
 - 2. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
 - 3. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:
 - 4. Project identification name and number.
 - a. Date when tests were performed.
 - b. Name of precast concrete fabricator.
 - c. Name of concrete testing agency.
 - d. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- D. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast

concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

PART 3 : EXECUTION

3.01 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting cast-in-place building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is complete.

3.02 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
- C. Install temporary steel or plastic spacing shims or bearing pads as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 2. Unless otherwise indicated, maintain uniform joint widths of 1/2 inch.
- D. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- E. Do not permit connections to disrupt continuity of roof flashing.
- F. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
- G. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.

For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.

3.03 ERECTION TOLERANCES

- A. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

3.04 REPAIRS

- A. Repair architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.05 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
- D. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 - 1. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION

WCU
Norton Intramural Fields
22-24232-01A

DIVISION 04

MASONRY



SECTION 04 20 00

UNIT MASONRY

PART 1 : GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Lintels.
 - 3. Brick.
 - 4. Mortar and grout materials.
 - 5. Reinforcement.
 - 6. Ties and anchors.
 - 7. Embedded flashing.
 - 8. Accessories.
 - 9. Mortar and grout mixes.
- B. Products Installed but not Furnished under This Section:
 - 1. Precast Trim
 - 2. Steel lintels in unit masonry.
 - 3. Steel shelf angles for supporting unit masonry.
 - 4. Cavity wall insulation
- C. Related Requirements:
 - 1. Section 07 19 00 "Water Repellents" for water repellents applied to unit masonry assemblies.
 - 2. Section 07 21 00 "Thermal Insulation" for cavity wall insulation.
 - 3. Section 07 62 00 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.02 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.
- C. Product Data: For each type of product.
- D. Shop Drawings: For the following:
 - 1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.

2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R. Indicate elevations of reinforced walls.

- E. Samples for Initial Selection:
1. Brick, in the form of straps of five or more bricks.
 2. Colored mortar.
 3. Weep/cavity vents.

1.03 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
 2. Masonry units.
 - a. Include data on material properties
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.
 - d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 3. Cementitious materials. Include name of manufacturer, brand name, and type.
 4. Mortar admixtures.
 5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 6. Grout mixes. Include description of type and proportions of ingredients.
 7. Reinforcing bars.
 8. Joint reinforcement.
 9. Anchors, ties, and metal accessories.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

- C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602.
- D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.05 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
 - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 : PRODUCTS

2.01 SOURCE LIMITATIONS

- A. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.02 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with TMS 602.

2.03 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.04 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide bullnose units for outside corners in interior spaces unless otherwise indicated.
- B. CMUs: ASTM C90, lightweight unless otherwise indicated.
1. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

2.05 LINTELS

- A. Masonry Lintels: Built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Temporarily support built-in-place lintels until cured.

2.06 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
- B. Clay Face Brick: Facing brick complying with ASTM C216, Type FBS
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Taylor Clay – Custom Mix – Variation from 117TP - Custom Color.
 - b. Palmetto Brick – Medium Red Smooth
 - 1) Brickyard Limited : Dennis Hopkins 704.379.7900
 - c. Triangle Brick – Red Common
 - d. Lee Brick - #200 Red
 - 1) Brickyard Limited : Dennis Hopkins 704.379.7900
 2. Type: FBS
 3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 4. Modular Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.
 5. Color and Texture: Match existing Brown Building brick, smooth red.

2.07 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 - 1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
- D. Aggregate for Mortar: ASTM C144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- E. Aggregate for Grout: ASTM C404.
- F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with **ASTM C494/C494M, Type C** and recommended by manufacturer for use in masonry mortar of composition indicated.
- G. Water: Potable.

2.08 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
 - 1. All Walls: Hot-dip galvanized carbon steel.
 - 2. Wire Size for Side Rods: 0.148-inch diameter.
 - 3. Wire Size for Cross Rods: 0.148-inch diameter.

4. Wire Size for Veneer Ties: 0.148-inch diameter.
 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 6. Provide in lengths of not less than 10 ft., with prefabricated corner and tee units.
- D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
- E. Masonry-Joint Reinforcement for Multiwythe Masonry:
1. Adjustable (two-piece) type, ladder design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch and maximum vertical adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

2.09 **TIES AND ANCHORS**

- A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
- C. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
 2. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.
 3. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.
 4. Masonry-Veneer Anchors; Slotted Plate with Prongs: Sheet metal anchor section, with screw holes at top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation; and raised rib-stiffened strap, stamped into center to provide a slot between strap and base for wire tie.
 - a. **Products:** Subject to compliance with requirements, provide one of the following:

- 1) Hohmann & Barnard, Inc: HB-213-2X WITH 2X Hook and HB-213 Washer.
- 2) [Wire-Bond](#); 2401RJ-711 Adjustable Veneer Anchor with 2402 Triangle tie.
- 3) Dayton Superior: DA213

2.10 **EMBEDDED FLASHING**

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" & and as follows:
1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch (0.40 mm) thick.
 2. Copper: ASTM B 370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. (4.9-kg/sq. m) weight or 0.0216 inch (0.55 mm) thick or ASTM B 370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. (3.7-kg/sq. m) weight or 0.0162 inch (0.41 mm) thick.
 3. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
 4. Fabricate through-wall metal flashing embedded in masonry from stainless steel with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.
 - a. [Products](#): Subject to compliance with requirements, [available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) [Cheney Flashing Company](#); [Cheney Flashing (Dovetail)] [or] [Cheney 3-Way Flashing (Sawtooth)].
 - 2) [Keystone Flashing Company, Inc.](#); Keystone 3-Way Interlocking Thruwall Flashing.
 - 3) [Sandell Manufacturing Co., Inc.](#); Mechanically Keyed Flashing.
 5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
 6. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
 7. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/4 inch (13 mm) out from wall, with outer edge bent down 30 degrees[and hemmed].

8. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.
- B. Flexible Flashing: Use one of the following unless otherwise indicated:
1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than [0.030 inch (0.76 mm)] [0.040 inch (1.02 mm)].
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
 - 2) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
 - 3) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
 - 4) Hohmann & Barnard, Inc.; Textroflash.
 - 5) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
 - 6) Polyguard Products, Inc.; Polyguard 300
 - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- C. Application: Unless otherwise indicated, use the following:
1. Where flashing is indicated to receive counterflashing, use metal flashing.
 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or flexible flashing with a metal drip edge.
 4. Where flashing is fully concealed, use metal flashing or flexible flashing.
- D. Solder and Sealants for Sheet Metal Flashings:
1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
 2. Solder for Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

- 3. Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- F. Termination Bars for Flexible Flashing: Stainless steelbars 0.075 inch by 1 inch

2.11 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated. Color match to brick.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use[one of] the following unless otherwise indicated:
 - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
 - a. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Blok-Lok Limited; Cell-Vent.
 - 2) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
 - 3) Heckmann Building Products Inc.; No. 85 Cell Vent.
 - 4) Hohmann & Barnard, Inc.; Quadro-Vent.
 - 5) Wire-Bond; Cell Vent.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. **Products:** Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Advanced Building Products Inc.](#); Mortar Break
 - b. [Archovations, Inc.](#); CavClear Masonry Mat.
 - c. [Dayton Superior Corporation, Dur-O-Wal Division](#); Polytite MortarStop.
 - d. [Mortar Net USA, Ltd.](#); Mortar Net.
 2. Provide one of the following configurations:
 - a. Strips, full-depth of cavity and 10 inches (250 mm) high, with dovetail shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.
 - b. Strips, not less than [3/4 inch (19 mm)] [1-1/2 inches (38 mm)] thick and 10 inches (250 mm) high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
- F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
1. **Products:** Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Dayton Superior Corporation, Dur-O-Wal Division](#); D/A 810, D/A 812 or D/A 817.
 - b. [Heckmann Building Products Inc.](#); No. 376 Rebar Positioner.
 - c. [Hohmann & Barnard, Inc.](#); #RB or #RB-Twin Rebar Positioner.
 - d. [Wire-Bond](#); O-Ring or Double O-Ring Rebar Positioner.
- G. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [Diedrich Technologies, Inc.](#)
 - b. [EaCo Chem, Inc.](#)
 - c. [ProSoCo, Inc.](#)

2.12 **CAVITY-WALL INSULATION**

- A. Polyisocyanurate Board Insulation: ASTM C 1289, Type I (aluminum-foil-faced), Class 2 (glass-fiber-reinforced).
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.13 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use portland cement-lime mortar unless otherwise indicated.
 - 3. For reinforced masonry, use portland cement-lime mortar.
 - 4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type S.
 - 3. For exterior, above-grade, load-bearing, nonload-bearing walls, and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
- D. Pigmented Mortar: Use colored cement product
 - 1. Pigments do not exceed 10 percent of portland cement by weight.
- E. Grout for Unit Masonry: Comply with ASTM C476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.

2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.1.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 10 to 11 inches as measured in accordance with ASTM C143/C143M.

PART 3 : EXECUTION

3.01 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.03 TOLERANCES

A. Dimensions and Locations of Elements:

- 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
- 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
- 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

- 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
- 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
- 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
- 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
- 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
- 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
- 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

- 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
- 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
- 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.

4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.04 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond, do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than [2 inches] [4 inches]. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 1. Install compressible filler in joint between top of partition and underside of structure above.

3.05 MORTAR BEDDING AND JOINTING

- A. Lay CMUs and hollow brick as follows:
 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Set precast trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 2. Allow cleaned surfaces to dry before setting.
 3. Wet joint surfaces thoroughly before applying mortar.
 4. Rake out mortar joints for pointing with sealant.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
 1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.
- E. Cut joints flush where indicated to receive cavity wall insulation and air barriers unless otherwise indicated.

3.06 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
 1. Individual Metal Ties: Provide ties as indicated installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. of wall area spaced not to exceed 24 **inches** o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
 - a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.
 - b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) ties to allow for differential movement regardless of whether bed joints align.
 2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

- a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement.
 - c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement to allow for differential movement regardless of whether bed joints align.
 3. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Bond wythes of cavity walls together using bonding system indicated on Drawings.
- C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- D. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as indicated.
1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.07 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
1. Fasten anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 2. Embed tie sections in masonry joints.
 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

- B. Provide not less than 1 inch of airspace between back of masonry veneer and face of insulation.
 - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.08 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at **corners**, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.09 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

- C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 "Joint Sealants," but not less than 3/8 inch
 - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.10 LINTELS

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

3.11 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
 - 3. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under air barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar
 - 4. At lintels and shelf angles, extend flashing 6 inches minimum, to edge of next full unit at each end. At heads and sills, extend flashing 6 inches minimum, to edge of next full unit and turn ends up not less than 2 inches to form end dams.
 - 5. Interlock end joints of sawtooth sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.

6. Install metal drip edges with sawtooth sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
 7. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.
- E. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
1. Use specified weep/cavity vent products to form weep holes.
 2. Space weep holes 24 inches o.c. unless otherwise indicated.
 3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
- F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches, to maintain drainage.
1. Fill cavities full height by placing pea gravel in cavities as masonry is laid, so that at any point, masonry does not extend more than 24 inches above top of pea gravel.
- G. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.
- H. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products form cavity vents.

3.12 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.
- B. Inspections: Special inspections in accordance with Level 2 in TMS 402.
1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
- C. Testing Prior to Construction: One set of tests.
- D. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.
- E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

3.14 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to

match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

3.15 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 20 00 "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

- C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

WCU
Norton Intramural Fields
22-24232-01A

DIVISION 05

METALS



SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural-steel materials.
 - 2. Shrinkage-resistant grout.
- B. Related Requirements:
 - 1. Section 05 12 13 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
 - 2. Section 05 50 00 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other steel items not defined as structural steel.
 - 3. Section 09 96 00 "High-Performance Coatings" for painting requirements.

1.02 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.03 COORDINATION

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

1.04 ACTION SUBMITTALS

- A. Product Data:
 - 1. Structural-steel materials.
 - 2. High-strength, bolt-nut-washer assemblies.
 - 3. Anchor rods.
 - 4. Threaded rods.
 - 5. Shop primer.

6. Galvanized-steel primer.
 7. Etching cleaner.
 8. Galvanized repair paint.
 9. Shrinkage-resistant grout.
- B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment Drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 5. Identify members not to be shop primed.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Welding certificates.
- C. Product Test Reports: For the following:
1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 2. Tension-control, high-strength, bolt-nut-washer assemblies.
- D. Survey of existing conditions.
- E. Source quality-control reports.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Option 1: Connection designs have been completed and connections indicated on the Drawings.
- C. Moment Connections: Type FR, fully restrained.
- D. Construction: Shear wall system.

2.02 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles, M-Shapes: ASTM A36/A36M.
- C. Plate and Bar: ASTM A36/A36M.

- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C or ASTM A1085/ASTMA1085M structural tubing.
- E. Welding Electrodes: Comply with AWS requirements.

2.03 BOLTS AND CONNECTORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Mechanically deposited zinc coating.

2.04 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 36.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A563 heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A36/A36M carbon steel.
 - 4. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 5. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.05 PRIMER

- A. Steel Primer:
 - 1. Comply with Section 09 96 00 "High-Performance Coatings."
- B. Galvanized-Steel Primer: MPI#80,.
 - 1. Etching Cleaner: MPI#25, for galvanized steel.
 - 2. Galvanizing Repair Paint: ASTM A780/A780M.

2.06 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.07 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 1. Camber structural-steel members where indicated.

2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 3.
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.08 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened except where otherwise indicated.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.09 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Galvanized elements to be top coated shall not be quenched, and shall be swept blasted to ensure proper adhesion of top coats. Refer to architectural for full extents of galvanized elements requiring top coats.
2. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
3. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.
4. Galvanize all structural steel that is exposed to weather in its final installed condition

2.10 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces of high-strength bolted, slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces unless indicated to be painted.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
 1. SSPC-SP 6 (WAB)/NACE WAB-3.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.03 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.04 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Pretensioned.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.

3.05 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 09 96 00 "High-Performance Coatings."

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.

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Norton Intramural Fields
22-24232-01A

- 3) Ultrasonic Inspection: ASTM E164.

END OF SECTION

SECTION 05 12 13 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Architecturally exposed structural steel (AESS).
2. Section 05 12 00 "Structural Steel Framing" requirements that also apply to AESS.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other metal items not defined as structural steel.
2. Section 09 96 00 "High-Performance Coatings" for surface preparation and priming requirements.

1.02 DEFINITIONS

- A. AESS: Architecturally exposed structural steel.
- B. Category AESS 2: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 2 and is designated as AESS 2 or Category AESS 2 in the Contract Documents.
- C. SEAC/RMSCA Guide Specification: SEAC/RMSCA's "Sample Specification, Section 05 02 13: Architecturally Exposed Structural Steel."

1.03 COORDINATION

- A. Coordinate surface preparation requirements for shop-primed items.
- B. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

1.04 ACTION SUBMITTALS

- A. Product Data:
 - 1. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 2. Filler.
 - 3. Primer.
 - 4. Galvanized-steel primer.
 - 5. Etching cleaner.
 - 6. Galvanized repair paint.

- B. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS.
 - 1. Identify AESS category for each steel member and connection, including transitions between AESS categories and between AESS and non-AESS.
 - 2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 3. Include embedment Drawings.
 - 4. Indicate orientation of mill marks and HSS seams.
 - 5. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
 - 6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation and location of bolt heads.
 - 7. Indicate exposed surfaces and edges and surface preparation being used.
 - 8. Indicate special tolerances and erection requirements.
 - 9. Indicate weep holes for HSS and vent holes for galvanized HSS.
 - 10. Indicate surface preparation, primer, and coating requirements, including systems specified in other Sections.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling AESS to prevent twisting, warping, nicking, and other damage during fabrication, delivery, and erection. Store materials to permit easy access for inspection and identification. Keep AESS members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect AESS members and packaged materials from corrosion and deterioration.
 - 1. Do not store AESS materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.06 FIELD CONDITIONS

- A. Field Measurements: Where AECS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."

2.02 FILLER

- A. Polyester filler intended for use in repairing dents in automobile bodies.

2.03 PRIMER

- A. Steel Primer:
 - 1. Comply with Section 09 96 00 "High-Performance Coatings."
- B. Galvanized-Steel Primer: MPI#80.
 - 1. Etching Cleaner: MPI#25, for galvanized steel.
 - 2. Galvanizing Repair Paint: ASTM A780/A780M.

2.04 FABRICATION

- A. Shop fabricate and assemble AECS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
 - 1. Use special care handling and fabricating AECS before and after shop painting to minimize damage to shop finish.
- B. Category AECS 2:
 - 1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 - 2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.

3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
 4. Make intermittent welds appear continuous, using filler or additional welding.
 5. Seal weld open ends of hollow structural sections with 3/8-inch closure plates.
 6. Limit butt and plug weld projections to 1/16 inch.
 7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
 8. Remove weld spatter, slivers, and similar surface discontinuities.
 9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
 10. Grind tack welds smooth unless incorporated into final welds.
 11. Remove backing and runoff tabs, and grind welds smooth.
 12. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
 13. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
 14. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
 15. Conceal fabrication and erection markings from view in the completed structure.
 16. Make welds uniform and smooth.
- C. Erection marks, painted marks, and other marks are permitted on galvanized- steel surfaces of completed structure.

2.05 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
1. Joint Type: Pretensioned.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments, showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.03 ERECTION

- A. Take special care during erection to avoid marking or distorting the AESS and to minimize damage to shop painting. Set AESS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.
 1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
 2. Grind tack welds smooth.
 3. Remove backing and runoff tabs, and grind welds smooth.
 4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
 5. Remove erection bolts in Category AESS 2 AESS, fill holes with weld metal or filler, and grind or sand smooth to achieve surface quality approved by Architect.
 6. Fill weld access holes in Category AESS 2 AESS with weld metal or filler and grind, or sand smooth to achieve surface quality as approved by Architect.
 7. Conceal fabrication and erection markings from view in the completed structure.
- B. In addition to ANSI/AISC 303, Section 10 requirements, comply with the following.
 1. Erection of Category AESS 2:
 - a. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
 - b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 - c. Remove weld spatter, slivers, and similar surface discontinuities.

- d. Grind off butt and plug weld projections larger than 1/16 inch.
- e. Continuous welds are to be of uniform size and profile.
- f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
- g. Splice members only where indicated on Drawings.
- h. No torch cutting or field fabrication is permitted.

3.04 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Pretensioned.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

3.05 REPAIR

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and touchup galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting, to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 09 96 00 "High-Performance Coatings."

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to inspect AECS as specified in Section 05 12 00 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AECS in place to determine acceptability relating to aesthetic effect.

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END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 : GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous framing and supports.
- B. Products furnished, but not installed, under this Section include the following
 - 1. Loose steel lintels.
 - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- C. Related Requirements:
 - 1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
 - 2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

1.02 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.

1.03 ACTION SUBMITTALS

- A. Product Data:
 - 1. Fasteners.
 - 2. Slotted channel framing.
- B. Shop Drawings: Show fabrication and installation details. Show anchorage and accessory items.] Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.

1.04 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

2.01 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. 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.
 2. Galvanized Steel: ASTM A653/A653M, [commercial steel, Type B] [structural steel, Grade 33], with G90 coating; [0.108-inch] [0.079-inch] [0.064-inch] nominal thickness

2.02 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.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. 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] [Group 2].

- E. 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.
 - F. 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.
- B. Post-Installed Anchors: 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.
 - 3. 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.

2.03 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."
- B. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.04 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

2.05 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports at exterior and where indicated..
- D. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

2.06 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.
- C. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- D. Galvanize exterior miscellaneous steel trim.
- E. Prime exterior miscellaneous steel trim with primer specified in Section 099600 "High-Performance Coatings."]

2.07 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches unless otherwise indicated.
- C. Prime loose steel lintels located in exterior walls with primer specified in Section 099600 "High-Performance Coatings."

2.08 STEEL WELD PLATES AND ANGLE

- 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.

2.09 GENERAL FINISH REQUIREMENT

- 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.

2.10 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.

- 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.

PART 3 : EXECUTION

3.01 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.

3.02 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 ceiling-hung toilet partitions overhead doors securely to, and rigidly brace from, building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

3.03 INSTALLATION OF MISCELLANEOUS STEEL TRIM

- A. Anchor to concrete construction to comply with manufacturer's written instructions.

3.04 INSTALLATION OF LOOSE 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.

3.05 REPAIRS

- A. 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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22-24232-01A

DIVISION 06

WOOD, PLASTICS, AND COMPOSITES



SECTION 06 10 00 -

ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preservative-treated lumber.
3. Dimension lumber framing.
4. Miscellaneous lumber.
5. Plywood backing panels.

B. Related Requirements:

1. Section 06 16 36 "Wood Panel Product Sheathing" for sheathing, subflooring, and underlayment.
2. Section 06 17 53 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.
3. railings.

1.02 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. Lumber grading agencies, and abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. SPIB: The Southern Pine Inspection Bureau.

1.03 ACTION SUBMITTALS

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

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.04 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content:
 1. Boards: 15 percent.
 2. Dimension Lumber: 15 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1, Use categories as follows:
 1. UC2: Interior construction not in contact with ground but may be subject to moisture. Include the following items:
 - a. Wood plates that are attached to masonry or installed over concrete slabs-on-grade.

2. UC3A (Commodity Specification A): Coated sawn products in exterior construction not in contact with ground but exposed to all weather cycles including intermittent wetting. Include the following items:
 - a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - b. Wood siding and trim.
 3. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
- D. Application: Treat items indicated on Drawings, and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 3. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 DIMENSION LUMBER FRAMING

- A. Ceiling Joists: Construction or No. 2 grade.
1. Species:
 - a. Southern pine or mixed southern pine; SPIB.
 - b. Spruce-pine-fir; NLGA.
- B. Joists, Rafters, and Other Framing by Grade: No. 2 grade.
1. Species:
 - a. Southern pine; SPIB.

2.04 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Furring.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 - 2. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
- D. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.
- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.05 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.06 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.

- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

2.07 METAL FRAMING ANCHORS

- A. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches wide by 0.062 inch thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.
- B. Materials: Unless otherwise indicated, fabricate from the following materials:
 - 1. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
 - a. Use for interior locations unless otherwise indicated.

2.08 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets:
 - 1. Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- F. Do not splice structural members between supports unless otherwise indicated.
- G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- H. 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.
- I. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- J. 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.
- K. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
- L. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.

- M. 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.

3.02 INSTALLATION OF WOOD BLOCKING AND NAILERS

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

3.03 INSTALLATION OF CEILING JOIST AND RAFTER FRAMING

- A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
- B. Rafters: Notch to fit exterior wall plates and use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
- C. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.04 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.

END OF SECTION

SECTION 06 16 00

SHEATHING

PART 1 : GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Wall sheathing.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for plywood backing panels.
 - 2. Section 06 1616 – WOOD PANEL PRODUCT SHEATHING for Composite Roof Sheathing

1.02 ACTION SUBMITTALS

- A. Product Data:
 - 1. Wall sheathing.
- B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 3. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.
- B. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

1.04 DELIVERY, STORAGE, AND HANDLING

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

PART 2 : PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, are to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies are to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations tie-ins to other installed air barriers, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.02 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPAC U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat all plywood unless otherwise indicated

2.03 WALL SHEATHING

- A. Plywood Sheathing, Walls: DOC PS 1 Exterior, Structural I.
 - 1. Span Rating: Not less than 16/0.
 - 2. Nominal Thickness: Not less than 1/2 inch.

2.04 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
 - 2. For wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
- G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

PART 3 : EXECUTION

3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
- A. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
 - B. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
 - C. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
 - D. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

END OF SECTION 061600

SECTION 06 16 36 - WOOD PANEL PRODUCT SHEATHING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Composite nail base insulated roof sheathing.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for plywood backing panels.

1.02 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.01 WOOD PANEL PRODUCTS

- A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- B. Factory mark panels to indicate compliance with applicable standard.

2.02 WALL SHEATHING

- A. Plywood Sheathing, Walls: DOC PS 1, Exterior Exposure 1 sheathing.
1. Span Rating: Not less than 32/16.
 2. Nominal Thickness: Not less than 15/32 inch.
- B. Oriented-Strand-Board Sheathing, Walls: DOC PS 2, Exposure 1 sheathing.
1. Span Rating: Not less than 32/16.

2. Nominal Thickness: Not less than 15/32 inch.

2.03 ROOF SHEATHING

- A. Plywood Sheathing, Roofs: DOC PS 1, Exterior Exposure 1 sheathing.
 1. Span Rating: Not less than 32/16.
 2. Nominal Thickness: Not less than 5/8 inch.
- B. Oriented-Strand-Board Sheathing, Roofs: DOC PS 2, Exposure 1 sheathing.
 1. Span Rating: Not less than 32/16.
 2. Nominal Thickness: Not less than 5/8 inch.

2.04 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

- A. Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C1289, Type V with DOC PS 2, Exposure 1 oriented strand board on one face.
 1. Polyisocyanurate-Foam Thickness: as indicated.
 2. Oriented-Strand-Board Nominal Thickness: 7/16 inch.
- B. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C1289, Type II, Class 1, with DOC PS 2, Exposure 1 oriented strand board adhered to spacers on one face.
 1. Polyisocyanurate-Foam Thickness: as indicated.
 2. Oriented-Strand-Board Nominal Thickness: 7/16 inch.
 3. Spacers: Wood furring strips or blocks not less than 3/4 inch thick and spaced not more than 12 inches o.c.

2.05 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.02 INSTALLATION OF WOOD STRUCTURAL PANEL

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall and Roof Sheathing:
 - a. Nail to wood framing.
 - b. Space panels 1/8 inch apart at edges and ends.

3.03 FIELD QUALITY CONTROL

- A. Testing and Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

END OF SECTION

SECTION 06 17 15 - ENGINEERED STRUCTURAL WOOD

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural composite lumber.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for dimension lumber items associated with engineered structural wood.
 - 2. Section 06 17 53 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on adhesives, fabrication, and protection.
 - 2. For connectors, include installation instructions.

1.03 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in ASTM D5055 or ASTM D5456, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store, stack, and handle engineered wood products to comply with recommendations of APA EWS E705.
 - 1. Store wrapped or banded together until ready for installation, on level well-drained area. Do not store in direct contact with the ground. Use stickers to separate bundles, spaced as recommended in writing by manufacturer.
- B. Do not stack other material on top of structural composite lumber.

PART 2 - PRODUCTS

2.01 SOURCE LIMITATIONS

- A. Obtain each type of engineered wood product from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable design stresses, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.03 STRUCTURAL COMPOSITE LUMBER

- A. Laminated-Veneer Lumber (LVL): Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored in accordance with ASTM D5456, and manufactured with exterior-type adhesive complying with ASTM D2559.
 - 1.
 - 2. Allowable Stresses: as indicated.

2.04 FASTENERS

- A. General: Fasteners are to be of size and type indicated and to comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.
- E. Carbon Steel Bolts: ASTM A307 with ASTM A563 hex nuts and, where indicated, flat washers all hot-dip zinc coated.

- F. Stainless Steel Bolts: ASTM F593, Alloy Group 1 or 2; with ASTM F594, Alloy Group 1 or 2 hex nuts and, where indicated, flat washers.

2.05 METAL FRAMING ANCHORS

- A. Allowable design loads, as published by manufacturer, are to meet or exceed those of basis-of-design products. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.
- B. Materials: Unless otherwise indicated, fabricate from the following materials:
 - 1. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
 - a. Use for interior locations unless otherwise indicated.

PART 3 - EXECUTION

3.01 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. Verify that joist flange widths match hanger widths.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Do not install in direct contact with concrete or masonry.

3.03 INSTALLATION OF STRUCTURAL COMPOSITE LUMBER

- A. Install to comply with ESR report, manufacturer's written instructions, and applicable code.
 - 1. Install in dry, covered conditions where average in-service moisture content of lumber is 16 percent or less.
 - 2. Install metal framing connections in accordance with AWC's "National Design Specification (NDS) for Wood Construction." Install fasteners through each fastener hole.
 - a. Connections based on NDS or manufacturer's test or code reports.

3. Install lumber plumb and level. Accurately fit, align, securely fasten, and install free from distortion or defects.
 4. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
- B. Cutting: Confirm size and location of field cutting, notching, and drilling with ESR report, registered design professional, and manufacturer.

END OF SECTION

SECTION 06 17 53 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Wood products.

1.02 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.
- B. Shop Drawings: Show fabrication and installation details for trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 - 2. Indicate sizes, stress grades, and species of lumber.
 - 3. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 4. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 - 5. Show splice details and bearing details.
- C. Delegated Design Submittals: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For metal connector-plate manufacturer and fabricator.
- B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.

- C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.

1.05 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
 - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
 - 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 - 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 - 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, registered in the State of North Carolina, to design metal-plate-connected wood trusses.
- B. Structural Performance: Metal-plate-connected wood trusses are to be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 - 1. Design Loads: As indicated.

2. Maximum Deflection under Design Loads:
 - a. Roof Trusses: Vertical deflection of $1/360$ of span.
- C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.02 WOOD PRODUCTS

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (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. Provide dressed lumber, S4S.
 3. Provide dry lumber with 15 percent maximum moisture content at time of dressing.
- B. Minimum Chord Size for Roof Trusses: 2 by 6 inches nominal for both top and bottom chords.
- C. Minimum Specific Gravity for Top Chords: 0.50.
- D. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 06 10 00 "Rough Carpentry."

2.03 METAL CONNECTOR PLATES

- A. Fabricate connector plates to comply with TPI 1.
- B. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.
 1. Use for interior locations unless otherwise indicated.

2.04 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.

- B. Nails, Brads, and Staples: ASTM F1667.

2.05 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Allowable design loads, as published by manufacturer, are to comply with or exceed those of basis-of-design products. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.

2.06 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.07 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.

- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.
- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- H. Securely connect each truss ply required for forming built-up girder trusses.
 - 1. Anchor trusses to girder trusses as indicated.
- I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - 1. Install bracing to comply with Section 06 10 00 "Rough Carpentry."
- J. Install wood trusses within installation tolerances in TPI 1.
- K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- L. Replace wood trusses that are damaged or do not comply with requirements.
 - 1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

3.02 REPAIRS AND PROTECTION

- A. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Repair damaged galvanized coatings on exposed surfaces in accordance with ASTM A780/A780M and manufacturer's written instructions.

END OF SECTION

SECTION 06 20 13

EXTERIOR FINISH CARPENTRY

PART 1 : GENERAL

1.01 SUMMARY

A. Section Includes:

1. Exterior trim.
2. Lumber soffits.

1.02 ACTION SUBMITTALS

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

1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

B. Samples: For each exposed product and for each color and texture specified.

C. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

D. Samples for Verification:

1. For each species and cut of lumber and panel products, with half of exposed surface finished; 50 sq. in. for lumber and 8 by 10 inches for panels.
2. For engineered wood soffits, 50 sq. in. for board types and 8 by 10 inches for panels.

1.03 INFORMATIONAL SUBMITTALS

A. Compliance Certificates:

1. For lumber that is not marked with grade stamp.
 2. For preservative-treated wood that is not marked with treatment-quality mark.
- B. Evaluation Reports: For the following, from ICC-ES:
1. Wood-preservative-treated wood.
- C. Sample Warranties: For manufacturer's warranties.

1.04 DELIVERY, STORAGE, AND HANDLING

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

1.05 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 : PRODUCTS

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
 2. For exposed lumber, mark grade stamp on end or back of each piece[, or omit grade stamp and provide certificates of grade compliance issued by inspection agency].
- B. Softwood Plywood: DOC PS 1.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Water-Repellent Preservative Treatment by Nonpressure Process: AWP A N1; dip, spray, flood, or vacuum-pressure treatment.
 - 1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC), combined with an insecticide containing chlorpyrifos (CPF).
 - 2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
 - 3. Application: Exterior trim.
- B. Preservative Treatment by Pressure Process: AWP A U1; Use Category [UC3a] [UC3b].
 - 1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 18 percent, respectively.
 - 2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 3. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
 - 4. Do not use material that is warped or does not comply with requirements for untreated material.
 - 5. Mark lumber with treatment-quality mark of an inspection agency approved by the ALSC's Board of Review.

2.03 EXTERIOR TRIM

- A. Lumber Trim for Transparent Finish (Stain or Clear Finish):
 - 1. Species and Grade:
 - a. Southern pine; pressure-preservative treated; SPIB B & B.
 - 2. Maximum Moisture Content: 19 percent with at least 85 percent of shipment at 12 percent or less.
 - 3. Finger Jointing: Not allowed
 - 4. Face Surface: Surfaced (smooth).

2.04 LUMBER SOFFITS

- A. Provide kiln-dried lumber siding complying with DOC PS 20
- B. Species and Grade:
 - 1. Southern pine; SPIB B & B
- C. Pattern:
 - 1. V-edge, smooth-faced tongue and groove, actual face width (coverage) and thickness of 3-1/8 by 23/32 inch

2.05 MISCELLANEOUS MATERIALS

- A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. For face-fastening siding, provide ringed-shank siding nails or hot-dip galvanized-steel siding nails
 - 2. For pressure-preservative-treated wood, provide hot-dip galvanized-steel fasteners.
- B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.
- C. Flashing: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.
- D. Insect Screening for Soffit Vents: Aluminum, 18-by-16-inch black mesh
- E. Continuous Soffit Vents: Aluminum hat channel shape with perforations], 2 inches wide and in lengths not less than 96 inches.
 - 1. Net-Free Area: 6sq. in./linear ft.
 - 2. Finish: Mill finish.
- B. Round Soffit Vents:
 - 3. Stamped aluminum louvered vents, [2 inches] [2-1/2 inches] [3 inches] [4 inches] in diameter, made to be inserted in round holes cut in soffit.
 - a. Finish: Mill finish.
 - 4. Molded-plastic louvered vents, [2 inches] [2-1/2 inches] [3 inches] [4 inches] <Insert dimension> in diameter, made to be inserted in round holes cut in soffit.
- F. Sealants: Clear Silicone at wood finish.

2.06 FABRICATION

- A. Back out or kerf backs of standing and running trim wider than 5 inches, except members with ends exposed in finished work.
- B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

PART 3 : EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are

- wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed.
 - 1. Cut to required lengths and prime ends.

3.03 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
 - 1. Do not use manufactured units with defective surfaces, sizes, or patterns.
- C. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials.
 - 1. Use concealed shims where necessary for alignment.
 - 2. Scribe and cut exterior finish carpentry to fit adjoining work.
 - 3. Refinish and seal cuts as recommended by manufacturer.
 - 4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
 - 5. Coordinate exterior finish carpentry with materials and systems in or adjacent to it.
 - 6. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.04 INSTALLATION OF STANDING AND RUNNING TRIM

- A. Install flat-grain lumber with bark side exposed to weather.
- B. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary.
 - 1. Use scarf joints for end-to-end joints.
 - 2. Stagger end joints in adjacent and related members.
- C. Fit exterior joints to exclude water.
 - 1. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint.
 - 2. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.
- D. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.05 ADJUSTING

- A. Replace exterior finish carpentry that is damaged or does not comply with requirements.
 - 1. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.
- B. Adjust joinery for uniform appearance.

3.06 CLEANING

- A. Clean exterior finish carpentry on exposed and semiexposed surfaces.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.

3.07 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062013

END OF SECTION

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22-24232-01A

DIVISION 07

**THERMAL AND MOISTURE
PROTECTION**



SECTION 07 19 00

WATER REPELLENTS

PART 1 : GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:
 - 1. Natural stone.
- B. Clay brick masonry.
 - 1. Natural stone.

1.03 PERFORMANCE REQUIREMENTS

- A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.
 - 1. Water Repellents: Comply with performance requirements specified, as determined by testing on manufacturer's standard substrate assemblies representing those indicated for this Project.
- B. Water Absorption: Minimum 80 percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.
 - 1. Clay Brick: ASTM C 67.
 - 2. Natural Stone: ASTM C 97.
- C. Water-Vapor Transmission: Comply with one or both of the following:
 - 1. Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, according to ASTM E 96/E 96M.
 - 2. Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, according to ASTM D 1653.

- D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, according to ASTM E 514.
- E. Durability: Maximum 5 percent loss of water-repellent properties after 2500 hours of weathering according to ASTM G 154 in comparison to water-repellent-treated specimens before weathering.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include manufacturer's printed statement of VOC content.
 - 2. Include manufacturer's standard colors.
 - 3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.
- B. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Applicator.
- B. Product Certificates: For each type of water repellent, from manufacturer.
- C. Preconstruction Testing Reports: For water-repellent-treated substrates.
- D. Warranty: Special warranty specified in this Section.

1.06 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.
- B. Mockups: Apply water repellent to each type of substrate required.
 - 1. Locate each test application as directed by Architect.
 - 2. Size: 10 sq. ft..
 - 3. Final approval by Architect of water-repellent application will be from test applications.
- C. Preinstallation Conference: Conduct conference at Project site.

1.07 PROJECT CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
1. Building has been closed in for not less than 30 days before treating wall assemblies.
 2. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
 3. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
 4. Rain or snow is not predicted within 24 hours.
 5. Not less than seven days have passed since surfaces were last wet.
 6. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.
- a. Warranty Period: Five years from date of Final Acceptance.

PART 2 : PRODUCTS

2.01 PENETRATING WATER REPELLENTS

- A. Silane, Penetrating Water Repellent: Clear, containing 20 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Advanced Chemical Technologies, Inc.; Sil-Act ATS-100.
 - b. BASF Construction Chemicals, LLC; Enviroseal 20 .

- c. Degussa Corp; Protectosil Aqua-Trete 20 .
- d. PROSOCO, Inc.; SL100.

PART 3 : EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
 - 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
 - 2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
 - 3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 - 4. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions[**and as follows:**][.]
 - 1. Clay Brick Masonry: ASTM D 5703.
 - 2. Natural Stone: ASTM C 1515.
- B. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

- C. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
 - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.03 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, using 15 psi- pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
 - 1. At Contractor's option, first application of water repellent on units may be completed before installing them. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces.
- C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.04 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 07 21 00

THERMAL INSULATION

PART 1 : GENERAL

1.01 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.(perimeter foundations)
2. Polyisocyanurate foam-plastic board insulation-n. (Wall/soffit)
3. Glass-fiber blanket insulation. (Ceiling/soffits)

B. Related Requirements:

1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
2. Section 061600 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
3. SECTION 06 16 36 – “Wood Panel Product Sheathing” for composite roof decking at standing seam metal roof.

1.02 ACTION SUBMITTALS

A. Product Data:

1. Extruded polystyrene foam-plastic board insulation.
2. Polyisocyanurate foam-plastic board insulation.
3. Glass-fiber blanket insulation.

1.03 INFORMATIONAL SUBMITTALS

- A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

1.04 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

2.01 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.
- B. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- C. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
- D. Thermal-Resistance R-value as indicated on Drawings in accordance with ASTM C518.

2.02 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
 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. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. Pactiv Building Products.
 2. Type IV, 25 psi.

2.03 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

- A. Polyisocyanurate Board Insulation, Foil Faced where no vapor barrier is installed: ASTM C1289, foil faced, Type I, Class 1 or 2.

2.04 MINERAL-WOOL BLANKET INSULATION

- A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

2.05 INSULATION FASTENERS

- A. 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.
- B. 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. Crawl spaces.
 - b. Ceiling plenums.
 - c. Attic spaces.
- C. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of [1 inch] [2 inches] [3 inches] between face of insulation and substrate to which anchor is attached.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.06 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

3.01 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.

3.02 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. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. 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.

3.03 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.04 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer.
 - 1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
 - 2. Press units firmly against inside substrates.
 - 3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.05 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. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 - 5. For wood-framed construction, install blankets in accordance with ASTM C1320 and as follows:
 - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
 - 6. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

3.06 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. 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 07 27 13 MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 : GENERAL

1.01 SUMMARY

- A. Section Includes: Self-adhering, vapor-retarding, air barrier.
 - 1. Modified bituminous sheet.

1.02 DEFINITIONS

- A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.
- C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

1.03 ACTION SUBMITTALS

- A. Product Data: Self-adhering, vapor-retarding, sheet air barrier. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; and tested physical and performance properties of products.
 - 1. Modified bituminous sheet.
- B. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air barrier materials, accessories, and assemblies specific to Project conditions.
 - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 3. Include details of interfaces with other materials that form part of air barrier.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- D. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ ABAA-certified installers and supervisors on Project.

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 FIELD CONDITIONS

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

PART 2 : PRODUCTS

2.01 SOURCE LIMITATIONS

- A. Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum **0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft.** , when tested in accordance with ASTM E2357.

2.03 SELF-ADHERING SHEET AIR BARRIER

- A. Modified Bituminous Sheet: 40-mil- thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick, cross-laminated polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits of authorities having jurisdiction.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW-705.
 - b. Grace, W. R. & Co. - Conn.; Perm-A-Barrier Wall Membrane.
 - c. Henry Company; [Blueskin SA] [or] [Blueskin SA LT].
 - d. Meadows, W. R., Inc.; SealTight Air-Shield.
 - e. Tremco Incorporated, an RPM company; ExoAir 110/110LT.
 - 2. Physical and Performance Properties:
 - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
 - b. Tensile Strength: Minimum 250 psi ASTM D 412, Die C.
 - c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
 - d. Puncture Resistance: Minimum 40 lbf ; ASTM E 154.
 - e. Water Absorption: Maximum 0.15 percent weight gain after 48-

- hour immersion at 70 deg F; ASTM D 570.
- f. Vapor Permeance: Maximum 0.05 perm , ASTM E 96/E 96M, Water Method.
- g. UV Resistance: Can be exposed to sunlight for **60** days in accordance with manufacturer's written instructions.

2.04 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid **waterborne** primer recommended for substrate by air-barrier material manufacturer.

PART 3 : EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
 - 3. Verify that substrates are visibly dry and free of moisture. **Test concrete substrates for capillary moisture by plastic sheet method in accordance with ASTM D4263.**
 - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and

overspray affecting other construction.

- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- H. Bridge **isolation, control and expansion joints** and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

3.03 INSTALLATION OF SELF-ADHERING SHEET AIR BARRIER

- A. Install materials in accordance with air-barrier manufacturer's written instructions and details and in accordance with recommendations in ASTM D6135 to form a seal with adjacent construction and ensure continuity of air and water barrier.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F.
 - 2. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
- B. Prepare, treat, and seal inside and outside corners and vertical and horizontal surfaces at terminations and penetrations with termination mastic and in accordance with ASTM D6135.
- C. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas

exposed for more than 24 hours.

- D. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.
 - 1. Apply sheets in a shingled manner to shed water.
 - 2. Roll sheets firmly to enhance adhesion to substrate.
- E. Apply continuous air-barrier sheets over accessory strips bridging substrate cracks, construction, and contraction joints.
- F. CMU: Install air-barrier sheet horizontally against the CMU beginning at base of wall. Align top edge of air-barrier sheet immediately below protruding masonry ties or joint reinforcement or ties, and firmly adhere in place.
 - 1. Overlap horizontally adjacent sheets a minimum of 2 inches and roll seams.
 - 2. Apply overlapping sheets with bottom edge slit to fit around masonry reinforcing or ties. Roll firmly into place.
 - 3. Seal around masonry reinforcing or ties and penetrations with termination mastic.
 - 4. Continue the sheet into all openings in the wall, such as doors and windows, and terminate at points to maintain an airtight barrier that is not visible from interior.
- G. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch-wide, transition strip.
- H. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- I. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
 - 1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install transition strip on roofing membrane or base flashing so that a

minimum of 3 inches of coverage is achieved over each substrate.

- J. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- K. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.
- L. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- M. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply **transition strip** so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
 - 1. Transition Strip: Roll firmly to enhance adhesion.
- N. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- O. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.
- P. Do not cover air barrier until it has been tested and inspected by testing agency.
- Q. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.04 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.
 - 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these

conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with air-barrier manufacturer's written instructions.

2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

- B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

SECTION 07 4113.16 STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes standing-seam metal roof panels.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.07 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.08 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Final Acceptance.

- B.** Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Final Acceptance.
- C.** Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 20 years from date of Final Acceptance.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A.** Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B.** Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- C.** Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.

- D.** Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. STANDING-SEAM METAL ROOF PANELS

1. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 - a. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
2. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels : Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced matching the existing adjoining roof between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:
 - 1) AEP Span; a BlueScope Steel companyBerridge Manufacturing Company.
 - 2) CENTRIA Architectural Systems.
 - 3) MBCI; a division of NCI Building Systems, L.P.
 - 4) Morin; a Kingspan Group company.
 - 5) Petersen Aluminum Corporation/PAC Clad.
 - b. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM

A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

- 1) Nominal Thickness: 22 gauge .
- 2) Exterior Finish: Two-coat fluoropolymer .
- 3) Color: As Selected from Manufacturer from Full Range
- c. Clips: Two-piece floating to accommodate thermal movement.
 - 1) Material: 0.028-inch- nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
- d. Joint Type: Double folded.
- e. Panel Coverage: 16 inches.
- f. Panel Height: 2.0 inches .

2.02 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
 3. Products: Subject to compliance with requirements, provide one of the following or equal:
 - a. Grace Construction Products, a unit of W. R. Grace & Co.; Grace Ice and Water Shield HT .
 - b. Henry Company; Blueskin PE200 HT.
 - c. Owens Corning; WeatherLock Metal High Temperature Underlayment.
 4. See Wood Panel Product Sheathing 06 16 36

2.03 MISCELLANEOUS MATERIALS

- A.** Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B.** Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C.** Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D.** Gutters and Gutter Expansion Joint: Formed to match existing gutters and from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
- E.** Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
- F.** Roof Curbs: Fabricated from same material as roof panels, nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch- nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to

withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 2-inch- thick, rigid insulation.
- G.** Panel Fasteners: Self-tapping screws designed to withstand design loads and of length to fasten through sheathing and rigid insulation to metal deck.
- H.** Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inchthick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.04 FABRICATION

- A.** General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B.** On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C.** Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D.** Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E.** Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.05 FINISHES

- A.** Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B.** Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C.** Steel Panels and Accessories:
 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.

3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.03 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
 1. Apply over the entire roof surface.

- B.** Cover Board: Mechanically attached past rigid insulation and through roof deck as required by UL guidelines for wind uplift resistance.
- C.** Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07 6200 "Sheet Metal Flashing and Trim."

3.04 METAL PANEL INSTALLATION

- A.** General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B.** Fasteners:
 - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C.** Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D.** Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

- E.** Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
1. Install clips to supports with self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 4. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F.** Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
- G.** Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 1. Provide elbows at base of downspouts to direct water away from building.
 2. Connect downspouts to underground drainage system indicated.
- J. Roof Curbs: Install flashing around bases where they meet metal roof panels.
- K. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.05 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.06 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

3.07 CLEANING AND PROTECTION

- A.** Protect Coverboard installations from damage and deterioration until the date of substantial completion.
- B.** Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- C.** Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 42 13.13

FORMED METAL WALL PANELS

PART 1 : GENERAL

1.01 SUMMARY

A. Section Includes:

1. Exposed-fastener, lap-seam metal wall panels.

B. Related Requirements:

1.02 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

1. Exposed-fastener, lap-seam metal wall panels.
2. Concealed-fastener, lap-seam metal wall panels.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.

1. Include Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

- B. Product Test Reports: For exposed-fastener, lap-seam metal wall panels, for tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.07 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.08 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
- B. Failures include, but are not limited to, the following:
 - 1. Structural failures including rupturing, cracking, or puncturing.
 - 2. Deterioration of metals and other materials beyond normal weathering.
- C. Warranty Period: Two years from date of Final Acceptance.
- D. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Final Acceptance.

PART 2 : PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.02 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Box-Rib-Profile, Exposed-Fastener Metal Wall Panels <Insert drawing designation>: Formed with raised, box-shaped ribs, evenly spaced across panel width, and with rib/recess sides angled 60 degrees or more.
 1. Manufacturers
 - a. Basis of Design PacClad Box Rib 1 or equal by manufacturer's including but not limited to:
 - 1) Peterson Aluminum
 - 2) PacClad
 - 3) Centria
 - 4) McElroy
 2. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: 0.040 inch.
 - b. Surface: Smooth, flat finish.
 - c. Exterior Finish: Two-coat fluoropolymer
 - d. Color: As selected by Architect from manufacturer's full range

3. Rib Spacing: Basis of Design PacClad Box Rib 1 or equal by above manufacturers.

4. Panel Height: 12 inches

2.03 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners[and factory-applied sealant] in side laps. Include accessories required for weathertight installation.
- B. Reveal-Joint, Concealed-Fastener Metal Wall Panels Formed with vertical panel edges and [intermediate stiffening ribs symmetrically spaced] [a flat pan] between panel edges; with narrow reveal joint between panels.

1. Manufacturers

a. Basis of Design PacClad Reveal Wall Panel or equal by manufacturer's including but not limited to:

- 1) Peterson Aluminum
- 2) PacClad
- 3) Centria
- 4) McElroy

2. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

- a. Thickness: 0.040 inch]
- b. Surface: Smooth, flat finish.
- c. Exterior Finish: Two-coat fluoropolymer
- d. Color: As selected by Architect from manufacturer's full range.

3. Panel Coverage: 7 inch with 1 ½ inch reveal (No V groove allowed)

2.04 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 - 2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.05 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual, 7th Edition" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual, 7th Edition" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.06 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions

or
 - 2. Mica Fluoropolymer: AAMA 2605. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 : EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected

3.02 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.03 INSTALLATION OF METAL PANELS

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
- B. Fasteners:
 - 1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 - 1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.

2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

E. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual, 7th Edition." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints

allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.04 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 42 43.11

HIGH DENSITY TIMBER PANEL

PART 1 : GENERAL

1.01 SUMMARY

- A. Supply and install pre-finished composite concealed mounted wood veneer panel exterior wall cladding rainscreen product.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's data sheet on each product to be used including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Quality Assurance: Certified test results from independent testing laboratory substantiating specified performance characteristics and physical properties.
- C. Design Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, wood grain orientation and finish colors.
- D. Samples: Submit two complete sets of color swatches representing manufacturer's full range of available colors, grain patterns and materials for each panel finish specified.
- E. Installer Qualifications: Certification stating that installer is experienced in the installation of the specified products, and who has completed installations similar in extent and design with a record of successful performance.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials to site in Manufacturer's original, unopened packaging, with labels clearly identifying product name and manufacturer.
- B. Panel Storage: Place inspected panels in a well ventilated enclosed place. Horizontal Storage: Lay panels on an elevated flat surface with maximum 24" between supports to ensure even distribution of loads. Storage Time: Cannot exceed five months as of factory dispatch date. Protective peel-off sheet must be removed immediately after panel is installed.
- C. ACCLIMATIZATION
 - 1. All boxes shall be opened and all components removed from the packaging and stacked flat with spacers between the pieces in their final environment for a minimum 3-4 days prior to installation. All components shall be conditioned in their final environment (temperature and humidity) for a least 4 days prior to installation. This is especially important for lineal material.
 - 2. PROJECT CONDITIONS
 - a. Do not install material under environmental conditions where it is likely to be immersed in water, or where the temperature is likely to exceed 120 degrees Fahrenheit for extended periods of time.

PART 2 : PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- 1. Prodema Prodex
- 2. Finland Color Plywood Corporation : Parklex Facade
- 3. Trespa

2.02 Composite Wood Veneer Exterior Wall Panel.

- A. Panels: Grade A rotary cut hardwood veneer from farmed forests and bonded to thermosetting phenol formaldehyde resin core.
- B. Colors to be as selected from Full Range of Wood Veneer

- C. Panel Dimensions: 96" (2440 mm) long x 48" (1220 mm) wide x (8 mm thick) or as shown on architectural drawings.
- D. Mounting : Visible mill finish screws on Manufacturer's Framing System
- E. All panels to be place with grain running end to end.

PART 3 : EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
 - 1. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
 - 2. Verify compatibility of different metallic surfaces in contact with each other to protect against electro-chemical corrosion.

3.02 PREPARATION

- A. Walls should be reasonably flat and plumb, but do not need to be smooth. Special blocking may be used to ensure a plumb sub-frame from which to mount the panels
 - 1. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions..
 - 2. If using metal furring (minimum recommended thickness) Aluminum – .080", Steel - .060"
 - a. Protect metal surface in contact with concrete, masonry mortar, plaster or other cementitious surface with isolation coating.
 - b. DO NOT use caulking, gaskets or sealants on panel face or edges.

3.03 INSTALLATION

- A. Protect all sub-surfaces with air barrier prior to mounting the rainscreen sub-frame.
 - 1. As with most rainscreen products a ventilated minimum unobstructed airspace of 20mm (3/4")_ is required between the structural wall and the back surface of the panels. A minimum gap of 6mm (1/4") between panels is also required along all perimeter edges.

2. All panels must be mounted onto vertical furring and must maintain a minimum 20mm (3/4") unobstructed vertical airspace to ensure proper air circulation.
 3. All ventilated facades must maintain an opening of .8" (20mm) at base and top to promote proper airflow (i.e. convention).
 4. Gap (Joint space) along all panel edges: > .6mm – 8mm. Consult manufacturer for special gap conditions.
 5. Cutting: Using a static circular saw with moving blade at 4000 – 6000 RPM is strongly recommended.
 - a. A sharp tungsten carbide or diamond edge blade must be used to prevent splintering and affecting the face of the panel.
 - b. Circular Saw: Cut panels with finished face up at a rate of approximately 20-60 ft./min.
 - c. You may lightly sand cut edges to ensure a clean, crisp edge to the protective coating. Do not sand panel face.
 - d. No finishing or sealing required after cutting.
 6. Prior to mounting, pre-drill .32" (8mm) diameter holes when using metal furring and .29" (7.40mm) diameter holes when using wood furring to install panels with the manufacturer approved screws.
 - a. Holes must be within .6" to 1.5" from the panel edge.
 - b. Do not over tighten fasteners as this can damage the outer coating and inhibit thermal expansion.
 - c. Screws placement must be respected using the following maxtrix:
- B. These measurements represent the maximum distance between fasteners.
- C. Distance between fasteners (Flat Wall). All panel in excess of 12" wide must be supported by a minimum of three vertical furring.

Panel Thickness (mm)	Distance Between Fastener
.125" (3mm)	12" (300 mm)
.25" (6mm or 8mm)	16" (400 mm)
.32" (8mm) or .40" (10mm)	24" (600 mm)
.5" (12mm)	32" (800 mm)
.55" (14mm), .63" (16mm), .71" (18mm), .79" (20mm)	40" (1000 mm)

.87" (22mm)	
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3.04 **MAINTENANCE**

- A. **IMPORTANT:** The relevant safety guidelines must be observed when using solvents and chemical cleaning products.
1. Prodema panels have a dirt-repellent surface. Over time, however, it may be necessary to clean the surface to restore the panels to their initial appearance. The only maintenance the Prodema panels require is cleaning, if necessary. The panels do not require any other wood-preservation treatment.
 2. Recommended guidelines for regular cleaning:
 - a. Always use NON-ABRASIVE household detergents dissolved in water.
 - b. Never use abrasive cleaning powders or pastes as they may scratch the surface of the panels.
 - c. Always rinse with plenty of clean water to prevent the appearance of rings. The panels do not need to be dried afterwards.
 - d. To prevent damage to the surface use soft, clean cloths and sponges.
 - e. Never use steel wool or Scotch Brite scouring pads as they may scratch the surface.
 3. Remove graffiti with clean smooth cloth and alcohol.

END OF SECTION

SECTION 076200

SHEET METAL FLASHING AND TRIM

PART 1 : GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Wall sheet metal fabrications.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Section SECTION 04 20 00 - UNIT MASONRY for materials and installation of manufactured sheet metal through-wall flashing and trim integral with masonry.
 - 3. Section SECTION 07 4113.16 - STANDING-SEAM METAL ROOF PANELS for materials and installation of sheet metal flashing and trim integral with roofing.
 - 4. Section SECTION 07 4213.13 – FORMED METAL WALL PANELS for sheet metal flashing and trim integral with metal wall panels.

1.02 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.03 ACTION SUBMITTALS

- A. Product Data:
 - 1. Wall sheet metal fabrications.
 - 2. Miscellaneous sheet metal fabrications.
- B. Product Data Submittals:
 - 1. Underlayment materials.
 - 2. Elastomeric sealant.
 - 3. Butyl sealant.
 - 4. Epoxy seam sealer.
- C. Shop Drawings: For sheet metal flashing and trim.

1. Include details for forming, including profiles, shapes, seams, and dimensions.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

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

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

PART 2 : PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual, 7th Edition" requirements for dimensions and

profiles shown unless more stringent requirements are indicated.

2.02 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled)
 - 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.

2.03 UNDERLAYMENT MATERIALS

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

2.04 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless steel rivets

suitable for metal being fastened.

- c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
- 2. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
- C. Solder:
 - 1. For Stainless Steel: ASTM B32, [Grade Sn60] [Grade Sn96], with acid flux of type recommended by stainless steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.
- G. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated [with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
 - 1. Source Limitations: Obtain reglets from single source from single manufacturer.
 - 2. Material: Stainless steel, 0.0188 inch thick.
 - 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 - 4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 - 5. Accessories:

- a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
- b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

H. Finish: Mill

2.05 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
 - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
 - 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
 - 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
 - 2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.

- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams:
 - a. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- G. Do not use graphite pencils to mark metal surfaces.

2.06 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:
 - a. Stainless Steel: 0.0156 inch thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:
 - a. Stainless Steel: thick.

PART 3 : EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF UNDERLAYMENT

- A. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.
1. Install in shingle fashion to shed water.
 2. Lapp joints not less than 4 inches.

3.03 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder
 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
 6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 7. Do not field cut sheet metal flashing and trim by torch.
 8. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
 - 1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated.
 - a. Form joints to completely conceal sealant.
 - b. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
 - c. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F.
- G. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- H. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
 - 1. Stainless Steel Soldering:
 - a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
 - b. Promptly remove acid-flux residue from metal after tinning and soldering.
 - c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.04 INSTALLATION OF WALL FLASHINGS

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

3.05 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.06 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

3.07 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 07 92 00

JOINT SEALANTS

PART 1 : GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
- B. Related Sections:
 - 1. Section 04 2000 "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
 - 2. Section 09 2900 "Gypsum Board" for sealing perimeter joints.

1.02 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. 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.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- B. Warranties: Sample of special warranties.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from

single manufacturer.

1.05 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.

PART 2 : PRODUCTS

2.01 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. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- 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. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- E. 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.

- F. 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.
- G. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.02 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
 - 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. Dow Corning Corporation
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc
 - d. Pecora Corporation
 - e. Tremco Incorporated

2.03 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems; Sonolac.
 - b. Bostik, Inc.; Chem-Calk 600.
 - c. May National Associates, Inc.; Bondaflex Sil-A 700.
 - d. Pecora Corporation; AC-20+.
 - e. Schnee-Morehead, Inc.; SM 8200.
 - f. Tremco Incorporated; Tremflex 834.

2.04 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the

following:

- a. Pecora Corporation
- b. USG Corporation; SHEETROCK Acoustical Sealant.
- c. National Gypsum
- d. Certaineed

2.05 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), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2.06 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

3.01 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.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 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 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.
- E. 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.

- F. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
 2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
 3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- G. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.
- H. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.04 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.

3.05 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.

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.END OF SECTION

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DIVISION 08

OPENINGS



SECTION 08 11 13 **HOLLOW METAL DOORS AND FRAMES**

PART 1 : GENERAL

1.01 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 - a. Section 087100 "Door Hardware (Descriptive Specification)" for door hardware for hollow-metal doors.

1.02 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.03 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.

7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 : PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ceco Door Products; an Assa Abloy Group company.
 2. Curries Company; an Assa Abloy Group company.
 3. Custom Metal Products.
 4. Steelcraft; an Ingersoll-Rand company.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.02 INTERIOR DOORS AND FRAMES (Located within complete enclosed interior rooms, not covered exterior areas)

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Uncoated cold-rolled steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - d. Edge Construction: Model 1, Full Flush
 - e. Core: Vertical steel stiffener.
3. Frames:
 - a. Materials: Uncoated, steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Construction: Full profile welded.
4. Exposed Finish: Prime.

2.03 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Maximum-Duty Doors and Frames: SDI A250.8, Level 4.
 1. Physical Performance: Level A according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm.)
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm), with minimum A40 (ZF120) coating.
 - d. Edge Construction: Model 1, Full Flush
 - e. Core: Polyisocyanurate with Steel Stiffener.
 - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.
 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm), with minimum A40 (ZF120) coating.
 - b. Construction: Full profile welded.
 4. Exposed Finish: Factory.

2.04 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

2.05 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) 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.
- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- H. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

- I. 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.
- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.06 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 - 2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm)]
 - 3. Top Edge Closures: Close top edges of doors with [nverted closures, except provide flush closures at exterior doors of same material as face sheets.
 - 4. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
 - 5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 3. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:

- 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
- b. Compression Type: Not less than two anchors in each frame.
- c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
4. Head Anchors: Two anchors per head for frames more than 42 inches (1067 mm) wide and mounted in metal-stud partitions.
5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with [butted] [or] [mitered] hairline joints.
 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow-metal work.
 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.07 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

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22-24232-01A

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.
- B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.
 1. Color and Gloss: Match Architect's sample

2.08 ACCESSORIES

- A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.
 1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
 2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 : EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Install frames with removable stops located on secure side of opening.
 - c. Install door silencers in frames before grouting.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
 - c. At Bottom of Door: [3/4 inch (19.1 mm)] [5/8 inch (15.8 mm)] plus or minus 1/32 inch (0.8 mm).
 - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

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22-24232-01A

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.04 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

END OF SECTION

SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 : GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Insulated service doors.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 - 5. Show locations of controls, locking devices, and other accessories.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer
- B. Sample Warranty: For special warranty.

1.04 CLOSEOUT SUBMITTALS

- A. Special warranty.
- B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

1.06 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Final Acceptance.

PART 2 : PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
- B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
 - 1. Design Wind Load: As indicated on Drawings
 - 2. Testing: According to ASTM E330/E330M or DASMA 108 for garage doors and complying with acceptance criteria of DASMA 108 .
 - 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
 - 4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20-lbf/sq. ft.] wind load, acting inward and outward.

- C. Seismic Performance: Overhead coiling doors are to withstand the effects of earthquake motions determined according to ASCE/SEI 7.

- 1. Component Importance Factor: as indicated on drawings.

2.03 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Manufacturers
 - a. Cookson
 - b. Raynor
 - c. Cornell
 - d. Overhead Door
 - e. Clopay
- B. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 - 1. Include tamperproof cycle counter.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft at 15 and 25 mph when tested according to ASTM E283.
- D. Insulated Door Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.
- E. Insulated Door Assembly U-Factor: 0.90 Btu/deg F x h x sq. ft..
- F. Door Curtain Material: Aluminum.
- G. Door Curtain Slats: Flat profile slats of 1-7/8-inch center-to-center height.
 - 1. Insulated-Slat Interior Facing: Metal.
 - 2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- H. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from aluminum extrusions and finished to match door.
- I. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats.

- J. Hood: Match curtain material and finish -Aluminum.
 - a. Shape: Square
 - b. Mounting: Face of wall
- K. Locking Devices: Equip door with locking device assembly keyed to campus cores. See Hardware specification.
 - 1. Locking Device Assembly: Cremone-type, both jamb sides locking bars, operable from inside and outside with cylinders.
- L. Manual Door Operator: Chain-hoist operator

2.04 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Aluminum Door Curtain Slats: ASTM B209 sheet or ASTM B221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch; and as required.
 - 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
 - 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum aluminum thickness of 0.032 inch.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.05 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is

attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Aluminum: 0.040-inch- thick aluminum sheet complying with ASTM B209, of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.

2.06 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 1. Lock Cylinders: As specified in Section 087100 "Door Hardware"
 2. Keys: 8 for each cylinder.
- B. Chain Lock Keeper: Suitable for padlock.

2.07 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
 1. At door head, use 1/8-inch- thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
 2. At door jambs, use replaceable, adjustable, continuous, nylon brushes
- B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
- C. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches high.
- D. Pole Hooks: Provide pole hooks and poles for doors more than 84 inches high.

2.08 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.09 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 ALUMINUM FINISHES

- A. Mill Finish: Manufacturer's standard.
- B. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 : EXECUTION

3.01 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.

3.03 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.04 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Final Acceptance, maintenance service includes months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.
 - 2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

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22-24232-01A

3.05 DEMONSTRATION

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

END OF SECTION 083323

SECTION 08 41 13 ALUMINUM-FRAMED ENTRANCES & STOREFRONTS

PART 1 : GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Storefront framing for window walls.
 - 2. Storefront framing for punched openings.
- B. Related Sections:
 - 1. Section 088000 "Glazing" for systems without aluminum support framing.

1.02 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Glazing-to-glazing contact.
 - e. Noise or vibration created by wind and by thermal and structural movements.

- f. Loosening or weakening of fasteners, attachments, and other components.
 - g. Failure of operating units.
 - 4. Structural Loads: As indicated on Drawings.
 - 5. Wind Loads: As indicated on Drawings.
 - 6. Seismic Loads: As indicated on Drawings
- B. Deflection of Framing Members:
 - 1. Deflection Normal to Wall Plane: Limited to [edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite] [$1/175$ of clear span for spans up to 13 feet 6 inches (4.1 m) and to $1/240$ of clear span plus $1/4$ inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m)] <Insert deflection limit> or an amount that restricts edge deflection of individual glazing lites to $3/4$ inch (19 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to [$L/360$ of clear span or $1/8$ inch (3.2 mm), whichever is smaller] [amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below them to less than $1/8$ inch (3.2 mm) and clearance between members and operable units directly below them to less than $1/16$ inch (1.5 mm).
- C. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
 - 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2percent of span.
 - 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- D. ASTM E 283 requires using a static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa) unless otherwise indicated, which is equivalent to a 25-mph (40-km/h) wind. Static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa) is equivalent to a 50-mph (80-km/h) wind.

- E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa).
- F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa)
- G. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa)] .
- H. AAMA 501.1's definition of water leakage allows up to 1/2 oz. (15 mL) of water to accumulate in a 15-minute period on an interior stop or stool integral to system.
- I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
- J. Insert U-factors of specific system components in first paragraph below if required for Project; options are examples only.
- K. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) when tested according to AAMA 1503.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 - 2. Retain subparagraph below for entrance systems or insert specific hardware schedule requirements.

3. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
 1. Revise subparagraphs below to suit Project.
 2. Joinery, including concealed welds.
 3. Anchorage.
 4. Expansion provisions.
 5. Glazing.
 6. Flashing and drainage.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer
- B. Seismic Qualification Certificates: For aluminum-framed systems, accessories, and components, from manufacturer.
- C. Welding certificates.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.
- E. Warranties: Sample of special warranties.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- B. Retain first paragraph below if aluminum-framed-systems manufacturer selects testing agency or if Contractor is required to provide services of a qualified testing agency in "Field Quality Control" Article. Qualification requirements are in addition to those specified in Section 014000 "Quality Requirements" which also includes the definition for "NRTL" (nationally recognized testing laboratory).
- C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- D. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- E. Retain first paragraph below for structural-sealant-glazed systems.
- F. Quality-Control Program for Structural-Sealant-Glazed System: Develop quality control program specifically for Project. Document quality-control procedures and verify results for aluminum-framed systems. Comply with ASTM C 1401 recommendations including, but not limited to, system material-qualification procedures, preconstruction sealant-testing program, procedures for system fabrication and installation, and intervals of reviews and checks.
- G. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- H. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- I. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.
- J. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Adhesive or cohesive sealant failures.
 - e. Water leakage through fixed glazing and framing areas.
 - f. Failure of operating components.
 - 2. Warranty Period: 10 years from date of Final Acceptance.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 20 years from date of Final Acceptance.

PART 2 : PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - 1. EFCO Corporation.
 - 2. TRACO/Kawneer.
 - 3. United States Aluminum.
 - 4. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
 - 5. YKK AP America Inc.

2.02 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Structural Profiles: ASTM B 308/B 308M.
 - 5. Retain subparagraph below for welding.
 - 6. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Retain paragraph below for internal steel reinforcement of aluminum framing members; revise to suit Project.
- C. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
 - 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.03 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Construction: Thermally broken
 - 2. Glazing System: Retained mechanically with gaskets on four sides
 - 3. Glazing Plane: Center
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials
- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
 - 1. Sealants used inside the weatherproofing system shall have a VOC content of 250g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 GLAZING SYSTEMS

- A. Glazing: As specified in Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.05 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 "Joint Sealants."
 - 1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

2.06 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Retain first paragraph below for welding. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from exterior.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using shear-block system.
- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.07 ALUMINUM FINISHES

- A. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range

PART 3 : EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in Section 088000 "Glazing."

- G. Install perimeter joint sealants as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

3.03 ERECTION TOLERANCES

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 : GENERAL

1.01 SECTION INCLUDES

- A. Finish hardware for doors as specified and as listed in "Hardware Groups" and required by actual conditions.
 - 1. Include screws, special screws, bolts, special bolts, expansion shields, and other devices for proper application of hardware.

1.02 GENERAL REQUIREMENTS

- A. Provide items, articles, materials, operations and methods listed, mentioned or scheduled herein or on drawings, in quantities as required to complete project. Provide hardware that functions properly. Prior to furnishing hardware, advise Architect of items that will not operate properly, are improper for conditions, or will not remain permanently anchored.

1.03 SUBMITTALS

- A. Hardware Schedule: Submit 5 copies of hardware schedule in vertical format as illustrated by the Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Schedules which do not comply will be returned for correction before checking.
- B. Hardware schedule shall clearly indicate architect's hardware group and manufacturer of each item proposed.
- C. The schedule shall be reviewed prior to submission by a certified Architectural Hardware Consultant (AHC), who shall affix his or her seal attesting to the completeness and correctness of the schedule.
 - 1. Provide 2 copies of illustrations from manufacturer's catalogs and data in brochure form.
 - 2. Check specified hardware for suitability and adaptability to details and surrounding conditions. Indicate unsuitable or incompatible items and proposed substitutions in hardware schedule.
 - 3. Provide listing of manufacturer's template numbers for each item of hardware in hardware schedule.

4. Furnish other Contractors and Subcontractors concerned with copies of final approved hardware schedule. Submit necessary templates and schedules as soon as possible to hollow metal, wood door, and aluminum door fabricators in accordance with schedule they require for fabrication.
 5. Samples: Lever design or finish sample: Provide 3 samples if requested by architect.
- D. Installation Instructions: Provide manufacturer's written installation and adjustment instructions for finish hardware. Send installation instructions to site with hardware.
- E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.
- F. Contract Closeout Submittals: Comply with specific requirements indicated below.
1. Operating and maintenance manuals: Submit 3 sets containing the following:
 2. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
 3. Catalog pages for each product.
 4. Name, address, and phone number of local representative for each manufacturer.
 5. Parts list for each product.
 6. Copy of final approved hardware schedule, edited to reflect "As installed".
 7. Copy of final keying schedule.
 8. One complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Obtain each type of hardware (ie. latch and locksets, hinges, closers) from single manufacturer, although several may be indicated as offering products complying with requirements.
- B. Supplier: Recognized architectural finish hardware supplier, with warehousing facilities, who has been providing hardware for period of not less than 3 years. The supplier shall be, or employ, a certified Architectural Hardware Consultant (AHC), who is registered in the continuing education program as administered by the Door and Hardware Institute. The hardware schedule shall be prepared and signed by a certified AHC.

- C. Installer: Firm with 3 years' experience in installation of similar hardware to that required for this project, including specific requirements indicated.
- D. Regulatory Label Requirements: Provide nationally recognized testing agency label or stamp on hardware for labeled openings. Where UL requirements conflict with drawings or specifications, hardware conforming to UL requirements shall be provided. Conflicts and proposed substitutions shall be clearly indicated in hardware schedule.
- E. Pre-Installation Conference: Prior to the installation of hardware, manufacturer's representatives for locksets, closers, and exit devices shall arrange and hold a jobsite meeting to instruct the installing contractor's personnel on the proper installation of their respective products. A letter of compliance, indicating when this meeting is held and who is in attendance, shall be sent to the Architect and Owner.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver hardware to jobsite in manufacturer's original packaging, marked to correspond with approved hardware schedule. Do not deliver hardware until suitable locked storage space is available. Check hardware against reviewed hardware schedule. Store hardware to protect against loss, theft or damage.
- B. Deliver hardware required to be installed during fabrication of hollow metal, aluminum, wood, or stainless steel doors prepaid to manufacturer.
- C. Provide ten year factory warranty on door closer body against defects in material and workmanship from date of occupancy of Project.
- D. Replace shortages and incorrect items with correct material at no additional cost to Owner.
- E. At completion of project, qualified factory representative shall inspect closer installations. After this inspection, letter shall be sent to Architect reporting on conditions, verifying that closers have been properly installed and adjusted.

1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply

with indicated requirements.

1.07 WARRANTY

- A. Guarantee workmanship and material provided against defective manufacture. Repair or replace defective workmanship and material appearing within period of one year after Final Acceptance.

PART 2 : PART 1- PRODUCTS

2.01 BUTTS AND HINGES

- ### A. Acceptable Manufacturers and Types:

Type	Ives	Hager	Stanley
Type 2	5BB1	BB1279	FBB179
Type 3	5BB1	BB1191	FBB191
Type 4	5BB1HW	BB1168	FBB168
Type 5	5BB1HW	BB1199	FBB199

- B. Application:
- | | | |
|----|--|--------------|
| 1. | Exterior outswinging doors | Type 5 x NRP |
| 2. | Exterior inswinging doors and vestibule doors | Type 4 |
| 3. | Interior doors with closers | Type 2 or 4 |
| 4. | Interior doors over 36 inches wide | Type 4 |
| 5. | Interior doors 36 inches or less without closer | Type 2 |
| 6. | Provide NRP (non-removable pins) at out-swinging lockable doors. | |
- C. Size:
- | | | |
|----|------------------|--------------------------|
| 1. | 1-3/4 inch Doors | 4-1/2 inch by 4-1/2 inch |
|----|------------------|--------------------------|
- D. Quantity:
1. Two hinges per leaf for openings through 60 inches high.
 2. One additional hinge per leaf for each additional 30 inches in height or fraction thereof.
 3. Four hinges for Dutch doors up to 90 inches in height.
- E. Drill 5/32 inch hole and use No. 12, 1-1/4 inch steel threaded to the head wood screws for hinges on wood doors.

2.02 CONTINUOUS GEARED HINGES

- A. Acceptable manufacturers:

Ives	Hager	Select
224HD	780-224HD	SL22HD

- B. Provide the above model of continuous hinges as specified. Coordinate hinge types with the door supplier.
- C. Provide electric power transfer (EPT) cutouts, or electric through-wire options as specified in hardware groups.

2.03 **LOCKSETS – Mortise**

- A. Acceptable Manufacturer and Series:

Manufacturer		Series
Schlage		L9000 x 17A
Corbin Russwin		Lockset with Lustra, LWM Trim
Best (Owner Preferred)		Coremax Cylinders

- B. Provide lock functions specified in Hardware Groups, with following provisions:
 - 1. Cylinders: Manufacturer's standard 6-pin cylinder.
 - 2. Locksets shall meet the requirements of ANSI/BHMA A156.13-1994, Operational Grade 1, and Security Grade 1.
 - 3. Backsets: 2-3/4 inches.
 - 4. Strikes: Provide wrought boxes and strikes with proper lip length to protect trim but not to project more than 1/8 inch beyond trim, frame or inactive leaf. Where required, provide open back strike and protected to allow practical and secure operation.

2.04 **KEYING**

- A. Master key or Grand master key cylinders and key in groups, unless otherwise specified. Factory masterkey with manufacturer retaining permanent keying records.
- B. Provide 6 masterkeys for each masterkey set. Provide 3 change keys for each lock. Stamp keys "DO NOT DUPLICATE."
- C. Submit proposed keying schedule to Architect. Meet with Owner and Architect to review schedule.
- D. Provide cylinders, keyed to WCU existing key system, for each lock.
- E. Provide construction keying for all locks or as directed by Owner.

2.05 **DOOR TRIM**

- A. Acceptable Manufacturers and Types:

Ives	Trimco	Quality
8303	1018-3B	40-5
8190	1191-3	521

- B. Pull Plates:
 - 1. Ives type 8303 4 inches by 16 inches unless otherwise indicated.
- C. Pulls:
 - 1. Ives Series 8190, unless otherwise indicated.
 - 2. Where required, mount back to back with push bars.
- D. Kick Plates and Mop Plates: Ives 8400 Series, minimum of 0.050 inch thick, beveled 4 edges.
 - 1. At single doors provide width two inches less than door width on stop side and one inch less than door width on pull side.
 - 2. At pairs of doors provide width one inch less than door width on both sides.
 - 3. Height of 10 inches, unless otherwise indicated.

2.06 **DOOR CLOSERS**

- A. Acceptable Manufacturers and Types of Exposed Closers:

LCN (Owner Preferred)	Sargent	Corbin Russwin
4011 / 4111	281 / 281-P10	DC8200 / DC8210 x A3

- B. Closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder.
- C. Provide non-sized closers, continuously adjustable over the full range of closer sizes, and allow for reduced opening force to meet opening force requirements of ANSI A117.1
- D. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, swing speed, and back check.
- E. Provide closers with solid forged steel main arms (and forearms for parallel arm closers) and where specified to have a cast-in solid stop on the closer shoe ("CUSH"). Parallel arm mounted closers shall have "EDA" type arms or, where specified, "CUSH" or "SCUSH" type arms.
- F. Surface closers shall be certified to exceed ten million full load cycles by a recognized independent testing laboratory.
- G. Provide drop plates, brackets, or adapters for arms as required to suit details.
- H. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- I. Provide back-check for closers.
- J. Provide hold-open arms where indicated in hardware groups.
- K. Provide track closers where indicated in hardware groups.

- L. Provide closers for doors as noted in Hardware Groups and, in addition, provide closers for labeled doors whether or not specifically noted in group.
- M. Provide closers meeting the requirements of UBC 7-2, 1997 and UL 10C positive pressure tests.
- N. Pressure relief valves (PRV's) will not be permitted.

2.07 OVERHEAD STOPS

- A. Acceptable Manufacturers

Glynn Johnson	ABH	Rixson
90	9000	9 Series

- B. Provide 90 Series overhead stops for interior doors equipped with regular arm surface type closer for doors that open against equipment, casework, sidelights, other objects that would make wall stops inappropriate.
- C. Provide sex bolt attachments for mineral core door application.

2.08 WALL STOPS AND HOLDERS

- A. Acceptable Manufacturers and Types:

Ives	Trimco	Door Controls
WS406/407CC V	1270WCCP	3212

- B. Provide WS407CCV Series wall stop as applicable, for each door leaf except where conditions require the use of an overhead stop.

2.09 THRESHOLDS

- A. Acceptable Manufacturers and Product:

Reese	National Guard	Reese
S404A	425	S205A
2005T	896S	S483A

- B. Where thresholds are specified in hardware groups, provide 425 thresholds unless detailed otherwise.
- C. Refer to drawings for special details. Provide accessories, shims and fasteners.

2.10 WEATHERSTRIPPING

A. Acceptable Manufacturers and Product:

	Zero	National Guard	Reese
Sweeps	39A	201NA	323C
Jams	429A	700SA	755C
Rain Drips	142A	16A	R201C

- B. Where weatherstripping is specified in hardware groups, provide 700SA unless detailed otherwise.
- C. Provide self-tapping fasteners for weatherstripping being applied to hollow metal frames.
- D. Where sweeps are specified in hardware groups, provide 201NA unless detailed otherwise.
- E. Where rain drips are specified in hardware groups, provide 16A x full frame width, unless detailed otherwise.

2.11 GASKETING

- A. Acceptable Manufacturers: Zero, National Guard, and Reese Enterprises. Refer to drawings for special details. Provide accessories, shims and fasteners.

Zero	National Guard	Reese
188S	5050	F-797B

- B. Where smoke gasket is specified in hardware groups, provide 5050, unless detailed otherwise.
- C. Provide gaskets for 20-minute doors and doors designated for smoke and draft control.
- D. Where frame applied intumescent seals are required by the manufacturer, provide gaskets that comply with UBC 7-2, 1997 and UL 10C positive pressure tests.

2.12 SILENCERS

- A. Acceptable Manufacturers and types:

Ives	Steelcraft	Don-Jo
SR64	Q146	1608

- B. Provide grey rubber silencers featuring pneumatic design that, once installed, forms an air pocket to absorb shock and reduce noise of door closing.
- C. Provide three (3) silencers per hollow metal strike jamb; two (2) per hollow metal double door head. Omit at doors scheduled to receive perimeter weatherstripping or smoke gasket.

- D. Silencers shall meet ANSI/BHMA A156.16, L03011

2.13 FASTENERS

- A. Including, but not limited to, wood or machine screws, bolts, nuts, anchors, etc. of proper type, material, and finish required for installation of hardware.
- B. Use phillips head for exposed screws. Do not use aluminum screws to attach hardware.
- C. Provide self-tapping (TEC) screws for attachment of sweeps and stop-applied weatherstripping only.

2.14 TYPICAL FINISHES AND MATERIALS

- A. Finishes, unless otherwise specified:
 - 1. Butts: Outswinging Exterior Doors
 - a. US32D (BHMA 630) on Stainless Steel
 - 2. Butts: Interior Doors and Inswinging Exterior Doors
 - a. US26D (BHMA 652) on Steel
 - 3. Continuous Hinges:
 - a. US28 (BHMA 628) on Aluminum
 - 4. Flush Bolts:
 - a. US26D (BHMA 626) on Brass or Bronze
 - 5. Exit Devices:
 - a. US26D (BHMA 626) on Brass or Bronze
 - 6. Locks and Latches:
 - a. US26D (BHMA 626) on Brass or Bronze
 - 7. Push Plates, Pulls and Push Bars:
 - a. US32D (BHMA 630) on Stainless Steel
 - 8. Kick Plates, Armor Plates, and Edge Guards:
 - a. US32D (BHMA 630) on Stainless Steel
 - 9. Overhead Stops and Holders:
 - a. US26D (BHMA 626) on Brass or Bronze
 - 10. Closers: Surface mounted.
 - a. Sprayed Aluminum Lacquer.
 - 11. Miscellaneous Hardware:
 - a. US26D (BHMA 626) on Brass or Bronze
 - 12. Thresholds:
 - a. US28 (BHMA 628) on Aluminum (AL).

PART 3 : PART 2- EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present,

for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

- B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with the existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install finish hardware in accordance with reviewed hardware schedule and manufacturer's printed instructions. Pre-fit hardware before finish is applied, remove and reinstall after finish is completed. Install hardware so that parts operate smoothly, close tightly and do not rattle.
- B. Installation of hardware shall comply with NFPA 80 and NFPA 101 requirements.
- C. Set units level, plumb and true to line and location. Adjust and reinforce attachment to substrate as necessary for proper installation and operation.
- D. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant, forming tight seal between threshold and surface to which set. Securely and permanently anchor thresholds, using countersunk non-ferrous screws to match color of thresholds (stainless steel screws at aluminum thresholds).
- F. The Contract Hardware Distributor (CHD) shall install all Hardware using Factory Trained / Approved Installers. At Project Completion, prior to turn over, the CHD and Security Integrator will jointly inspect each opening, make final adjustments to insure a complete functional installation and turn over to Owner.

3.03 FIELD QUALITY CONTROL

- A. After installation has been completed, provide services of qualified hardware consultant to check Project to determine proper application of finish hardware according to schedule. Also check operation and adjustment of hardware items.
- B. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

3.04 ADJUSTING AND CLEANING

- A. At final completion, hardware shall be left clean and free from disfigurement. Make final adjustment to door closers and other items of hardware. Where hardware is found defective repair or replace or otherwise correct as directed.
- B. Adjust door closers to meet opening force requirements of Uniform Federal Accessibility Standards.
- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of space or area, return to work during week prior to acceptance or occupancy, and make final check and adjustment of hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors.
- D. Instruct Owner's personnel in proper adjustment and maintenance of door hardware and hardware finishes.
- E. Clean adjacent surfaces soiled by hardware installation.

3.05 PROTECTION

- A. Provide for proper protection of items of hardware until Owner accepts Project as complete.

3.06 HARDWARE GROUPS

- A. Located on drawings.

SECTION 08 80 00

GLAZING

PART 1 : GENERAL

1.01 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Storefront framing.

1.02 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.03 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. Basic Wind Speed: 85 mph (Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

1.04 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
 - 1. Insulating glass Units – One

- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.05 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass and glazing products, from manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- D. Source Limitations for Glass: Obtain ultraclear float glass coated float glass and insulating glass from single source from single manufacturer for each glass type.
- E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
 - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- G. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's

name, type of glass, thickness, and safety glazing standard with which glass complies.

- H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.09 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass 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 Final Acceptance.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which 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 Final Acceptance.

PART 2 : PRODUCTS

2.01 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
 1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.02 GLASS PRODUCTS

- A. Clear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent.
 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Guardian Industries Corp.
 - b. Pilkington North America
 - c. PPG Industries, Inc.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 2. For uncoated glass, comply with requirements for Condition A.
 3. For coated vision glass, comply with requirements for Condition C (other coated glass).

2.03 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, and complying with other requirements specified.
1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
 2. Spacer: Manufacturer's standard spacer material and construction Aluminum with black, color anodic finish.
 3. Desiccant: Molecular sieve or silica gel, or blend of both.
- B. Glass: Comply with applicable requirements in "Glass Products" Article and in as indicated by designations in "Insulating-Glass Types" Article.

2.04 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.
- 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:

2.05 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.06 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.

2.07 INSULATING GLASS TYPES

- A. Glass Type “GL-1”, Low-E-coated, clear insulating glass.
 - 1. Overall Unit Thickness: 1 inch.
 - 2. Minimum Thickness of Each Glass Lite: 6 mm.
 - 3. Outdoor Lite: Clear heat-strengthened float glass, except fully tempered glass where required.
 - a. Low-E Coating: Sputtered on second surface.
 - b. Basis-of-Design Product: Guardian, Superneutral SNX 62/27 on Clear or equal by:
 - 1) Pilkington North America
 - 2) PPG Industries, Inc.
 - 4. Interspace Content: Air.
 - 5. Indoor Lite: Clear annealed float glass, except fully tempered float glass where required.

6. Winter Nighttime U-Factor: 0.29 maximum.
7. Summer Daytime U-Factor: 0.27 maximum.
8. Visible Light Transmittance: 62 percent minimum.
9. Solar Heat Gain Coefficient: 0.27 maximum.

PART 3 : EXECUTION

3.01 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.

3.02 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.03 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 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.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

3.04 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. 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; remove as recommended in writing by glass manufacturer.

- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

SECTION 08 90 00

LOUVERS AND VENTS

GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.
2. Fixed, formed-metal acoustical louvers.

1.02 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
- C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- D. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing
 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 2. Show mullion profiles and locations.

- C. Samples: For each type of metal finish required.

1.04 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 : PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
- B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces .
- E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual, 7th Edition" for fabrication, construction details, and installation procedures.

2.03 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Wind-Driven-Rain-Resistant Louver :
- Manufacturers: Subject to compliance with requirements, [provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. Construction Specialties, Inc.
 - e. Nystrom, Inc.
 - f. Ruskin Company; Tomkins PLC.
 - g. United Enertech.
2. Louver Depth: 5 inches
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch
4. Louver Performance Ratings:
- a. Free Area: Not less than 50 % for 48-inch- wide by 48-inch- high louver.
 - b. Point of Beginning Water Penetration: Not less than 900 fpm.
 - c. Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area exhaust velocity.
5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.04 LOUVER SCREENS

- A. General: Provide screen at [each exterior louver] [louvers indicated].
- 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Bird screening
- B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
- 1. Metal: Same type and form of metal as indicated for louver to which screens are attached
 - 2. Finish: Same finish as louver frames to which louver screens are attached.

3. Type: Rewirable frames with a driven spline or insert.
4. Louver Screening for Aluminum Louvers:
5. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

2.05 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, [G60] [G90] zinc coating, mill phosphatized
- D. Fasteners: Use types and sizes to suit unit installation conditions.
 1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- E. Postinstalled 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 according to ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.06 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and

frames at head and sill, to produce uniform appearance.

- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide subsills made of same material as louvers for recessed louvers.
- F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.07 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than [50] [70] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 : EXECUTION

3.01 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.03 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to

screws where required to protect metal surfaces and to make a weathertight connection.

- C. Form closely fitted joints with exposed connections accurately located and secured
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.04 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

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DIVISION 09

FINISHES



SECTION 09 29 00

GYPSUM BOARD

PART 1 : GENERAL

1.01 SUMMARY

A. Section Includes:

1. Exterior gypsum board for ceilings at Public Restrooms (where moisture resistant gypsum board ceilings are indicated on drawings).

1.02 ACTION SUBMITTALS

A. Product Data: For the following:

1. Exterior gypsum soffit board where mold resistant board .
2. Joint treatment materials.

B. Samples for Verification: For the following products:

1.03 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.

1.04 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 : PRODUCTS

2.01 SOURCE LIMITATIONS

- A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.02 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.

2.03 EXTERIOR GYPSUM BOARD FOR INTERIOR CEILINGS IN PUBLIC BATHROOMS

- A. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
 - 1. Manufacturers:
 - a. USG
 - b. Certaineed
 - c. National Gypsum
 - 2. Core: 5/8 inch, Type X.

2.04 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Exterior Applications (Utilize in interior public toilet room ceilings):
 - 1. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

2.05 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- D. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 : EXECUTION

3.01 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.

3.02 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- 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
- G. (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.
- H. 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.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

3.03 INSTALLATION OF EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
 - 1. Install with 1/4-inch open space where panels abut other construction or structural penetrations. Neatly seal joints and use backer rod where joints exceed ¼ in.
 - 2. Fasten with corrosion-resistant screws.

3.04 INSTALLATION OF TILE BACKING PANELS

- A. Water-Resistant Backing Board: Install where indicated with 1/4-inch gap where panels abut other construction or penetrations.

3.05 INSTALLATION OF 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. Exterior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.

3.06 FINISHING OF 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. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

3.07 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

SECTION 093013

CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glazed wall tile.
 - 2. Metal edge strips.

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.
 - 1. 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 "American National Standard Specifications for Installation of Ceramic Tile."
- B. Face Size: Actual tile size, excluding spacer lugs.
- C. Module Size: Actual tile size plus joint width indicated.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Full-size units of each type of trim and accessory for each color and finish required.
 - 3. Metal edge strips in 6-inch lengths.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does not contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 1. 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 unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by 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.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 TILE PRODUCTS

- A. Glazed Wall Tile Type WT-1:

1. Basis of Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Florida Tile Industries, Inc.
 - b. Daltile; Division of Dal-Tile International Inc.
 - c. Crossville Ceramics
2. Module Size:
 - a. Florida Tile – Fluent
 - 1) 4-in x 16-in
 - b. Daltile – Color Wheel Linear
 - 1) 4-in x 16-in
 - c. Crossville – Color By Numbers
 - 1) 4-in x 12-in
3. Thickness:
 - a. Florida Tile – Fluent
 - 1) 5/16 inch
 - b. Daltile – Color Wheel Linear
 - 1) 3/8 inch
 - c. Crossville – Color By Numbers
 - 1) 1/4 inch
4. Face: Pattern of design indicated, with manufacturer's standard edges.
5. Finish: Bright, opaque glaze.
6. Tile Color and Pattern: As indicated by manufacturer's designations.
 - a. Florida Tile – Fluent
 - 1) Grey Glossy, Staggered Bond.
 - b. Daltile – Color Wheel Linear
 - 1) Desert Gray, Staggered Bond.
 - c. Crossville – Color By Numbers
 - 1) 1812 Overture Gloss, Staggered Bond.
7. Grout Color: As indicated by manufacturer's designations.
8. Mounting:
 - a. Factory, back mounted.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base for Thinset Mortar Installations: Coved, module size:
 - 1) Florida Tile – Fluent
 - a) 4-in x 16-in
 - 2) Daltile – Color Wheel Linear
 - a) 4-in x 16-in
 - 3) Crossville – Color By Numbers
 - a) 4-in x 12-in
 - b. Internal Corners: Field-buttet square corners. For coved base use angle pieces designed to fit with stretcher shapes.

2.4 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.
 - 1. Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Laticrete International, Inc.
 - b. K-B as manufactured by C.E. Kaiser Company, Inc.
 - c. Tile-Mate Sanded as manufactured by Upco Company.
 - 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.5 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. Standard Cement Grout: ANSI A118.6.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Dry Bond as manufactured by Laticrete International, Inc.
 - b. K-B as manufactured by C.E. Kaiser Company, Inc.
 - c. L&M Ceramic Mosaic as manufactured by L&M Surco Manufacturing Company, Inc.

2.6 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. 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; ASTM A666, 300 Series exposed-edge material. Basis of Design Schluter designations as indicated or equal.
 - 1. Wainscot caps: Basis of Design Schluter Quadec or Equal – Stainless Steel.
- 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. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C-Cure; Penetrating Sealer 978
 - b. Jamo Inc.; Penetrating Sealer
 - c. MAPEI Corporation; KER 004, Keraseal Penetrating Sealer for Unglazed Grout and Tile.
 - d. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer
 - e. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer
 - f. TEC; a subsidiary of H.B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

2.7 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of 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 installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION OF CERAMIC TILE

- 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.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Jointing Pattern: Lay tile in staggered grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Glazed Wall Tile: 1/16 inch (1.6 mm) As recommended by Tile Manufacturer.
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- H. Metal Edge Strips: Install at locations indicated, at top of tile wainscot and exposed vertical edge of tile wainscot.

- I. Grout Sealer: Apply grout sealer to cementitious grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 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 latex-portland cement 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. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

3.5 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. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Wall Installations, Masonry or Concrete:
 1. TCNA W202 Latex-Portland Cement Mortar on Concrete Masonry Units (CMU): Thinset mortar.
 - a. Ceramic Tile Type: Glazed wall tile WT-1
 - b. Thinset Mortar: Latex-portland cement mortar.
 - c. Grout: Sand-portland cement grout.

WCU
Norton Intramural Fields
22-24232-01A

END OF SECTION 093013

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 : GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Thermoset-rubber base.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet

1.04 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.

1.05 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 periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Final Acceptance, 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

2.01 THERMOSET-RUBBER BASE

- A. Manufacturers:
 - 1. Roppe
 - 2. Johnsonite
 - 3. Tarkett
 - 4. National Rubber
 - 5. Mannington
- B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 1. Style and Location:
 - a. Style B, Cove: Provide in Public Bathrooms
- 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: Black

2.02 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.

PART 3 : EXECUTION

3.01 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.

3.02 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 materials are the same temperature as 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.

3.03 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 3 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 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.04 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 surfaces.
- C. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION

END OF SECTION

SECTION 09 91 23

INTERIOR PAINTING

PART 1 : GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior and covered exterior substrates (exterior hollow metal door and frames):
 - 1. Concrete masonry units (CMU).
 - 2. Gypsum board.
 - 3. Steel Door and Frame
- B. Related Requirements:
 - 1. Section 099600 "High-Performance Coatings" for high-performance and special-use coatings on galvanized steel and public toilet room floors.

1.03 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

- B. Samples for Initial Selection: For each type of topcoat product.
- 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 (200 mm) 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.

1.05 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. Paint: 1 gal. (3.8 L) of each material and color applied.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.07 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 : PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Benjamin Moore & Co.
 - 2. Duron, Inc.
 - 3. ICI Paints.
 - 4. PPG Architectural Finishes, Inc.
 - 5. Pratt & Lambert.
 - 6. Sherwin-Williams Company (The).

2.02 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Primers, Sealers, and Undercoaters: 200 g/L.
- D. Colors: As selected by Architect from manufacturer's full range.
 - 1. Steel Door and Frame Colors shall be medium to dark.

2.03 BLOCK FILLERS

- A. Block Filler, Latex, Interior/Exterior: MPI #4.

2.04 PRIMERS/SEALERS

- A. Primer Sealer, Interior, Institutional Low Odor/VOC: MPI #149.
- B. Primer Sealer, Alkyd, Interior: MPI #45.

2.05 METAL PRIMERS

- A. Primer, Alkyd, Anti-Corrosive, for Metal: MPI #79.

2.06 WATER-BASED PAINTS

- A. Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (Gloss Level 5): MPI #147.

2.07 SOLVENT-BASED PAINTS

- A. Alkyd, Interior, Semi-Gloss (Gloss Level 5): MPI #47.

PART 3 : EXECUTION

3.01 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 CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
 - 5. Plaster: 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.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed 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 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.03 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. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.04 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.

3.05 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Traffic Surfaces (See High Performance Coatings)
- B. CMU Substrates:
 1. Institutional Low-Odor/VOC Latex System:

- a. Block Filler: Block filler, latex, interior/exterior[, MPI #4.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, MPI #143.
 - d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, MPI #144.
 - e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, MPI #145.
 - f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, MPI #147.
2. High-Performance Architectural Latex System (Public Bathrooms):
- a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5), MPI #141.
- C. Steel Substrates (Hollow Metal Doors):
1. Alkyd System:
- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, MPI #79.
 - b. Prime Coat: Primer, alkyd, quick dry, for metal[, MPI #76.
 - c. Prime Coat: Primer, alkyd, anti-corrosive, for metal[, MPI #79 or primer, alkyd, quick dry, for metal, MPI #76.
 - d. Prime Coat: Shop primer specified in Section where substrate is specified.
 - e. Intermediate Coat: Alkyd, interior, matching topcoat.
 - f. Topcoat: Alkyd, interior, flat (Gloss Level 1), MPI #49.
 - g. Topcoat: Alkyd, interior, (Gloss Level 3), MPI #51.
 - h. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5), MPI #47.
 - i. Topcoat: Alkyd, interior, gloss (Gloss Level 6)[, MPI #48.
- D. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5), MPI #147.
2. High-Performance Architectural Latex System:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c.
 - d. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5), MPI #141.

END OF SECTION

END OF SECTION

SECTION 09 96 00 **HIGH-PERFORMANCE COATINGS**

PART 1: GENERAL

1.01 SCOPE

- A. The work of this section includes the surface preparation and painting of all surfaces related to the painting and high performance coating on exposed galvanized steel headers, supports and Exposed Steel (AECC Truss) and Horizontal Concrete Floor Finishes in Public Toilet Rooms.

1.02 RELATED WORK SPECIFIED ELSEWHERE (if applicable)

- A. Coating and painting of all other surfaces is specified in Section 9.

1.03 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Without limiting the general aspects of other requirements of these specifications, all surface preparation, coating and painting of surfaces shall conform to the applicable requirements of the Steel Structures Painting Council, NACE, ICRI and the manufacturer's printed instructions.
- B. The Architect's decision shall be final as the interpretation and/or conflict between any of the referenced specifications and standards contained herein.

1.04 CONTRACTOR

- A. The Contractor shall have five years practical experience and successful history in the application of specified products in similar projects. He shall substantiate this requirement by furnishing a list of references and job completions.
- B. Applicator must successfully demonstrate to the product manufacturer the ability to apply the material correctly and within the confines of the specifications. The Contractor must provide a letter from the manufacture stating their acceptance of the Contactor for this project to apply these products.
- C. The Contractor shall provide a site mock up as necessary with each paint system as a representative of how the systems shall be installed and their final appearance (to include color, sheen, texture etc), which is to be approved by the Architect before any work is started. For overcoat projects this mock up shall be used to test for adequate adhesion. This approved mock up shall be the quality standard for the rest of the project. This mock up location, size and other job specifics needs shall be detailed by the Architect.

1.05 QUALITY ASSURANCE

- A. General: Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application, and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and accepted professional standards and are approved by the Architect.

- B. Surface Preparation: Surface preparation will be based upon comparison with: "Pictorial Surface Preparation Standards for Painting Steel Surfaces", SSPC-Vis-1 and ASTM Designation D2200; "Standard Methods of Evaluating Degree of Rusting on Painted Steel Surfaces" SSPC-Vis-2 and ASTM Designation D610; "Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive" or "Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays" and ICRI CSP Surface Profile Chips.

- C. Application: No coating or paint shall be applied: When the surrounding air temperature or the temperature of the surface to be coated is below the minimum required temperature for the specified product; to wet or damp surfaces or in fog or mist; when the temperature is less than 5 degrees F. above the dewpoint; when the air temperature is expected to drop below 40 degrees F. within six hours after application of coating. Dewpoint shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychrometric Tables. If above conditions are prevalent, coating or painting shall be delayed or postponed until conditions are favorable. The day's coating or painting shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions.

- D. Thickness and Holiday Checking: Thickness of coatings and paint shall be checked with a non-destructive, magnetic type thickness gauge. The integrity of coated interior surfaces shall be tested with an approved inspection device. Non-destructive holiday detectors shall not exceed the voltage recommended by the manufacturer of the coating system. For thicknesses between 10 and 20 mils (250 microns and 500 microns), a non-sudsing type wetting agent, such as Kodak Photo-Flo, may be added to the water prior to wetting the detector sponge. All pinholes shall be marked, repaired in accordance with the manufacturer's printed recommendations, and retested. No pinholes or other irregularities will be permitted in the final coating.

- E. Inspection Devices: The Contractor shall furnish, until final acceptance of coating and painting, inspection devices in good working condition for detection of holidays and measurement of dry-film thickness of coating and paint. The Contractor shall also furnish U.S. Department of Commerce; National Bureau of Standard certified thickness calibration plates to test accuracy of dry film

thickness gauges and certified instrumentation to test accuracy of holiday detectors.

- F. All necessary testing equipment shall be made available for the Architect's use at all times until final acceptance of application. Holiday detection devices shall be operated in the presence of the Architect.

1.06 SAFETY AND HEALTH REQUIREMENTS

- A. General: In accordance with requirements set forth by regulatory agencies applicable to the construction industry and manufacturer's printed instructions and appropriate technical bulletins and manuals, the Contractor shall provide and require use of personnel protective lifesaving equipment for persons working on or about the project site.
- B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets, which shall be worn by all persons while in the vicinity of the work. In addition, workers engaged in or near the work during sandblasting shall wear eye and face protection devices and air purifying halfmask or mouthpiece respirators with appropriate filters. Barrier creams shall be used on any exposed areas of skin.
- C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminant to the degree a hazard does not exist. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.
- D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protective devices.
- E. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Architect, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The Architect shall determine the level of illumination for inspection purposes.
- F. Confined Space: When applicable it is mandatory that all work be performed in compliance with OSHA'S rules and regulations for working in confined space. Atmospheres within confined spaces as defined by the Occupational Safety and Health Administration are classified as being either a Class A, Class B or Class C environment.

PART 2 : PRODUCTS

2.01 GENERAL

- A. Basis of Design: Tnemec Company, Incorporated 101 Rice Bent Way Unit #5 Columbia, SC 29229 (803) 736-1553. Contact is Mr. Nick Vause (803) 422-3650 or nvause@tnemec.com. Or equal by
 - 1. PPG
 - 2. Valspar
- B. Requests for substitution shall include manufacturer's literature for each product giving the name' product number, generic type, descriptive information, solids by volume, recommended dry film thickness, cost savings and certified test reports showing results to equal the performance criteria of the products specified herein. No request for substitution shall be considered that will decrease film thickness, the number of coats or offer a change in the generic type of coatings specified. In addition, a list of five similar projects shall be submitted in which each product has been used and rendered satisfactory service.
- C. Manufacturer's color charts shall be submitted to the Architect at least 30 days prior to paint application. General contractor and painting contractor shall coordinate work so as to allow sufficient time (five to ten days) for paint to be delivered to the jobsite.
- D. All materials shall be brought to the jobsite in original, sealed containers. They shall not be used until the Architect has inspected contents and obtained data from information on containers or labels. Materials exceeding storage life recommended by the manufacturer shall be rejected.
- E. All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings or paint must be stored to conform to City, County, State and Federal safety codes for flammable coating or paint materials. At all times, coating and paints shall be protected from freezing.
- F. A NACE certified technical representative from the paint manufacturer shall visit the job site to support the Contractor's personnel, the Owner and/or the Architect as needed and/or requested. Visits shall be made as needed to help with hold point inspections for the Owner or Architect. Additional visit shall be made as needed and/or requested by Owner, Architect or Contractor. 48 hours' notice is required by the Contractor for each hold point inspection.
- G. All parties, to include the owner or owners representative, architect, general contractor, installer, any subs and the product manufacture, shall meet prior to any work is started to review the spec and discuss job specific expectations, need and requirements

H. Exterior Coating Systems

1. Exterior Exposed Galvanized
 - a. Surface Preparation: Remove any storage stains per Section 6.2 of ASTM D6386. Sweep (Abrasive) Blasting per ASTM D 6386 to achieve a uniform anchor profile (1.0 - 2.0 mils). The surface must be clean and dry before painting.
 - b. 1st Coat: 100% Solid Inorganic Hybrid Water-Based Epoxy applied at 2.0 – 8.0 dry mils. (performance equal to Tnemec Series 27WB-15BL Typoxy)
 - c. 2nd Coat: Aliphatic Acrylic Polyurethane applied at 2.0 – 3.0 dry mils. (performance equal to Tnemec Series 73 Endura Shield)
 - d. 3rd Coat: Advanced Thermoset Solution Fluoropolymer applied at 2.0–3.0 dry mils.(performance equal to Tnemec Series 1070 Fluoronar)
 - e.

I. Interior Coating Systems

1. Concrete Substrates, Horizontal Surfaces.
 - a. Epoxy System MPI INT 3.2C:
 - b. Prime Coat: Epoxy, matching topcoat.
 - c. Intermediate Coat: Epoxy, matching topcoat.
 - d. Topcoat: Epoxy, gloss, MPI #77.

PART 3 : EXECUTION

3.01 GENERAL

- A. All surface preparation, coating and painting shall conform to applicable standards of the Steel Structures Painting Council, NACE, ICRI and the manufacturer's printed instructions. Material applied prior to approval of the surface by the Architect shall be removed and reapplied to the satisfaction of the Architect at the expense of the Contractor.
- B. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice. Continuity of personnel shall be maintained and transfers of key personnel shall be coordinated with the Architect.
- C. The Contractor shall provide an English speaking supervisor at the work site during cleaning and application operations. The supervisor shall have the

authority of sign change orders, coordinate work, and make decisions pertaining to the fulfillment of the contract.

- D. Dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the finish must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.
- E. The Contractor's coating and painting equipment shall be designed for application of materials specified and shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air. Contractor's equipment shall be subject to approval of the Architect.
- F. Application of the first coat shall follow immediately after surface preparation and cleaning and before rust bloom or flash rusting occurs. Any cleaned areas not receiving first coat within this period shall be recleaned prior to application of first coat.

3.02 SURFACE PREPARATION

- A. The latest revision of the following surface preparation specifications of the Steel Structures Painting Council and NACE shall form a part of this specification:
 - 1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.
 - 2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by hand chipping, scraping, sanding and wire brushing.
 - 3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust' loose mill scale and other detrimental foreign matter to degree specified by power wire brushing, power impact tools or power sanders.
 - 4. Brush-Off Blast Cleaning (SSPC-SP7/NACE 4): Brush-off blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose coating. Tightly adherent mill scale, rust, and coating may remain on the surface. Mill scale, rust, and coating are considered tightly adherent if they cannot be removed by lifting with a dull putty knife after abrasive blast cleaning has been performed.
 - 5. Commercial Blast Cleaning (SSPC-SP6/NACE 3): Blast cleaning until at

- least 66 percent of each element of surface area is free of all visible residues.
6. Near White Blast Cleaning (SSPC-SP10/NACE 2): Blast cleaning to nearly white metal cleanliness, until at least 95 percent of each element of surface area is free of all visible residues.
 7. Surface Preparation of Concrete (SSPC-SP13/NACE 6): This standard gives requirements for surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems.
 8. Power Tool Cleaning to Bare Metal (SSPC-SP11): This standard covers the requirements for power tool cleaning to produce a bare metal surface and to retain or produce a minimum 25 micrometer (1.0 mil) surface profile. This standard is suitable where a roughened, clean, bare metal surface is required, but where abrasive blasting is not feasible or permissible.
 9. Blast cleaning for all surfaces shall be by dry method unless otherwise directed.
- B. Particle size of abrasives used in blast cleaning shall be that which will produce a 1.5 – 2.0 mil (37.5 microns - 50.0- microns) surface profile or in accordance with recommendations of the manufacturer of the specified coating or paint system to be applied.
 - C. Abrasive used in blast cleaning operations shall be new, washed, graded and free of contaminants that would interfere with adhesion of coating or paint and shall not be reused unless specifically approved by the Architect.
 - D. During blast cleaning operations, caution shall be exercised to insure that surrounding existing coatings or paint are not exposed to abrasion from blast cleaning.
 - E. The Contractor shall keep the area of his work and the surrounding environment in a clean condition. He shall not permit blasting materials to accumulate as to constitute a nuisance or hazard to the accomplishment of the work, the operation of the existing facilities, or nuisance to the surrounding environment.
 - F. Blast cleaned surfaces shall be cleaned prior to application of specified coatings or paint. No coatings or paint shall be applied over damp or moist surfaces.
 - G. Specific Surface Preparation: Surface preparation for the specific system shall be

as noted in Section 2.01 Paragraphs D.

3.03 APPLICATION, GENERAL

- A. Coating and paint application shall conform to the requirements of the Steel Structures Painting Council Paint Application Specification SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting," and the manufacturer of the coating and paint materials.
- A. Thinning shall be permitted only as recommended by the manufacturer approved by the Architect, and utilizing the thinners stated in Section 2.01 Paragraphs D.
- B. Each application of coating or paint shall be applied evenly, free of brush marks, sags, runs, with no evidence of poor workmanship. Care shall be exercised to avoid lapping on glass or hardware. Coatings and paints shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.
- C. Protective coverings or drop cloths shall be used to protect floors, fixtures, and equipment. Care shall be exercised to prevent coatings or paint from being spattered onto surfaces that are not to be coated or painted. Surfaces from which materials cannot be removed satisfactorily shall be recoated or repainted as required to produce a finish satisfactory to the Architect.
- D. When two coats of coating or paint are specified, where possible, the first coat shall contain sufficient approved color additive to act as an indicator of coverage or the two coats must be of contrasting color.
- E. Film thickness per coat specified in Section 2.01 Paragraphs D are minimum required. If roller application is deemed necessary, the Contractor shall apply additional coats as to achieve the specified thickness.
- F. All material shall be applied as specified.
- G. All welds, edges and other irregular surfaces shall receive a brush coat of the specified product prior to application of the first complete coat.

3.04 COATING SYSTEMS APPLICATION

- A. After completion of surface preparation as specified for the specific system, materials shall be applied as noted in Section 2.01 Paragraphs D.

3.05 COLOR SCHEME

- A. Colors: Submittals will be made to the Architect for approval prior to application.

1. Galvanized Steel Headers: Full range as Selected by Architect to match Brick Color
2. Galvanized Steel Truss: Full range as Selected by Architect to Match Metal Panel.
3. Concrete Floor: As selected from Full Range

3.06 SOLVENT VAPOR REMOVAL

- A. Where appropriate all solvent vapors shall be completely removed by suction-type exhaust fans and blowers before placing in operating service.

3.07 CLEAN UP

- A. Upon completion of the work, all staging, scaffolding, and containers shall be removed from the site or destroyed in a manner approved by the Architect. Coating or paint spots and oil or stains upon adjacent surfaces shall be removed and the jobsite cleaned. All damage to surfaces resulting from the work of this section shall be cleaned, repaired, or refinished to the satisfaction of the Architect at no cost to the Owner.

3.08 WARRANTY

- A. The Contractor will warrant the work free of defects in material and workmanship for a period of one year from the acceptance of the work. At the end of one year, the Contractor will return for a one-year anniversary inspection of the work. The Contractor will correct any deficiencies found with no cost to the owner. Inspections shall be conducted in to conform to owners spec.

END OF SECTION

WCU
Norton Intramural Fields
22-24232-01A

DIVISION 10

SPECIALTIES



SECTION 10 21 13 CEILING MOUNTED TOILET COMPARTMENTS

PART 1 : GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Solid-plastic toilet compartments.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for blocking a overhead support of floor-and-ceiling-anchored compartments.
 - 2. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.02 COORDINATION

- A. Coordinate requirements for overhead supports, blocking, reinforcing, and other supports concealed within wall and ceiling to ensure that toilet compartments can be supported and installed as indicated.

1.03 ACTION SUBMITTALS

- A. Product Data:
 - 1. Solid-plastic toilet compartments:
 - 2. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachment details.
 - 2. Show locations of cutouts for compartment-mounted toilet accessories.
 - 3. Show locations of centerlines of toilet fixtures.
 - 4. Show locations of floor drains.
 - 5. Show overhead support or bracing locations.
- C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

1. Include Samples of hardware and accessories involving material and color selection.
- D. Samples for Verification: Actual sample of finished products for each type of toilet compartment, hardware, and accessory.
 1. Size: Manufacturer's standard size.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For toilet compartments.

1.05 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

PART 2 : PRODUCTS

2.01 SOURCE LIMITATIONS

- A. Obtain plastic toilet compartments from single source from single manufacturer.
- B. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.
- C. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:
- D. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf (1112 N) applied at any direction and at any point, without deformation of panel.
- E. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 for toilet compartments designated as accessible.

2.02 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturers
 1. ASI-Global Partitions Corporation.
 2. Bobrick Washroom Equipment, Inc.

3. Bradley Corporation; Mills Partitions.
 4. SCRANTON Hiny Hiders
 5. General Partitions
- B. Toilet-Enclosure Style: Ceiling hung.
- C. Urinal-Screen Style: Wall hung
- D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) material, not less than 1 inch (25 mm) thick, seamless, with eased edges, and with homogenous color throughout thickness of material.
1. Heat-Sink Strip: Manufacturer's continuous, stainless steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
 2. Color: One color in each room as selected by Architect from manufacturer's full range.
- E. Urinal-Screen Construction: Matching panel construction.
- F. Brackets (Fittings):
1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
- G. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid plastic.

2.03 HARDWARE AND ACCESSORIES

- A. Door Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty institutional operating hardware and accessories.
1. Hinges: Manufacturer's minimum 0.062-inch- (1.59-mm-) thick, stainless steel continuous, spring-loaded type allowing emergency access by lifting door. Mount with through bolts.
 2. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast stainless steel latch unit, designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible. Mount with through bolts.

3. Coat Hook: Manufacturer's heavy-duty, combination cast stainless steel hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.
 4. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast stainless steel bumper at outswinging doors. Mount with through bolts.
 5. Door Pull: Manufacturer's heavy-duty, cast stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible. Mount with through bolts.
- B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match 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.

2.04 MATERIALS

- A. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless Steel Castings: ASTM A743/A743M.

2.05 FABRICATION

- A. 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. Ceiling-Hung Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, inswinging doors for standard toilet enclosures and 36-inch- (914-mm-) wide, outswinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for toilet enclosures designated as accessible.

PART 3 : EXECUTION

3.01 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.

3.02 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 or Screens: 1/2 inch (13 mm).
 - b. Panels or Screens and Walls: 1 inch (25 mm).
 - 2. Full-Height (Continuous) Brackets: Secure panels or screens 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. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust, so bottoms of doors are level with bottoms of pilasters 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.

3.03 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION

SECTION 10 28 00 TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 : GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Childcare accessories.
 - 3. Underlavatory guards.
 - 4. Custodial accessories.
- B. Related Requirements:

1.02 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.

1.03 ACTION SUBMITTALS

- A. Product Data:
 - 1. Public-use washroom accessories.
 - 2. Underlavatory guards.
 - 3. Custodial accessories.
- B. Product Data Submittals: For each 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.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.

2. Identify accessories using designations indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranties.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

1.06 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 Final Acceptance.

PART 2 : PRODUCTS

2.01 OWNER-FURNISHED MATERIALS

- A. Owner-Furnished Contractor Installed Materials:
 1. Toilet Paper Dispensers
 2. Paper Towel Dispenser
 3. Soap Dispenser
 4. Waste Receptacle (Loose)

2.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 1. Grab Bars: Installed units are able to resist 250 lbf (1112 N) concentrated load applied in any direction and at any point.

2.03 PUBLIC-USE WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Specialties, Inc.
 2. Bobrick Washroom Equipment, Inc.

3. Bradley Corporation.
- B. Grab Bar:
1. Mounting: Flanges with concealed fasteners.
 2. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin on ends and slip-resistant texture in grip area).
 3. Outside Diameter: 1-1/2 inches (38 mm).
 4. Configuration and Length: As indicated on Drawings
- C. Sanitary-Napkin Disposal Unit
1. Mounting: Surface mounted.
 2. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
 3. Receptacle: Removable.
 4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin
- D. Mirror Unit
1. Frame: Stainless steel angle, 0.05 inch (1.3 mm) thick
 - a. Corners: Welded and ground smooth.
 2. Size: As indicated on Drawings

2.04 CHILDCARE ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Diaper-Changing Station :
 2. American Specialties, Inc.
 3. Diaper Deck & Company, Inc.
 4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 5. Koala Kare Products; a division of Bobrick Washroom Equipment, Inc.

- B. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
 - 1. Engineered to support a minimum of 250-lb (113-kg) static load when opened.
- C. Mounting: Surface mounted, with unit projecting not more than 4 inches (100 mm) from wall when closed.
- D. Operation: By pneumatic shock-absorbing mechanism.
- E. Material and Finish: HDPE in manufacturer's standard color.
- F. Liner Dispenser: Built in.

2.05 UNDERLAVATORY GUARDS

- A. Underlavatory Guard :
- 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:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Plumberex Specialty Products, Inc.
 - 2. Truebro by IPS Corporation.
- D. Underlavatory Guard to be located at exposed lavatory drains at break room, cater to room and family style restroom:
 - 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.

2.06 CUSTODIAL ACCESSORIES

- A. Source Limitations: Obtain [custodial accessories] [each type of custodial accessory] from single source from single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. A & J Washroom Accessories, Inc.

2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation.
- C. Mop and Broom Holder:
1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
 2. Length: 36 inches (914 mm).
 3. Hooks: Three.
 4. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
 5. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
 - b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

2.07 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- (0.8-mm-) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- (0.9-mm-) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- G. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.08 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

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
 - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

3.02 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 10 44 15

FIRE EXTINGUISHERS

PART 1 : GENERAL

1.01 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.04 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.05 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Final Acceptance.

PART 2 : PRODUCTS

2.01 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each location indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - b. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - c. Potter Roemer LLC.
 2. Valves: Manufacturer's standard.
 3. Handles and Levers: Stainless steel.
 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 UL-rated 2-A:10-B:C, 10-lb nominal capacity, with mono ammonium phosphate-based dry chemical in enameled-steel container.
- C. Wet Chemical Agent Type in Steel Containter UL-rated Type L; 10-lb.

PART 3 : EXECUTION

3.01 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.

3.02 INSTALLATION

- A. General: Install fire extinguishers in cabinet locations indicated and in compliance with requirements of authorities having jurisdiction.
 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

END OF SECTION

Section 10 73 11

AWNINGS

PART 1 : General

1.01 Summary:

- A. Overhead Supported Canopy – C-Beam

1.02 1.2 Engineering Design Criteria

- A. International Building Code
- B. ASCE 7-10, Minimum Design Loads for Buildings and Other Structures
- C. Aluminum Design Manual 2015
- D. AWS D1.2 – 2014, Structural Welding Code - Aluminum
- E. E. Local governing codes and standards for site location

1.03 1.3 General Description of Work

- A. A. Work in this section shall include design, fabrication, and installation of aluminum protective covers. All work shall be in accordance with the shop drawings and this specification section.

1.04 Submittals

- A. A. Shop Drawings – Submit complete shop drawings including:
 - 1. Overall canopy layout dimensions
 - 2. Cut section details including elevation, bent layout dimensions, canopy connection details, and wall connection details
 - 3. Flashing details pertaining to aluminum canopy
 - 4. Canopy anchorage details
 - 5. Delegated Design – Provide North Carolina Professional Engineer stamped, sealed and dated drawings that the proposed canopy design and layout meets or exceeds all applicable loadings as indicated in the Appendix B. Shop drawings shall not be approved until signed, sealed, and dated sealed shops are received.
- B. Product Data – Submit manufacturer's product information, specifications, and installation instructions for the aluminum canopy.
- C. Samples – Submit color selection samples of actual coated aluminum material or actual anodized aluminum material.
- D. D2015 and ASCE 7-10.

1.05 Quality Assurance

- A. Manufacturer Qualifications: Minimum five years experience in design, fabrication, and production of aluminum protective covers.
- B. Components shall be assembled in shop to greatest extent possible to minimize field assembly.
- C. Aluminum protective cover, including material and workmanship, shall be warranted from defects for a period of one year from date of completion of aluminum protective cover installation.

PART 2 : Products and Materials

2.01 Acceptable Manufacturers

- A. Mitchell Metals, LLC 1761 McCoba Drive Smyrna, GA 30080
Phone: 770.431.7300; www.mitchellmetals.net
- B. Dittmer Architectural Aluminum 1006 Shepard Road Winter Springs, FL 32708
Phone: 407.699.1755; www.dittdeck.com
- C. Mapes Industries 7748 North 56th Street Lincoln, NE 68514
888-273-1113; canopy@mapes.com Lawrence
- D. Parasol Awnings 4834 Hickory Hill Rd Memphis, TN 38141
901-368-4477; <https://parasolawnings.com/suspended-metal-canopies/>

2.02 2.2 Design & Assembly

- A. Canopy shall use perimeter extruded gutter and extruded decking running perpendicular to wall being attached to. Perimeter gutter shall be wrapped with 10" C-Beam on three sides. Extruded Decking shall be a roll-locked design where the extruded cap and pan shall interlock to make a rigid structure. Crimped decking is not allowed.
- B. Canopy gutter frame shall be welded into a single frame unless shipping does not allow. If shipping does not allow, canopy frame shall be riveted together at the corners and caulked inside to make a water-tight frame.
- C. Canopy gutter frame shall have a 10in C-Beam decorative frame attached to it using ½ in x 1-1/8 in 300 series stainless steel connector bolts at a minimum of 3 feet - 0 in on center. The 10" C-Beam frame shall encase only three sides of the canopy gutter frame. All connections between the canopy frame and the 10" C-

Beam frame shall be caulked.

- D. Canopy shall be secured to the wall using a 6 in x 6 in extruded wall bracket. A 2 in x 2 in OHS square tube shall be used to connect the canopy frame to the extruded wall bracket. The 2 in x 2 in OHS square tube shall be secured to the canopy frame using an extruded saddle bracket. The extruded saddle bracket shall connect to a 2 in x 2 in frame support tube that sits inside of the decking pan. The 2 in x 2 in frame support tube shall connect to the gutter frame using 4 – 300 series stainless steel fasteners, 2 at each end.
- E. Canopies shall drain from the decking to the perimeter gutter, and discharge from the bottom of the gutter out of a drain scupper. Downspouts can be used to drain the water from the overhead supported canopy to the ground upon the architect's request.
- F. Canopy shall be pitched toward the scupper/downspout to allow proper drainage out of the canopy frame.

2.03 2.3 Materials

- A. Overhead Support Tubes
 - 1. Overhead support tubes shall be 2" x 2" square tubing (minimum of 0.125 in thick).
- B. Frame Supports
 - 1. Frame support tubes shall be 2" x 2" square tubing (minimum of 0.125" thick).
- C. Decking
 - 1. Extruded decking shall exceed loading requirements in section 1.2 Engineering Design Criteria. Minimum 3" x 6" cap and pan.
- D. Gutter
 - 1. Gutter shall be radius cornered aluminum extrusion that exceeds loading requirements in section 1.2 – Engineering Design Criteria. Minimum gutter size shall be 4 in x 6" at 0.093 in thick.
- E. C-Beam
 - 1. C-Beam shall be 10 in x 2 ½ in x 0.125 in.
- F. Flashing
 - 1. Flashing shall be made of aluminum sheet painted to match the color of

the canopy. Minimum flashing thickness shall be 0.040" thick.

2.04 Fasteners

- A. A. All framing fasteners shall be stainless steel with neoprene washers. All rivets are 3/16" aluminum. All decking fasteners shall be long life coated steel with a series stainless steel cap and neoprene washer.

2.05 Finishes

- A. A. Factory applied baked enamel
 - 1. 1) Enamel is to comply with AAMA 2603.
 - 2. 2) Color is to be as selected by architect from manufacturer's standard color chart.

PART 3 : Execution

3.01 3.1 Erection

- A. Canopies are to be installed according to approved shop drawings and plans.
- B. The entire structure shall be installed straight, true, and plumb according to standard construction procedures.
- C. All fasteners penetrating the building's face shall be caulked.
- D. Any blocking necessary to install the overhead supported canopy shall be installed by the General Contractor according to the approved shop drawings prior to canopy installation.
- E. Canopies shall be installed with minimal slope to allow water flow from top of canopy to draining scuppers/downspouts and eliminate ponding.
- F. All joints, corners, and connections shall be tight and clean.
- G. All exposed fasteners are to be painted to match the canopy color.
- H. Decking is to be aligned and secured to aluminum frame structure.

3.02 3.2 Cleaning

- A. All canopy surfaces exposed are to be cleaned after installation is complete.
- B. Surplus materials and debris shall be removed from the jobsite after installation is complete.

3.03 Protection

- A. Contractor shall ensure protection of installed aluminum canopies from other construction so that canopies are without damage at time of substantial completion of project.

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.END OF SECTION

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DIVISION 22

PLUMBING



SECTION 220080 - PROJECT RECORD DOCUMENTS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
- B. See Division 22 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- C. See Division 22 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS**2.1 RECORD DRAWINGS**

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - c. Indicate dimensions to locate underground and concealed lines from fixed reference points.
 - d. Indicate burial depth for underground lines.
 - 2. Mark the Contract Drawings completely and accurately.
 - 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 4. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "AS-BUILT MARKED PRINT" in a prominent location.
 - 1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "AS-BUILT MARKED PRINTS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Note related Change Orders and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
- 2.4 MISCELLANEOUS RECORD SUBMITTALS
- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION**3.1 RECORDING AND MAINTENANCE**

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

END OF SECTION 220080

SECTION 220100 - PENETRATION FIRESTOPPING**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

1.2 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:
 - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
 - 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
 - a. Penetrations located outside wall cavities.
 - b. Penetrations located outside fire-resistance-rated shaft enclosures.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
 - 1. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.
 - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems bearing classification marking of qualified testing and inspecting agency.
- B. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application on Drawings or that are produced by one of the following manufacturers:

1. Grace, W. R. & Co. - Conn.
2. Hilti, Inc.
3. Johns Manville.
4. Nelson Firestop Products.
5. 3M; Fire Protection Products Division.
6. Tremco; Sealant/Weatherproofing Division.
7. USG Corporation.

2.2 FIRESTOPPING

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.

PART 3 - EXECUTION

3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 FIELD QUALITY CONTROL

- A. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

END OF SECTION 220100

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. General provisions.
 - 2. Scope.
 - 3. Permits and Fees.
 - 4. Visit to Job Site.
 - 5. Workmanship.
 - 6. Drawings and Specifications.
 - 7. Tests.
 - 8. Allowance for added work.
 - 9. Incidental construction work.
 - 10. Access Doors
 - 11. Supervision.
 - 12. Electrical work by others.
 - 13. Existing facilities, utilities, etc.
 - 14. Adaptation of work to existing conditions.
 - 15. Submittal procedures.
 - 16. Product requirements.
 - 17. Closeout procedures.
 - 18. Operation and Maintenance Manuals.
 - 19. As-built Documents.
 - 20. Demonstration and Training.
 - 21. Warranty.
 - 22. Commissioning Support

PART 2 - NOT APPLICABLE**PART 3 - EXECUTION****3.1 GENERAL PROVISIONS**

- A. This Contractor's attention is directed to the requirements of Instructions to Bidders, General Conditions and Supplementary General Conditions as bound in the specifications which apply in full to the plumbing work.
- B. Where the requirements of this Division conflict with other articles in these Specifications, the Contractor shall utilize the more stringent method.

3.2 SCOPE

- A. Provide all labor, materials, tools, equipment, and transportation, and perform all operations necessary for and reasonably incidental to proper execution and completion of all "Plumbing" work, whether specifically mentioned or not, all as indicated, specified herein, and/or implied thereby to carry out the apparent intent thereof.
- B. These drawings may be superseded by later revised or detailed drawings, specifications, or sketches prepared by the Designer, as needed for clarification, and this Contractor shall conform to all reasonable coordination requests.
- C. All items not specifically mentioned in the specifications or noted on the drawings, but which obviously are required to make the working installation complete, shall be included automatically.
- D. For projects which are bid or awarded as Single Prime contracts, organization of the Specifications into divisions, sections, and articles, and arrangement of the Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be done by any trade, unless specifically shown or noted otherwise.

3.3 PERMITS AND FEES

- A. This Contractor shall secure all permits required for the completion of this contract. He shall obtain and deliver to the Owner all certificates of inspection issued by the authorities having jurisdiction.

3.4 VISIT TO JOB SITE

- A. Before submitting a bid, this Contractor shall visit the job site for the purpose of thoroughly examining the site and conditions under which the work must be performed.
- B. The submission of a bona fide bid will be construed to mean that this Contractor understands and is satisfied with conditions under which the contract must be fulfilled.

- C. No extra compensation will be allowed for situations arising from failure of this Contractor to be thoroughly familiar with site conditions, including charges and requirements for connection to utilities as shown for this project.
- 3.5 WORKMANSHIP
- A. Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved.
 - B. Work shall be performed by experienced and skilled mechanics under the supervision of a competent foreman.
 - C. Substandard workmanship will be cause for rejection of work and replacement by Contractor.
 - D. The Contractor shall reimburse the Designer for all costs incurred by the Designer due to Contractor's substandard or non-conforming work.
- 3.6 DRAWINGS AND SPECIFICATIONS
- A. The drawings show the location and arrangement of fixtures, piping, and equipment, together with details of connections of certain principal items.
 - B. The layout shown shall be followed as closely as circumstances will permit, but this Contractor shall lay out his work so as to avoid conflict with other Contractors and trades, and to avoid any unnecessary cutting or damage to walls, floors, and supporting structural members.
 - C. This Contractor shall carefully and accurately locate all sleeves and install at the proper time all necessary hangers, inserts, etc., which will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of above items.
 - D. This Contractor shall refer to architectural, mechanical, and electrical drawings and shall cooperate fully with other Contractors and trades while installing piping, fixtures, and other equipment because of close space limits.
 - 1. In case of conflict, notify Designer before proceeding with installation.
 - 2. Refer to architectural drawings for exact building dimensions and location of partition walls, doors, chases, etc.
 - 3. Plumbing drawings are not to be scaled for such dimensions.
 - E. The drawings and specifications complement each other and together are intended to give a complete description of the work.
 - 1. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown in plans, shall be furnished the same as if mentioned or shown in both places.
 - 2. If conflicts exist, then the most stringent method shown or described shall apply.
 - F. Any switches, controls, or equipment included in this contract work (drawings and/or specifications) that are not specifically shown on drawings shall be located for convenient use and access.
 - G. Contractor shall coordinate all equipment arrangement and lay-out in field prior to beginning any actual installation of his work.
 - H. If Contractor notes any discrepancy, omission, or conflict found in plans or specifications, he shall call to the immediate attention of the Designer, prior to receipt of bids.
 - I. It is the intention that piping, air ducts and light fixtures are designed and laid out to clear each other.
 - 1. It shall be the responsibility of this Contractor to coordinate his work with that of other trades to avoid any such conflicts.
 - 2. Any conflicts that occur after work of one trade is installed and was not prior coordinated shall be relocated or rearranged at the total expense of this Contractor, as directed by Designer.
 - 3. Any conflicts that cannot be corrected in field by relocation or elevation changes shall be reported to the Designer in writing prior to any installation.
 - J. The drawings are not intended to show each and every complete or accurate detail.
 - 1. The figures and writing on drawings shall be taken instead of scaling.
 - 2. It is this Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement.
 - 3. This Contractor shall take and be responsible for all field measurements.
 - 4. Exact locations and relations are to be defined in the field and shall be satisfactory to the Designer.
 - K. Because of the small scale of plumbing drawings it is not possible to indicate all offsets, fittings, and accessories which may be required.

1. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings and accessories that may be required to meet the conditions.
- 3.7 TESTS
- A. The Designer reserves the right to conduct acceptance tests of all equipment, piping, or any other work furnished under these specifications to determine the fulfillment of special requirements.
 1. Such tests shall be conducted in the presence of authorized representatives of the Contractor, Owner, Engineer, and Architect at such time as the Designer may designate.
 2. This Contractor shall perform all tests, bear cost of same and make adjustments of equipment and wiring as may be deemed necessary by the Designer.
- 3.8 ALLOWANCE FOR ADDED WORK
- A. Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall first be submitted and approved in writing.
 1. No claim for addition to the contract sum will be valid unless so ordered and approved by the Owner and Designer, prior to start of work.
 2. Any conflicts corrected by relocation or elevation changes do not constitute extra work.
- 3.9 INCIDENTAL CONSTRUCTION WORK
- A. All blocking for openings for piping in concrete floors, masonry walls or partitions shall be provided by this Contractor.
 1. This Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other Contractors as shown upon, or reasonably implied by the drawings and specifications.
 2. He shall properly complete and finish up his work after other Contractors have finished as the Designer may direct.
 - B. All excavating required for the installation of this system shall be done by this Contractor.
 1. Backfill shall be accomplished as specified in appropriate section of specifications.
 - C. Chases are prohibited in masonry walls which are not to be plastered or paneled.
 1. Set piping, blocking, carriers, etc. indicated to be concealed before walls are constructed in order that walls may be constructed around them.
 2. This Contractor shall furnish all sleeves in floors, beams, walls, etc., for each such penetration as needed for installing his work and installation of sleeves by Contractor.
 - D. Unless otherwise noted, the Contractor will provide openings and lintels as new construction progresses, but this Contractor shall fully designate his requirements prior to construction.
 1. Failure to furnish his requirements prior to building construction and failure to coordinate his work with the building construction shall make this Contractor responsible for removing, replacing and painting building construction as required for installation of his work.
- 3.10 ACCESS DOORS
- A. Provide and install access doors in walls, ceilings, etc. as required for access to valves and other devices requiring access in ceilings, chases, soffits, etc.
 - B. Access doors in non-fire rated walls or ceilings shall be as follows:
 1. Nominal 24" x 24" minimum size.
 2. 16-gage steel frame with 14-gage door panel and galvanized steel drywall bead.
 3. Flush style with provision to conceal flange with drywall cement.
 4. Double-acting concealed spring hinges to allow opening to 175 degrees.
 5. Flush, Allen-head operated with steel cam.
 6. Gray prime-painted steel, for painting to match adjacent finished surfaces.
 7. Basis of Design: Milcor Style DW; Comparable Products by Karp, Elmdor, Acudor.
 - C. Access doors in fire-rated walls or ceilings shall be as follows:
 1. Nominal 24" x 24" minimum size.
 2. UL 1-1/2 hour, Class B fire rating.
 3. Prime-painted stainless steel: 16-gage frame with 20-gage door panel, for painting to match adjacent finished surfaces.
 4. 2" mineral fiber insulation between inner and outer panel.
 5. Continuous hinge, steel with stainless steel pin.
 6. Self-closing and self-latching panel closer.
 7. Flush mounted paddle latch and locking system with flush, key-operated cylinder lock with two keys.
 8. Basis of Design: Milcor Style UFR; Comparable Products by Karp, Elmdor, Acudor.

3.11 SUPERVISION

- A. This Contractor shall have in charge of the work at all times during construction a thoroughly competent foreman with extensive experience in the work to be performed under this contract.
 - 1. Anyone deemed not capable by the Designer shall be replaced immediately upon request, and after satisfactory foreman has been assigned, he shall not be withdrawn without the written consent of the Designer.

3.12 ELECTRICAL WORK BY OTHERS

- A. Refer to the drawings for the details of locations of circuit breakers, junction boxes, disconnect switches, conduits and slack wire required where this contractor's electrical work terminates and electrical work by others begins.
- B. The Electrical Contractor shall furnish and install all power circuits for equipment furnished by others.
- C. In Mechanical Rooms the wiring by the Electrical Contractor shall generally terminate in a power wiring gutter, line side of disconnect switches or starters, junction box, or electrical panel.
 - 1. From these points power wiring to the equipment furnished by the Plumbing Contractor shall generally be by the Plumbing Contractor.
 - 2. Power wiring to mechanical equipment outside equipment rooms will generally be run by the Electrical Contractor to line side of a disconnect switch or junction box in the vicinity (within 3'-0") of the plumbing equipment.
 - 3. Power wiring from that point to the equipment will be by the Plumbing Contractor.
- D. Plumbing Contractor is to refer to the drawings for location and type of service connections to be provided under the electrical contract.
 - 1. Where service disconnect switches are required and not furnished as part of the equipment, they shall be furnished and installed by contractor that furnishes the equipment, unless indicated otherwise.
 - 2. Other Contractors shall furnish and install conduit, boxes, wiring and all items of control for equipment they furnish or Owner furnished equipment, unless specifically shown on electrical drawings.

3.13 EXISTING FACILITIES

- A. In existing facilities, disruption of operations must be kept to a minimum and coordinated with Owner.
 - 1. Work in existing buildings must be cleaned up daily immediately after finishing that portion of work and equipment left in order for Owner to continue operations.
 - 2. When it is necessary to interrupt utility services in the fulfillment of this contract, such interruptions shall be kept to a minimum and coordinated with Owner.
 - 3. Once work has begun, it shall be pursued diligently until completed.
- B. Every precaution shall be taken to prevent damage to existing underground lines and structures and public utilities.
 - 1. Damage to existing water and sewer lines, culverts, service connections, underground cables, and similar surface and sub-surface structures shall be at the risk of this Contractor, whether or not locations thereof are shown on plans, and the repairing of such damage shall be by this Contractor and shall be completed without delay.
 - 2. Compensation for such repairs shall be based on normal and reasonable costs.
- C. The locations of any existing underground utilities that are shown are in an approximate way only and have not been independently verified by the Owner or its representative.
 - 1. The Contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the Contractor's failure to exactly locate and preserve any and all underground utilities.

3.14 ADAPTATION OF WORK TO EXISTING CONDITIONS

- A. It is reasonably implied that this Contractor shall furnish all labor and materials to provide Owner with a new and satisfactory system in these facilities.
 - 1. Contractor is to include necessary work for adaptation of equipment to conditions that may be found to produce conflicts during construction.
 - 2. When any such conditions are encountered, this Contractor is to consult with Designer and then modify installation as directed without additional costs, and to include any incidental materials required.

3.15 SUBMITTAL PROCEDURES

- A. Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 3. Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Contractor approval: Affix review stamp to cover sheet, with initials and date of Contractor's approval of submittals.
1. By submitting Shop Drawings, Product Data, Samples and similar submittals, this Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria and details related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work, the Contract Documents and the Work of other trades.
- C. Comply with requirements in Division 01 Sections for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows.
1. Time for review shall commence on Designer's receipt of submittal.
 2. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 3. Allow 21 days for initial review of each submittal.
 - a. Allow additional time if coordination with subsequent submittals is required.
 - b. Designer will advise Contractor when a submittal being processed must be delayed for coordination.
 4. Allow 15 days for review of each resubmittal.
- E. Identification: Identify submittals as required in Division 01 sections.
- F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
1. Summarize deviations on transmittal or List of Deviations included with submittal.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling.
1. Transmit each submittal using a transmittal form.
 2. Designer will discard submittals received from sources other than Contractor.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked "Furnish as Submitted" or "Furnish as Corrected."
 4. Where submittals contain specific questions or comments, provide a separate sheet with specific answers to each question or comment.
- J. At Contractor's written request, copies of Designer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
1. Allow 21 days from Designer's receipt of written request for CAD files for delivery of files
 2. Files will be delivered via email or compact disc.
 3. Files will be delivered without RN&M Title Blocks, standard details, schedules, etc.
 4. CAD files provided for Contractor's use are not to be construed as the Contract Documents. Use of CAD files for submittals or other uses are at the Contractor's risk.
- K. Prepare and submit Action Submittals required by individual Specification Sections.
1. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 2. Number of Copies: Submit at least eight copies of Product Data, unless otherwise indicated.
 - a. Designer will return all but three copies.
 - b. Retain or duplicate sufficient copies for inclusion in Operation and Maintenance Manuals.
 3. Shop Drawings: Prepare Project-specific information, drawn accurately to scale.
 - a. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Designer's CAD Drawings is otherwise permitted.
 5. Sheet Size: At least 8-1/2 by 11 inches but no larger than size of project drawings.

7. Number of Copies: Two opaque (bond) copies of each submittal. Designer will return one copy.
 8. Manufacturers and Materials Suppliers List: Submit three copies of manufacturers and materials suppliers list within 20 days of Contract Award, unless otherwise indicated. Designer will return two copies.
 10. Subcontract List: Submit within 20 days of Contract Award three copies of list of proposed subcontractors. Designer will return two copies. Subcontract list to include all tiers of subcontractors.
 - L. Contractor's Review and Approval: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents.
 1. Note corrections and field dimensions.
 2. Mark with approval stamp before submitting to Designer.
 - M. Designer's Action: Designer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
 1. Designer will review each submittal, make marks to indicate corrections or modifications required, and return it.
 2. Designer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - a. Furnish as Submitted
 - b. Furnish as Corrected: Incorporate comments marked on or attached to submittal.
 - c. Revise and Resubmit: Major items of the submittal do not comply, requiring a resubmittal.
 - N. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
 - O. Submittals not required by the Contract Documents may not be reviewed and may be discarded.
 - P. The Contractor is responsible for compliance with the Contract Documents, dimensions, details, coordination, and satisfactory performance of materials and equipment provided and installed.
- 3.16 PRODUCT REQUIREMENTS
- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 1. Basis-of-Design Product: Item identified by manufacturer's product name, make, and model number, used to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, dimensions, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
 2. Comparable Product: Product that is listed in the Contract Documents, or added by Addendum, and demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified or basis-of-design product.
 3. Owner-preferred Alternate Product: Product that is listed in the Contract Documents, and for which an Alternate Bid price is submitted. When an Alternate Bid item is accepted in the Contract, no substitutions will be allowed.
 4. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor after award of Contract.
 5. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - B. Comparable Product Requests: Submit three copies of each request for consideration, at least 10 days prior to receipt of bids, for products not listed in the Contract Documents. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 1. Documentation: Show compliance with requirements for Comparable Products and the following, as applicable:

- a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed product.
 - b. Detailed comparison of significant qualities of proposed product with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 2. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation. Designer will notify Contractor of approval or rejection of proposed comparable product request.
 - a. Form of Approval: Addition of the item to the list of Comparable Products by Addendum, prior to receipt of bids.
 - b. Use product specified if Designer cannot make a decision on use of a comparable product request within time allocated.
 - C. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, features, options, and other items needed for a complete installation and indicated use and effect, and as required or recommended by the manufacturer for a complete installation, whether or not specifically indicated on the drawings or specifications.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Designer will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
 - D. Product Selection Procedures:
 1. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 2. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 3. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.
 - E. Responsibility of the Contractor: The responsibility for determining dimensions, utility requirements, fitting of work with other trades, sequencing and coordination of work, for Product Substitutions and Comparable Products rests solely with the Contractor.
 - F. Manufacturer's Warranties: Where specifications require manufacturer's warranties, the provisions of the Contract Documents take precedence over any manufacturer's "standard" warranty provisions, exclusions, etc.
 1. The start of manufacturer's warranties shall be the date of Substantial Completion of the project or phase of the project, notwithstanding any language or exclusion in any document submitted by the contractor or manufacturer.
- 3.17 CLOSEOUT PROCEDURES
- A. Substantial Completion: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 2. Complete startup testing of systems.
 3. Submit test records.
 4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 5. Complete final cleaning requirements, including touchup painting.

6. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
 7. Submit a written request for inspection for Substantial Completion. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
 8. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 9. Results of completed inspection will form the basis of requirements for Final Completion.
 - B. Final Completion: Before requesting final inspection for determining date of Final Completion, complete the following:
 1. Submit certified copy of Designer's Substantial Completion inspection list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit documentation of training.
 3. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
 4. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - C. Cleaning: This Contractor shall provide all systems and equipment in a new and clean condition.
 1. Clean all items furnished and installed in accordance with manufacturer's recommendations.
 2. Provide instruction to Owner in proper cleaning of all items provided as part of this Division.
 3. Cooperate with CMAR in cleaning of building.
- 3.18 OPERATION AND MAINTENANCE MANUALS
- A. Submit four complete copies of Operation and Maintenance Manuals to Designer for review prior to request for inspection for Substantial Completion.
 - B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
 - C. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name, address, and telephone number of Contractor.
 6. Name and address of Architect.
 7. Name and address of Engineer.
 - D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - E. List of Material Suppliers and Subcontractors: List contact information for each material supplier and subcontractor.
 - F. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
 1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

- a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
 - G. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
 - H. Descriptions: Include the following: Product name and model number, Manufacturer's name, Equipment identification with serial number of each component, Equipment function, Operating characteristics, Limiting conditions, Performance curves, Engineering data and tests, Complete nomenclature and number of replacement parts.
 - I. Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
 - J. Describe the sequence of operation, and diagram controls as installed.
 - K. List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
 - L. Provide manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
 - M. Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:
 - N. Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - O. Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
 - P. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - Q. Provide complete approved submittal data with all annotations.
 - R. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
- 3.19 AS-BUILT DOCUMENTS
- A. As-built Marked Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings.
 - 1. Mark Record Prints to show the actual installation where installation varies from that shown originally.
 - 2. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up As-built Marked Prints.
 - 3. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - 4. Record data as soon as possible after installation.
 - 5. Record and check the markup before enclosing concealed installations.
 - 6. Indicate dimensions to locate underground and concealed conduits and lines from fixed reference points.
 - 7. Indicate burial depth for underground lines.
 - 8. Indicate location of all valves and cross-reference to valve tag list.
 - 9. Mark the Contract Drawings completely and accurately.
 - a. Mark record sets with erasable, red-colored pencil.
 - b. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

10. Maintain As-built Marked Prints in a clean, legible, up-to-date condition in the project office, and available to the Designer for inspection upon request throughout construction.
 - B. Record Specifications: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Note related Change Orders and As-built Marked Prints where applicable.
- 3.20 DEMONSTRATION AND TRAINING
- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with Owner with at least seven days' advance notice.
 - C. Warranty service: Train Owner in repair and troubleshooting during each warranty service call.
 - D. For each training session, submit on letterhead name of trainer, date of training, names of Owner's personnel trained, and systems/equipment trained on.
 - E. For factory training, documentation to be on letterhead of organization conducting training.
- 3.21 WARRANTY
- A. This Contractor shall guarantee all materials, equipment, workmanship and each and every piece of apparatus which he furnished and which he installs under this contract against defects and failures of any nature for a period of one year from date on which the system is accepted.
 - B. Apparatus furnished by this Contractor shall be guaranteed to be satisfactory when operated under rated conditions in accordance with manufacturer's instructions and to be of size, function, and capacity specified on drawings or in the specifications.
 - C. Equipment manufacturers shall warrant equipment furnished for this project for same time span as installing contractors warranty period as set above and elsewhere in these specifications.
 1. Warranty start date shall be as established by the Designer. Refer to General Conditions, Supplementary General Conditions, and Division 1 specifications for establishment of warranty start dates.
 2. The provisions of the Contract Documents supersede and override any manufacturer's standard warranty provisions.
 - D. Upon notice from the Designer or Owner, Contractor shall immediately check system, make necessary repairs or adjustments as required; due to faulty workmanship, materials, faults, operation or equipment, without cost to the Owner, and instruct Owner in proper operation, adjustment, and care of systems.
 - E. During the one-year warranty period, the Contractor shall be responsible for all preventive maintenance, including routine lubrication, filter changing, inspections, and adjustments.
 1. Contractor shall provide all materials, consumables, equipment, supplies, etc. required for preventive maintenance.
 2. Perform preventive maintenance in accordance with manufacturer's recommendations.
 3. During preventive maintenance, instruct Owner in proper preventive maintenance procedures.
 - F. The Contractor shall submit service call tickets, reports, or other documentation of each warranty service call to the Designer.
- 3.22 COMMISSIONING SUPPORT
- A. This contractor shall support all Commissioning as requested by the Commissioning Agent, to include but not limited to the following:
 1. Performance tests
 2. Piping tests as requested
 3. Factory startup of equipment
 4. Any commissioning activity, as requested by the Commissioning Agent.

END OF SECTION 220500

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT**PART 1 - GENERAL****1.1 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.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS**2.1 GENERAL MOTOR REQUIREMENTS**

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of **3300 feet** above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Rotor: Random-wound, squirrel cage.
- E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating.
- G. Insulation: **Class F**
- H. Code Letter Designation:
 - 1. Motors Smaller than **15 HP**: Manufacturer's standard starting characteristic.
- I. Enclosure Material: Cast iron for motor frame sizes **324T** and larger; rolled steel for motor frame sizes smaller than **324T**.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and 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.

SECTION 220513**COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT**

- 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 220513

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Metal-bellows expansion joints.
2. Pipe bends and loops.
3. Alignment guides and anchors.
4. Analysis by Professional Engineer for any Seismic joint which will be required for the seismic category as noted on the Architectural Drawings.

1.2 SUBMITTALS

- A. Calculations for Seismic joints at building joints.
- B. Product Data: For each type of product indicated.
- C. Delegated-Design Submittal: For each anchor and alignment guide 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 requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- D. Welding certificates.
- E. Product certificates.
- F. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
 2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS**2.1 EXPANSION JOINTS**

- A. Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type with external tie rods.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. Adscos Manufacturing, LLC.
 - b. Flex-Hose Co., Inc.
 - c. Metraflex, Inc.
 - d. Piping Technology & Products, Inc.
 - e. Senior Flexonics, Inc.; Pathway Division.
 2. Metal-Bellows Expansion Joints for Copper Piping: Single-ply phosphor-bronze bellows, copper pipe end connections, and brass shrouds.
 3. Metal-Bellows Expansion Joints for Stainless-Steel Waterway: Single-ply stainless-steel bellows, stainless-steel-pipe end connections, and steel shroud.
 4. Metal-Bellows Expansion Joints for Steel Piping Single-ply stainless-steel bellows, steel pipe end connections, and carbon-steel shroud.
 5. Minimum Pressure Rating: 175 psig unless otherwise indicated.
 6. Configuration Single bellows type, unless otherwise indicated.
 7. End Connections: Flanged or threaded

2.2 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. Adscos Manufacturing, LLC.
 - b. Flex-Hose Co., Inc.
 - c. Metraflex, Inc.
 - d. Piping Technology & Products, Inc.

e. Senior Flexonics, Inc.; Pathway Division.

2.3 MATERIALS FOR ANCHORS

- A. Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Stud: Threaded, zinc-coated carbon steel.
 - 2. Expansion Plug: Zinc-coated steel.
 - 3. Washer and Nut: Zinc-coated steel.
- E. Concrete: Portland cement mix, **3000 psi** minimum. Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- F. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: **5000-psi**, 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- B. Install expansion joints of sizes matching size of piping in which they are installed.
- C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.2 PIPE BEND AND LOOP INSTALLATION

- A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Attach pipe bends and loops to anchors.
 - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.3 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.4 ALIGNMENT-GUIDE INSTALLATION

- A. Install guides on piping adjoining pipe expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.

3.5 ANCHOR INSTALLATION

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints are indicated.
- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION 220516

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Thermometers.
 - 2. Gages.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

PART 2 - PRODUCTS**2.1 SOLAR DIGITAL THERMOMETER**

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following: Sika, Miljoco, Weiss, Weksler
- B. Case: High impact ABS plastic.
- C. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- D. Range: -50°F to 300 °F minimum, field switchable between Fahrenheit and Celsius.
- E. Accuracy: Greater value of 1° or 1%.
- F. Resolution: 0.1°.
- G. Recalibration: Internal potentiometer.
- H. Power: Bi-directional solar photovoltaic elements.
- I. Environmental Conditions
 - 1. Ambient Temperature: -30°F to 140 °F.
 - 2. Maximum Relative Humidity: 100%.

2.2 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.3 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following: AMETEK, Inc., Ernst Gage Co., Eugene Ernst Products Co., KOBOLD Instruments, Inc., Marsh Bellofram, Miljoco Corp., Noshok, Inc., Palmer - Wahl Instruments Inc., REO TEMP Instrument Corporation, Terice, H. O. Co., Weiss Instruments, Inc., Weksler Instruments Operating Unit, WIKA Instrument Corporation, Winters Instruments.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
 - 1. Case: Liquid-filled type, drawn steel or cast aluminum, 6-inch diameter.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 - 6. Pointer: Red or other dark-color metal.
 - 7. Window: Glass or plastic.
 - 8. Ring: Metal or plastic.
 - 9. Accuracy: Grade C, plus or minus 3 percent of middle half scale.
 - 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 - 11. Range for Fluids under Pressure: Two times operating pressure.
- C. Pressure-Gage Fittings:
 - 1. Valves: NPS 1/4 brass or stainless-steel needle type.
 - 2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
 - 3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION**3.1 THERMOMETER APPLICATIONS**

- A. Install solar powered digital thermometers in piping as shown on Drawings.
- B. Install bimetallic-actuated dial thermometers in the following locations on ductwork as shown on Drawings.

SECTION 220519

METERS AND GAGES FOR PLUMBING PIPING

3.2 GAGE APPLICATIONS

- A. Install pressure gages as shown on Drawings.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).
- E. Install needle-valve and syphon fitting in piping for each pressure gage for steam.

3.4 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

3.5 ADJUSTING

- A. Calibrate thermometers according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Water System Valves
 - a. Ball Valves
 - b. Butterfly Valves
 - c. Swing Check Valves
 - d. Spring Loaded Check Valves
 - e. Stop & Waste Valves
 - f. Balance Valves
 - g. Drain Valves
 - h. Buried Water Service Valves
 - i. Corporation Stop Valves
 - j. Curb Stop Valves
 2. Waste System Valves
 - a. Gate Valves
 - b. Ball Valves
 - c. Swing Check Valves
 - d. Spring Loaded Check Valves
 3. Natural Gas Systems
 - a. Shut-off Valves
 - b. Exterior Below Grade Shutoff Valves
 - c. Gas Pressure Regulators
 4. Compressed Air Systems
 - a. Shut-off Valves
 - b. Safety Exhaust Shut-off Valves
 - c. Pressure Reducing Valves
 5. Specialty Valves and Valve Accessories
 - a. Gauge Valves
 - b. Water Pressure Reducing Valves
 - c. Safety Relief Valves
 - d. Sewer Air and Vacuum Valves
- B. Related Sections:**
1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.2 SUBMITTALS

- A. Product Data:** For each type of valve indicated.

1.3 QUALITY ASSURANCE

- A. ASME Compliance:** ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance:** NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS**2.1 GENERAL REQUIREMENTS FOR VALVES**

- A.** Refer to valve schedule articles for applications of valves.
- B.** Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C.** Valve Sizes: Same as upstream piping unless otherwise indicated.
- D.** Each valve type shall be of same manufacturer.
- E. Valve Actuator Types:**
1. Gear Actuator: For quarter-turn valves **NPS 8** and larger.
 2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves **NPS 6** and smaller[**except plug valves**].
 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

- F. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- G. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.
- 2.2 WATER SYSTEM VALVES
 - A. All water system valves to be rated at not less than 125 water working pressure at 240 degrees F unless noted otherwise.
 - B. Ball valves:
 - 1. 3" and smaller: Two or three piece bronze body; sweat ends, chrome plated bronze ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 600 psig WOG. Provide valve stem extensions for valves installed in all piping with insulation. Apollo 70-200, Grinnell 3700, Hammond 8511, Milwaukee BA150, Nibco S580-70, Watts B-6001.
 - C. Butterfly valves:
 - 1. 2-1/2" and larger: Cast or ductile iron body; stainless steel shaft; bronze, copper or teflon bushings; EPDM resilient seat; EPDM seals; bronze, aluminum-bronze, EPDM encapsulated ductile iron or stainless steel disc. 200 psig WOG through 12", 150 psig WOG through 24". Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use tapped lug type valves with stud bolts or cap screws, or grooved end connection valves, permitting removal of downstream piping while using the valve for system shutoff. Centerline LT series, DeZurik 632, Grinnell Series 8000, Hammond 6200 Series, Milwaukee M or C Series, Nibco LD2000/LC2860, Victaulic 300/608/700/709, Watts BF-03.
 - 2. Provide 10 position locking lever handle actuators for valves 6" and smaller. Provide worm gear operators with external position indication for valves 8" and larger.
 - 3. Provide valve stem and neck extensions for butterfly valves when used in low temperature service subject to condensation buildup where handles do not clear insulation.
 - D. Swing check valves:
 - 1. 3" and smaller: Bronze body, sweat ends, Y-pattern, regrindable bronze seat, renewable bronze disc, Class 125, suitable for installation in a horizontal or vertical line with flow upward. Crane 1342, Grinnell 3300SJ, Hammond IB941, Nibco S413B, Watts CVYS.
 - 2. 4" and larger: Cast iron body, flanged ends, bronze trim, bolted cap, renewable bronze seat and disc, Class 125, non-asbestos gasket, suitable for installation in a horizontal or vertical line with flow upward. Crane 373, Grinnell 6300A, Hammond IR1124, Milwaukee F2974, Nibco F918B, Watts Series 411.
 - E. Spring loaded check valves:
 - 1. 2" and smaller: Bronze body, sweat or threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, Class 125, teflon seat unless only bronze available. ConBraCo 61 series, Grinnell 3600SJ, Mueller 203BP, Nibco S480Y, Val-Matic S1400 series.
 - 2. 2-1/2" and larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, Class 125. APCO 300 or 600 series, Centerline CLC with full body option, Hammond IR9354, Milwaukee 1800 series, Mueller Steam 101AP or 105AP, Nibco W910 or F910, Val-Matic 1400 or 1800 or 8000 series.
 - F. STOP & WASTE VALVES:
 - 1. 1" and smaller, Bronze body, sweat or threaded ends, 400 psi WOG, stainless steel ball and stem, full port ball valve, with threaded drain cap, Watts B-6300/6301 SS series. Apollo, Grinnell, Hammond, Milwaukee or Nibco manufacturer.
 - G. Balance valves:

1. 2" and smaller: Two or three piece bronze body ball valve, sweat or threaded ends, chrome plated brass ball, glass filled teflon seat, threaded packing nut, with adjustable memory stop position indicator and extended handle stem, suitable for 400 psig water working pressure at 240 degrees F. Watts B-6000/B-6001 BS Apollo, Grinnell, Hammond, Milwaukee Or Nibco manufacturer.
- H. Drain valves:
 1. 3/4 inch ball valve with integral threaded hose adapter, sweat or threaded inlet connections, with threaded cap and chain on hose threads, Watts B-6000-CC/B-6001-CC series.
- I. Buried Water Service Gate valves:
 1. Cast iron body, resilient elastomer coated cast iron disc, permanently lubricated stuffing box, bronze non-rising stem and stem nut, double O-ring stem seal, Delrin thrust bearings, electroplated nuts and bolts, cast iron operating nut, AWWA C509, rated for 200 psi. Coat valve inside and out with fusion bonded epoxy, AWWA C550. Clow F-6100, Kennedy 1571, M&H 3067, Mueller A-2360, Waterous 500, Watts 406RW.
- J. UNDERGROUND WATER SERVICE BUTTERFLY VALVES:
 1. Rubber-seated butterfly valve meeting the requirements of AWWA C504, for Class 150B. Body and disc shall be constructed of cast iron. Disc shall be lens shaped.
 2. Interior and exterior surfaces of valve shall be provided with epoxy coating meeting the requirements of AWWA C550. Disc shall be provided with a stainless steel disc edge.
 3. Valve stem shall be stainless steel. Packing shall be permanent duty "chevron V-type" or "O-ring" type. Bearings shall be permanent, non-metallic, and self-lubricating.
 4. Valve seat shall be a single piece of elastomeric material that is not penetrated by the valve shaft.
 5. Provide manual operator that is suitable for underground service and includes a standard 2" square operating nut.
 6. Valve shall be provided with mechanical joint connections.
 7. Mueller, Clow, Henry Pratt, or approved equal.
- K. Corporation Stop valves:
 1. 2" and smaller: Bronze body ground key valve, bronze plug, AWWA taper thread inlet and copper flare outlet nut connections or compression type, AWWA C800.
- L. Curb Stop valves:
 1. 2" and smaller: Bronze body plug valve, bronze plug, quarter turn check, O-ring seals, copper flare nut connections or compression type, AWWA C800.
- 2.3 valve boxes
 - A. GATE/BUTTERFLY VALVE BOXES:
 1. Valve boxes shall be 5 1/4", cast iron valve boxes. Boxes shall be threaded, three-piece design with stay-put "WATER" cover. Provide appropriately sized bonnet.
 2. Provide valve box extensions as necessary to accommodate depth of cover shown on plans, or 6.5' minimum.
 3. Valve boxes shall be Tyler, or approved equal.
- 2.4 CURB STOP BOXES:
 - A. Curb stop boxes shall be 1 1/4" minimum diameter, cast iron, arch style, valve boxes. Boxes shall be telescopic, extendable to accommodate 7' bury. Lid shall be two piece threaded, with a plug having a pentagonal bolt for removal.
 - B. Ford, Mueller, or approved equal.
- 2.5 WASTE SYSTEM VALVES
 - A. Gate valves:
 1. 2" and smaller: Bronze body, bronze trim, threaded ends, solid wedge, rising stem, union bonnet, malleable iron hand wheel, suitable for 300 psi WOG. Crane 431UB, Grinnell 3080, Hammond IB629, Lunkenheimer 3151, Milwaukee 1151(M), Nibco T134, Powell 2714, Stockham B120.
 2. 2-1/2" and larger: Iron body, bronze trim, bolted bonnet, O.S. & Y., solid wedge, flanged, suitable for 200 psi WOG. Crane 465-1/2, Grinnell 6020A, Hammond

IR1140, Lunkenheimer 1430, Milwaukee F2885, Nibco F617-O, Powell 1793, Stockham G623.

B. Ball valves:

1. 3" and smaller: Two or three piece bronze body; sweat or threaded ends, chrome plated bronze ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG. Apollo 70-200, Grinnell 3700, Hammond 8511, Milwaukee BA150, Nibco S585-70, Watts B-6001.

C. Swing check valves:

1. 1-1/2" and smaller: Bronze body, threaded ends, Y-pattern, regrindable bronze seat, renewable bronze disc, Class 125, suitable for installation in a horizontal or vertical line with flow upward. Crane 1342, Grinnell 3300SJ, Hammond IB941, Nibco S413B, Watts CVYS.
2. 2" and larger: Cast iron body, flanged ends, bronze trim, bolted cap, renewable bronze seat and disc, Class 125, non-asbestos gasket, outside lever and weight or spring, suitable for installation in a horizontal or vertical line with flow upward. Crane 383, Grinnell 6300A, Milwaukee F2974, Nibco F918B.

D. Spring loaded check valves:

1. 2" and smaller: Bronze body, sweat or threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, Class 125, teflon seat unless only bronze available. ConBraCo 61 series, Grinnell 3600SJ, Mueller 203BP, Nibco S480Y, Val-Matic S1400 series.
2. 2-1/2" and larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, Class 125. APCO 300 or 600 series, Centerline CLC with full body option, Hammond IR9354, Milwaukee 1800 series, Mueller Steam 101AP or 105AP, Nibco W910 or F910, Val-Matic 1400 or 1800 or 8000 series.

2.6 NATURAL GAS SYSTEMS

A. Shut-off valves:

1. 4" and smaller: Ball or eccentric plug valve, bronze or cast iron body, 2" and under threaded ends, 2-1/2" and over flanged ends, chrome plated bronze ball, bronze or nickel plated cast iron plug, TFE or Hycar seats and seals, lever handle, 175 psi W.O.G., U.L listed for use as natural gas shut-off. Apollo 80-100, DeZurik 425.
2. 5" and larger: Cast iron body, flanged ends, stainless steel bearings, resilient faced plugs, totally enclosed hand wheel actuators, 175 psi W.O.G., U.L. listed for use as natural gas shut-off.

B. Exterior below grade shut-off valves:

1. Plug or ball valve, body of same polyethylene type as piping system, pipe stub ends, high strength plastic stem and operating nut, position indicator, polyethylene plug or polypropylene ball, Buna-N seats and double stem seals, rated for 96 psi natural gas service (150 psi non-lethal service).

C. Gas pressure regulators:

1. 2" and smaller: Cast iron body, aluminum spring and diaphragm, Nitrile diaphragm, threaded ends, 150 psi W.O.G., -20 degrees F to 150 degrees F.

2.7 COMPRESSED AIR SYSTEMS

A. Shut-off valves:

1. 3" and smaller: Two or three piece bronze body; threaded ends, chrome plated bronze ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 600 psig WOG. Apollo 70-100, Milwaukee BA100, Nibco T585-70 or T-590-Y, Watts B-6000.

B. Safety exhaust shut-off valves:

1. 3" and smaller: Two or three piece bronze body; threaded ends, chrome plated bronze ball; downstream vent port; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 175 psig WOG. Apollo 70-100-41, Watts B-6000.

C. Pressure reducing valves:

1. Bronze or aluminum body and trim, diaphragm or balanced piston, 250 psig maximum, 0-125 psig adjustable output, internal relief, 1/4" outlet gauge tapping.

2.8 SPECIALTY VALVES AND VALVE ACCESSORIES

- A. Gauge valves:
 - 1. Use 1/4" ball valves. Needle valves and gauge cocks will not be accepted.
- B. Water pressure reducing valves:
 - 1. Bronze body, diaphragm operated, with an integral thermal expansion bypass valve, inlet union, stainless steel strainer, renewable monel or stainless steel seat and adjustable reduced pressure range, 300 psig at 160 degrees F. Pre-set for the scheduled pressure. A. W. Cash, Conbraco, Watts, Wilkins.
- C. Safety relief valves:
 - 1. Bronze body, temperature and pressure actuated, stainless steel stem and spring, thermostat with non-metallic coating, test lever, suitable for 125 psig water working pressure at 240 degrees F, sized for full BTUH input and operating pressure of equipment, with valve capacity on metal label. For equipment less than or equal to 200,000 BTUH input, provide AGA, UL or ASME listed and labeled valve. Provide ASME listed and labeled valve for larger equipment. Bell & Gossett, A. W. Cash, Conbraco, Watts, Wilkins. Temperature and pressure relief valve shall be sized per AGA rating for BTUH input.
- D. Sewer air and vacuum valves:
 - 1. Combination air release/air and vacuum valve consisting of cast iron elongated body; size as shown on drawings; stainless steel valve, trim and float; Hycar or Buna-N rubber seat; inlet, backflushing and blowoff valves; 5' backflushing hose with quick disconnect fittings; 150 psig. Apco Series 440 SCAV, Crispin S20A/S20 Series, Val-Matic 800 Series.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.
- F. Install valve tags/identification per Division 22 Section "Identification for Plumbing Piping and Equipment" prior to installation of ceilings.

3.2 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 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
- D. See Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

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. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Equipment supports.
- C. 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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. 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. Available Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.

7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco 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-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.
- 2.4 METAL FRAMING SYSTEMS
 - A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
 - B. Available Manufacturers:
 1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 3. GS Metals Corp.
 4. Power-Strut Div.; Tyco International, Ltd.
 5. Thomas & Betts Corporation.
 6. Tolco Inc.
 7. Unistrut Corp.; Tyco International, Ltd.
 - C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
 - D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- 2.5 THERMAL-HANGER SHIELD INSERTS
 - A. Description: **100-psig**- minimum, compressive-strength insulation insert encased in sheet metal shield.
 - B. Available Manufacturers:
 1. Carpenter & Paterson, Inc.
 2. ERICO/Michigan Hanger Co.
 3. PHS Industries, Inc.
 4. Pipe Shields, Inc.
 5. Rilco Manufacturing Company, Inc.
 6. Value Engineered Products, Inc.
 - C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
 - D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
 - E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
 - F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
 - G. Insert Length: Extend **2 inches** beyond sheet metal shield for piping operating below ambient air temperature.
- 2.6 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. Available 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 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. Available 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.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: **5000-psi**, 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 noninsulated 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 noninsulated stationary pipes, **NPS 1/2 to NPS 8**.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, **NPS 1/2 to NPS 30**.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, **NPS 4 to NPS 36**, with steel pipe base stanchion support and cast-iron floor flange.
 - 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, **NPS 1 to NPS 30**, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, **NPS 2 to NPS 42**, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- 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-joint 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. 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. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 - L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
 - M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
 - N. 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. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
 - C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
 - D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
 - E. 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.
 - F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
 - G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - H. 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.
 - I. Install lateral bracing with pipe hangers and supports to prevent swaying.
 - J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2** and larger 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.
 - K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - L. 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.
 - M. 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.
 - 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.
 - d. **NPS 8 to NPS 14: 24 inches** long and **0.075 inch** thick.
 - e. **NPS 16 to NPS 24: 24 inches** long and **0.105 inch** thick.
 5. Pipes **NPS 8** and Larger: Include wood inserts.
 6. Insert Material: Length at least as long as protective shield.
 7. 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 trapeze pipe hangers and equipment supports.
 - B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
 - C. Field Welding: Comply with AWS D1.1 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.

SECTION 220529**HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT****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 220529

SECTION 220548 VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes performance requirements for delegated design of vibration and seismic controls.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading: Refer to Structural Drawings for Seismic Design Category, Building Use Group, and Seismic design parameters.

1.3 SUBMITTALS

- A. Product Data: For all products provided.
- B. 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.
- C. Welding certificates.
- D. Qualification Data: For professional engineer, NC Seal.
- E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved 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

- A. Products shall be selected by engineer providing delegated design services.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes 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 Delegated Design 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.

3.2 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 inches**.
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
- 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 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: 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.
- 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.

SECTION 220548 VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

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. 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.

3.3 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 22 Section "Domestic Water Piping" for piping flexible connections.

3.4 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 postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least 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. If 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, certified by Professional Engineer who provided Delegated Design.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Valve tags.
 - 4. Ceiling markers for concealed valves.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.
- B. Color Code Schedule: Per ANSI/ASME A13.1

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.
- 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 or self-tapping screws.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive. Stenciling is not allowed.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.3 VALVE TAGS

- A. General Requirements for Valve Tags: 1-1/2" diameter 19 gage brass, black-filled.
- B. Lettering: 1/4" top line service abbreviation, 1/2" bottom line sequential number.
- C. Mounting: #16 brass jack chain.

2.4 CEILING MARKERS

- A. All concealed plumbing items are to be indicated on the ceiling to readily show their location. The contractor to either use color coding per the Site standard or ANSI/ASME A13.1 for color selection. Marking shall be a color dot sticker.

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.
- C. Install all pipe labels, equipment labels, and valve tags prior to concealing piping, equipment, or valves.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting High-Performance Coatings."
- 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 **50 feet** along each run. Reduce intervals to **25 feet** in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule: Per ANSI/ASME A13.1 for the following systems:
 - 1. Domestic Cold Water Piping.
 - 2. Domestic Hot Water Piping.
 - 3. Domestic Hot Water Recirculation Piping.
 - 4. Sanitary Waste Piping
 - 5. Sanitary Vent Piping
 - 6. Rain Leader
 - 7. Emergency Overflow Leader
 - 8. Dental Air
 - 9. Compressed Air
 - 10. Dental Vacuum

3.4 VALVE TAG INSTALLATION

- A. Install valve tags on valves as follows:
 - 1. All main and branch shut-off valves.
 - 2. All water heater shut-off/isolation valves.
 - 3. All pump shut-off valves.
- B. Valve tag list:
 - 1. Mount valve tag list in main mechanical equipment room, in frame under glass.
 - 2. Provide copy of valve tag list in Operation and Maintenance Manuals.
 - 3. Indicate valve tag numbers on as-built marked prints.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION**PART 1 - GENERAL****1.1 SUMMARY**

1. Section Includes insulation materials and methods for plumbing piping and equipment.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail attachment and covering of heat tracing inside insulation.
 3. Detail insulation application at pipe expansion joints for each type of insulation.
 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.
 8. Detail field application for each equipment type.
- C. Field quality-control reports.

1.3 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.
- B. Heat Loss Characteristics: Minimum pipe insulation thickness shall comply with North Carolina Energy Code Chapter 8, based on insulation having a maximum conductivity (k) of 0.27 Btu per inch/h*ft²* °F.

1.4 DEFINITIONS

- A. Concealed: shafts, furred spaces, spaces above finished ceilings, utility tunnels, and crawl spaces. All other areas, including walk-through tunnels, shall be considered exposed.

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. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Manufacturers: Armstrong, Certainteed Manson, Childers, Dow, Extol, Halstead, H.B. Fuller, Imcoa, Knauf, Owens-Corning, Pittsburgh Corning, Rubatex, Johns-Mansville, or approved equal.
- F. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof.
- G. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.

2.2 RIGID FIBERGLASS INSULATION:

- A. Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.
- B. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

2.3 SEMI-RIGID FIBERGLASS INSULATION:

- A. Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees F, minimum compressive strength of 125 PSF at 10% deformation, rated for service to 450 degrees F. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.
- B. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

2.4 ELASTOMERIC INSULATION:

- A. Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75 degrees F, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor transmission of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.

2.5 URETHANE INSULATION:

- A. Rigid closed cell polyisocyanurate, minimum nominal density of 1.8 lbs. per cu. ft., thermal conductivity of not more than 0.19 at 75 degrees F aged 180 days, minimum compressive strength of 19 psi parallel and 10 psi perpendicular, maximum water vapor transmission of 4 perm inch, maximum water absorption of .2% by volume, rated for service range of -290 degrees F to 300 degrees F.

2.6 PVC FITTING COVERS AND JACKETS:

- A. White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be .02 inch (20 mil).

2.7 INSULATION INSERTS AND PIPE SHIELDS

- A. Manufacturers: B-Line, Pipe Shields, Value Engineered Products
- B. Construct inserts with calcium silicate, minimum 140 psi compressive strength. Piping 12" and larger, supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180 degree coverage on bottom of supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.
- C. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered pre-manufactured product described above. On low temperature systems, extruded polystyrene may be substituted for calcium silicate provided insert and shield length and gauge are increased to compensate for lower insulation compressive strength.
- D. Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1"x 6" block for piping through 2-1/2" and three 1" x 6" blocks for piping through 4". Submit shield schedule to demonstrate equivalency to pre-engineered/pre-manufactured product described above.
- E. Wood blocks will not be accepted.

2.8 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be .015 inch for aluminum and .010 inch for stainless steel.
- D. Tack fasteners to be stainless steel ring grooved shank tacks.
- E. Staples to be clinch style.
- F. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.
- G. Finishing cement to be ASTM C449.
- H. Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.
- I. Bedding compounds to be non-shrinking and permanently flexible.
- J. Vapor barrier coatings to be non-flammable, fire resistant, polymeric resin.
- K. Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 PIPING, VALVE, AND FITTING INSULATION

A. General:

1. Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket seams and 2" tape on butt joints, firmly cemented with lap adhesive. Additionally secure with staples along seams and butt joints. Coat staples with vapor barrier mastic on systems requiring vapor barrier.
2. Water supply piping insulation shall be continuous throughout the building and installed adjacent to and within building walls to a point directly behind the fixture that is being supplied.
3. Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation.
4. Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.

B. Insulation Inserts and Pipe Shields:

1. Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.

C. Fittings and Valves:

1. Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of the same thickness as adjoining insulation.
2. Cover insulation with fabric reinforcing and mastic or where temperatures do not exceed 150 degrees, PVC fitting covers.
3. Secure PVC fitting covers with tack fasteners and 1-1/2" band of mastic over ends, throat, seams or penetrations.
4. On systems requiring vapor barrier, use vapor barrier mastic.

D. Elastomeric and Polyolefin:

1. Where practical, slip insulation on piping during pipe installation when pipe ends are open.
2. Miter cut fittings allowing sufficient length to prevent stretching.
3. Completely seal seams and joints for vapor tight installation.
4. For elastomeric insulation, apply full bed of adhesive to both surfaces.
5. For polyolefin, seal factory preglued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to both surfaces.

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.
3. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
4. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
5. 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.
3. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
4. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
5. 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.

3.4 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.
- B. Semi-Rigid Fiberglass:
 - 1. Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place.
 - 2. Fill all joints, seams and depressions with insulating cement to a smooth, even surface.
 - 3. Cover with reinforcing fabric and 2 coats of mastic. .
 - 4. Use vapor barrier mastic on systems requiring a vapor barrier.
- C. Elastomeric/Polyolefin:
 - 1. Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints.
 - 2. Place insulation with edge joints firmly butted pressing to surface for full adhesion.
 - 3. Seal seams and joints vapor tight.

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. All hot and cold water piping shall be insulated.
- C. 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.
- D. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

- E. 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 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.7 Piping Insulation Schedule:

- A. Provide insulation on all piping as indicated in the following schedule:

Service	Insulation Types	Insulation Thickness
Hot Water Supply	Rigid Fiberglass	1"
Hot Water Circulating	Rigid Fiberglass	1"
Cold Water	Rigid Fiberglass	1/2"
Tempered Water	Rigid Fiberglass	1"
Non-Potable Cold Water	Rigid Fiberglass *	1/2"
Non-Potable Hot Water	Rigid Fiberglass *	1/2"
All Horizontal Storm Piping and 4'-0" of vertical Piping thereafter, & Roof Drain bodies	Rigid Fiberglass	1/2"

* = Elastomeric type is acceptable

- B. The following piping and fittings are not to be insulated:
1. Chrome plated exposed supplies and stops (except where specifically noted).
 2. Water hammer arrestors.
 3. Piping unions and flanges for systems not requiring a vapor barrier.

3.8 Equipment Insulation Schedule:

- A. Provide equipment insulation as follows:
1. Storage Tanks: Semi-Rigid Fiberglass, 2" thick.

2. Backflow Preventer: Elastomeric, ½" thick, sheet type, pipe size type or combination of both.
Fabricated for ease of removal and replacement when testing and servicing is required

END OF SECTION 220700

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes water-distribution piping and related components outside the building for **water service**.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.2 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.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 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 potable-water-service piping, including materials, installation, testing, and disinfection.
 - 3. 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. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NSF Compliance:
 - 1. Comply with NSF 14 for plastic potable-water-service piping. **Include marking "NSF-pw" on piping.**
 - 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.4 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 **Construction Manager** no fewer than **two** days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without **Construction Manager's** written permission.

1.5 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS**2.1 PIPE AND FITTINGS**

- A. Soft Copper Tube: **ASTM B 88, Type K**, water tube, annealed temper.
 - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
- B. Hard Copper Tube: **ASTM B 88, Type K**, water tube, drawn temper.
 - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

2.2 JOINING MATERIALS

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series.

2.3 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

PART 3 - EXECUTION**3.1 EARTHWORK**

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 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, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping **NPS 3/4 to NPS 3** shall be soft copper tube, **ASTM B 88, Type K**; wrought-copper, solder-joint fittings; and brazed joints.
- F. Underground water-service piping **NPS 4 and NPS 6** shall be **any of** the following:
 - 1. Soft copper tube, **ASTM B 88, Type K**; wrought-copper, solder-joint fittings; and brazed joints.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Division 22 Section "Common Work Results for Plumbing" for piping-system common requirements.

3.4 PIPING INSTALLATION

- A. Bury piping with depth of cover over top at least **24 inches**.
- B. 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.
- C. Sleeves are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

3.5 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 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 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 221113

SECTION 221116 – DOMESTIC WATER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building. The compressed air piping and valves are also included as shown on the drawings.
2. Specialty valves.
3. Flexible connectors.
4. Water meters furnished by utility company for installation by Contractor.
5. Water meters.

B. Related Section:

1. Division 22 Section "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.2 SUBMITTALS

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

B. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Description:
 - a. Pressure Rating: 150 psig at 180 deg F
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.

2.6 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig
 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 EARTHWORK**

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- F. Install domestic water piping level and plumb.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. 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.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping adjacent to equipment and specialties to allow service and maintenance.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- Q. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- R. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install auto-flow valve in each hot-water circulation return branch and discharge side of each pump and circulator. Use ball valves for piping NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65) and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.6 FLEXIBLE CONNECTOR INSTALLATION

- A. Install bronze-hose flexible connectors in copper domestic water tubing.

3.7 WATER METER INSTALLATION

- A. See details on drawings.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch
- E. 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.

F. Install supports for vertical copper tubing every 10 feet.

G. Where piping is installed in metal studs, install in punched hole and install plastic bushings to prevent contact between pipe and stud.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.

2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.

4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

D. Compressed air piping not to be water tested. Blow down piping and conduct air pressure test – to hold 200 psig for 30 minutes.

3.13 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water, NPS 3 and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings joints.

D. Aboveground domestic water piping and compressed air piping, shall be:

1. Hard copper tube, ASTM B 88, Type L; cast-wrought- copper solder-joint fittings; and soldered joints.

3.14 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use globe valves for piping NPS 2 and smaller. Use butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated water mixing valves.
 - 6. Strainers.
 - 7. Hose bibbs.
 - 8. Wall hydrants.
 - 9. Drain valves.
 - 10. Water hammer arresters.
 - 11. Trap-seal primer valves.
- B. See Division 22 Section "Domestic Water Piping" for water meters.
- C. See Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: **125 psig**, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
 - 1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS**2.1 VACUUM BREAKERS**

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1001.
 - 3. Size: **NPS 1/4 to NPS 3**, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Rough bronze.
- B. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. MIFAB, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Woodford Manufacturing Company.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1001.
 - 3. Body: Bronze, nonremovable, with manual drain.
 - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 5. Finish: Chrome or nickel plated in interior finished areas, Rough bronze in equipment rooms and exterior.

2.2 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1013.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
 5. Size: As shown on drawings.
 6. Body: Bronze for NPS 2 and smaller; steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 8. Configuration: Designed for horizontal, straight through flow.
 9. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Double-Check Backflow-Prevention Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1015.
 3. Operation: Continuous-pressure applications, unless otherwise indicated.
 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 5. Size: As shown on Drawings.
 6. Body: Bronze for NPS 2 and smaller; steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 8. Configuration: Designed for horizontal, straight through flow.
 9. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
- C. Backflow-Preventer Test Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.
- 2.3 WATER PRESSURE-REDUCING VALVES
- A. Water Regulators:
1. Basis of Design Product: as shown on drawings. Comparable products by:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1003.
 3. Pressure Rating: Initial working pressure of 200 psig.
 4. Size: As shown 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 NPS 3**.
 6. Valves for Booster Heater Water Supply: Include integral bypass.
 7. End Connections: Threaded for **NPS 2** and smaller; flanged for **NPS 2-1/2 and NPS 3**.
- 2.4 BALANCING VALVES
- A. Auto flow control valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. FDI.
 - b. Griswold.
 - c. Hays.
 2. Pressure Rating: **400-psig** minimum CWP.
 3. Size: **NPS 2** or smaller.
 4. Body: Copper alloy.
 5. Seats and Seals: Replaceable.
 6. End Connections: Solder joint or threaded.
- 2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES
- A. Water-Temperature Limiting Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Conbraco Industries, Inc.
 - c. Leonard Valve Company.
 - d. Symmons Industries, Inc.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1017.
 3. Pressure Rating: **125 psig**.
 4. Type: Thermostatically controlled water mixing valve.
 5. Material: Bronze body with corrosion-resistant interior components.
 6. Connections: Threaded union inlets and outlet.
 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 8. Tempered-Water Setting: As shown on Drawings.
 9. Tempered-Water Design Flow Rate: As shown on Drawings.
 10. Valve Finish: Chrome plated or Rough bronze.
- B. Primary, Thermostatic, Water Mixing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Symmons Industries, Inc.
 2. Standard: ASSE 1017.
 3. Pressure Rating: **125 psig**.
 4. Type: Exposed-mounting or Cabinet-type, thermostatically controlled water mixing valve.
 5. Material: Bronze body with corrosion-resistant interior components.
 6. Connections: Threaded union inlets and outlet.
 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 8. Valve Pressure Rating: **125 psig** minimum, unless otherwise indicated.
 9. Tempered-Water Setting: As shown on Drawings.
 10. Tempered-Water Design Flow Rate: As shown on Drawings.
 11. Selected Valve Flow Rate at **45-psig** Pressure Drop: As shown on Drawings.
 12. Pressure Drop at Design Flow Rate: As shown on Drawings.
- 2.6 STRAINERS FOR DOMESTIC WATER PIPING
- A. Y-Pattern Strainers:
1. Pressure Rating: **125 psig** minimum, unless otherwise indicated.

2. Body: Bronze for **NPS 2** and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for **NPS 2-1/2** and larger.
 3. End Connections: Threaded for **NPS 2** and smaller; flanged for **NPS 2-1/2** and larger.
 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
 5. Perforation Size:
 - a. Strainers **NPS 2** and Smaller: **0.020 inch**.
 - b. Strainers **NPS 2-1/2 to NPS 4**: **0.045 inch**.
 - c. Strainers **NPS 5** and Larger: **0.10 inch**.
 6. Drain: Pipe plug.
- 2.7 HOSE BIBBS
- A. Hose Bibbs:
1. Standard: ASME A112.18.1 for sediment faucets.
 2. Body Material: Bronze.
 3. Seat: Bronze, replaceable.
 4. Supply Connections: **NPS 1/2 or NPS 3/4** threaded or solder-joint inlet.
 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 6. Pressure Rating: **125 psig**.
 7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
 9. Finish for Service Areas: Rough bronze.
 10. Finish for Finished Rooms: Chrome or nickel plated.
 11. Operation for Equipment Rooms: Wheel handle or operating key.
 12. Operation for Service Areas: Wheel handle.
 13. Operation for Finished Rooms: Operating key.
 14. Include operating key with each operating-key hose bibb.
 15. Include integral wall flange with each chrome- or nickel-plated hose bibb.
- 2.8 WALL HYDRANTS
- A. Nonfreeze Wall Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts Drainage Products Inc.
 - e. Woodford Manufacturing Company.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
 3. Pressure Rating: **125 psig**.
 4. Operation: Loose key.
 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 6. Inlet: **NPS 3/4 or NPS 1**.
 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
 8. Box: Deep, flush mounting with cover.
 9. Box and Cover Finish: Polished nickel bronze.
 10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
 11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
 12. Operating Keys(s): Two with each wall hydrant.
- B. Vacuum Breaker Wall Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
 - d. Zurn Plumbing Products Group; Light Commercial Operation.
 2. Standard: ASSE 1019, Type A or Type B.

3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
 4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
 5. Pressure Rating: **125 psig**.
 6. Operation: Loose key.
 7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 8. Inlet: **NPS 1/2 or NPS 3/4**.
 9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.
- 2.9 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.
- 2.10 WATER HAMMER ARRESTERS
- A. Water Hammer Arresters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASSE 1010 or PDI-WH 201.
 3. Type: Copper tube with piston.
 4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.
- 2.11 TRAP-SEAL PRIMER VALVES
- A. Supply-Type, Trap-Seal Primer Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 2. Standard: ASSE 1018.
 3. Pressure Rating: **125 psig** minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: **NPS 1/2** threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: **NPS 1/2** threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
- PART 3 - EXECUTION
- 3.1 INSTALLATION
- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
 - C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
 - D. Install balancing valves in locations where they can easily be adjusted.
 - E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. 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 water hammer arresters in water piping according to PDI-WH 201.
 - H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
 - I. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
 - J. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Intermediate atmospheric-vent backflow preventers.
 - 2. Reduced-pressure-principle backflow preventers.
 - 3. Double-check backflow-prevention assemblies.
 - 4. Water pressure-reducing valves.
 - 5. Primary, thermostatic, water mixing valves.
 - 6. Supply-type, trap-seal primer valves.
 - K. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."
- 3.2 FIELD QUALITY CONTROL
- A. Perform the following tests and prepare test reports:
 - 1. Test each backflow preventer according to authorities having jurisdiction and the device's reference standard.
 - B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.
- 3.3 ADJUSTING
- A. Set field-adjustable pressure set points of water pressure-reducing valves.
 - B. Set field-adjustable flow of balancing valves.
 - C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.
- END OF SECTION 221119

SECTION 221123 - DOMESTIC WATER PUMPS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following all-bronze and bronze-fitted centrifugal pumps for domestic cold- and hot-water circulation:
 - 1. Close-coupled, in-line, sealless centrifugal pumps.
- B. See Division 22 Section "Domestic-Water Packaged Booster Pumps" for booster systems.
- C. See Division 33 Section "Water Supply Wells" for well pumps.

1.2 SUBMITTALS

- A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CLOSE-COUPLED, IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Manufacturers:
 - 1. Armstrong Pumps Inc.
 - 2. Bell & Gossett Domestic Pump; ITT Industries.
 - 3. Grundfos Pumps Corp.
 - 4. Taco, Inc.
- B. Description: Factory-assembled and -tested, single-stage, close-coupled, in-line, sealless centrifugal pumps as defined in HI 5.1-5.6.
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.
 - 2. Casing: Bronze, with threaded companion-flange connections.
 - 3. Impeller: Corrosion-resistant material.
 - 4. Motor: Single speed, unless otherwise indicated. Comply with requirements in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
- C. Capacities and Characteristics: As shown on drawings.

2.3 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 - 1. Manufacturers:
 - a. Honeywell International, Inc.
 - b. Square D.
 - c. White-Rodgers Div.; Emerson Electric Co.
 - 2. Type: Water-immersion sensor, for installation in hot-water circulation piping.
 - 3. Range: **50 to 125 deg F.**
 - 4. Operation of Pump: On or off.
 - 5. Transformer: Provide if required.
 - 6. Power Requirement: **120 V, ac.**
 - 7. Settings: Start pump at **110 deg F** and stop pump at **120 deg F.**
- B. Timers: Electric time clock for control of hot-water circulation pump.
 - 1. Manufacturers:

- a. Honeywell International, Inc.
 - b. Intermatic, Inc.
 - c. Johnson Controls, Inc.
 - d. Maple Chase Company.
 - e. TORK.
- 2. Type: Programmable, seven-day clock with manual override on-off switch.
- 3. Enclosure: Suitable for wall mounting.
- 4. Operation of Pump: On or off.
- 5. Transformer: Provide if required.
- 6. Power Requirement: **120 V, ac.**
- 7. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.
- C. Time Delay Relay: Control for hot-water storage tank circulation pump.
 - 1. Manufacturers:
 - a. Honeywell International, Inc.
 - b. Intermatic, Inc.
 - c. Johnson Controls, Inc.
 - d. Square D.
 - e. White-Rodgers Div.; Emerson Electric Co.
 - 2. Type: Adjustable time delay relay.
 - 3. Range: Up to five minutes.
 - 4. Setting: Five minutes.
 - 5. Operation of Pump: On or off.
 - 6. Transformer: Provide if required.
 - 7. Power Requirement: **120 V, ac.**
 - 8. Programmable Sequence of Operation: Limit pump operation to periods of burner operation plus maximum five minutes after the burner stops.
- 2.4 FLEXIBLE CONNECTORS
 - A. Manufacturers:
 - 1. Anamet, Inc.
 - 2. Flex-Hose Co., Inc.
 - 3. Flexicraft Industries.
 - 4. Metraflex, Inc.
 - B. Description: Corrugated, bronze inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze-welded to tubing. Include **125-psig** minimum working-pressure rating and ends matching pump connections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Install **in-line, sealless** centrifugal pumps with motor and pump shafts horizontal.
- E. Install continuous-thread hanger rods and **spring hangers** of sufficient size Mechanical Vibration to support pump weight. Vibration isolation devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- F. Install immersion-type thermostats in hot-water return piping.
- G. Install timers [on wall in engineer's office] <Insert other>.
- H. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- I. Install piping adjacent to pumps to allow service and maintenance.
- J. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section "Domestic Water Piping."
 - 1. Install flexible connectors adjacent to pumps in suction and discharge piping of close-coupled, horizontally mounted, in-line centrifugal pumps.

2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves for domestic water piping and Division 22 Section "Domestic Water Piping Specialties" for strainers.
 3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tapplings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and gage connectors.
- K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- M. Connect **thermostats and timers** to pumps that they control.
- END OF SECTION 221123

SECTION 221316 – DRAIN, WASTE AND VENT PIPING**PART 1 - GENERAL****1.1 SUMMARY**

1. This Section includes drain, waste, and vent piping, including rain water leaders and acid waste piping.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: **10-foot head of water.**

1.3 SUBMITTALS

- A. Field quality-control inspection and test reports.

1.4 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, CISPI approved, domestic manufactured.
 1. Gaskets: ASTM C 564, rubber.
- B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301, CISPI approved, domestic manufactured.
 1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve, such as Clamp All couplings rated at 15 psi with FM label.
- C. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.
- D. Acid Drain: CPVC Type IV, Grade I, ASTM Cell Class 23447.
 1. All system components shall be certified by NSF International for use in chemical waste drain systems and bear the mark NSF-cw. All system piping shall be Schedule 40 CPVC produced to the dimensional requirements of ASTM F 2618 and the manufacturer's specifications. All pipe fittings shall be CPVC drainage patterns meeting the requirements of ASTM F 2618 and the manufacturer's specifications, as applicable.
 2. Solvent welded joints shall be made with ChemDrain One-Step solvent cement conforming to ASTM F 493. The system shall be protected from items that are not compatible with CPVC compounds; materials like thread sealants, plasticized vinyl products, fire stopping devices or other aggressive chemical agents.

2.2 CAST IRON ALTERNATE MATERIAL

- A. At the contractor's option, SCH 40 PVC pipe and fittings may be substituted for the cast iron system above and below the slab. PVC piping to be installed per manufacturer's instructions and the NCPC.

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.

3.2 SANITARY WASTE AND VENT

- A. Interior Above Ground may be one of the following:
 1. Hubless cast iron soil pipe and fittings, ASTM A888; with no-hub couplings, CISPI 310.
 2. Type M copper water tube, H (drawn) temper, ASTM B88; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for vent branch takeoffs up to one-half (1/2) the diameter of the main.

3. Galvanized steel pipe, Schedule 40, Type F, Grade A, ASTM A53; with cast iron threaded drainage fittings, ASTM B16.12.
- B. Interior Below Ground may be one of the following:
 1. Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74; with neoprene rubber compression gaskets, ASTM C564 and CISPI HSN 85.
- 3.3 RAIN WATER LEADERS
 - A. Same as Sanitary Waste and Vent piping above.
- 3.4 PIPING INSTALLATION
 - A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
 - B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
 - C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
 - D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Common Work Results for Plumbing."
 - E. 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."
 - F. 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.
 - G. 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.
 - H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping **NPS 3** and smaller; 1 percent downward in direction of flow for piping **NPS 4** and larger.
 2. 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.
 - I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
 - J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- 3.5 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. 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.
- 3.6 HANGER AND SUPPORT INSTALLATION
 - A. Seismic-restraint devices are specified in Division 22 Section "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 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, 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: 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 steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. **NPS 1-1/4: 84 inches** with **3/8-inch** rod.
 2. **NPS 1-1/2: 108 inches** with **3/8-inch** rod.
 3. **NPS 2: 10 feet** with **3/8-inch** rod.
 4. **NPS 2-1/2: 11 feet** with **1/2-inch** rod.
 5. **NPS 3: 12 feet** with **1/2-inch** rod.
 6. **NPS 4 and NPS 5: 12 feet** with **5/8-inch** rod.
 7. **NPS 6: 12 feet** with **3/4-inch** rod.
 - I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. **NPS 1-1/4: 72 inches** with **3/8-inch** rod.
 2. **NPS 1-1/2 and NPS 2: 96 inches** with **3/8-inch** rod.
 3. **NPS 2-1/2: 108 inches** with **1/2-inch** rod.
 4. **NPS 3 to NPS 5: 10 feet** with **1/2-inch** rod.
 5. **NPS 6: 10 feet** with **5/8-inch** rod.
 - J. Install supports for vertical copper tubing every **10 feet**.
 - K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.
 - L. Install hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 1. **NPS 1-1/2 and NPS 2: 48 inches** with **3/8-inch** rod.
 2. **NPS 3: 48 inches** with **1/2-inch** rod.
 - M. Install supports for vertical CPVC piping every **48 inches**.
- 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.

3.8 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.
 1. Piping shall be tested to 10' of static head, prior to backfill.
 2. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 3. Prepare reports for tests and required corrective action.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following sanitary drainage piping specialties:
1. Cleanouts.
 2. Floor drains.
 3. Miscellaneous sanitary drainage piping specialties.
 4. Flashing materials.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS**2.1 CLEANOUTS**

- A. Exposed Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. 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 or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

- B. Cast-Iron Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy in finished areas; rough bronze in service areas, equipment rooms, etc..
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

- C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. 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 or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group.
2. Standard: ASME A112.6.3 without backwater valve.
3. Pattern: Area drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Sediment Bucket: As scheduled.
10. Top or Strainer Material: Nickel bronze.
11. Top of Body and Strainer Finish: Chrome plated Nickel bronze, except in equipment rooms.
12. Top Shape: Round, except Square in areas with hard tile floor finishes.
13. Dimensions of Top or Strainer: 5" diameter unless otherwise noted.
14. Top Loading Classification: Light Duty.
15. Funnel: Not required.
16. Trap Material: Cast iron.
17. Trap Pattern: Deep-seal P-trap.
18. Trap Features: Trap-seal primer valve drain connection.
19. Additional Requirements: See drawings for additional floor drain requirements.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 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.

D. 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.

E. 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.
- 2.4 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 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.
 - C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
 - D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
 - E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 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.
 - F. Install deep-seal traps on floor drains and other waste outlets, if indicated.
 - G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
 - H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
 - I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
 - J. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
 - K. 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 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Light-commercial electric water heaters.
 - 2. Commercial electric booster heaters.
 - 3. Water heater accessories.

1.2 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.
- D. Warranty.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period(s): From date of Substantial Completion:
 - a. Commercial Electric Water Heaters: Five years.

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. Basis of Design Product: As shown on Drawings.
 - 2. Comparable Products: As listed.

2.2 COMMERCIAL ELECTRIC WATER HEATERS

- A. Commercial, Storage Electric Water Heaters: Comply with UL 1453 requirements for storage-tank-type water heaters.
 - 1. Basis of Design Product: As shown on Drawings.
 - 2. Comparable Products by one of the following:
 - a. Bock Water Heaters, Inc.
 - b. Bradford White Corporation.
 - c. Lochinvar Corporation.
 - d. State Industries, Inc.
 - 3. Storage-Tank Construction: Non-ASME-code, non-metallic composite material.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) **NPS 2** and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) **NPS 2-1/2** and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. 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: None required.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - c. Insulation: Comply with ASHRAE/IESNA 90.1.
 - d. Jacket: High density polyethylene dent and scratch resistant.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - 1) Staging: Input not exceeding 18 kW per step.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
 - 5. Special Requirements:
 - a. NSF 5 construction.
 - b. Compliance with North Carolina Building Code.
 - 6. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.
 - 7. Capacity and Characteristics: Refer to Drawings.
- 2.3 WATER HEATER ACCESSORIES
- A. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of **18 inches** above the floor.
 - B. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
 - C. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than **NPS 3/4**.
 - D. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
 - E. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
 - 2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install 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.
- 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 water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
- E. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- F. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.
- G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- H. Fill water heaters with water.

SECTION 223300

ELECTRIC DOMESTIC WATER HEATERS

3.2 CONNECTIONS

- A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections.
- B. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial electric water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 223300

SECTION 224000 - PLUMBING FIXTURES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Faucets for lavatories, sinks, and other fixtures.
 - 2. Flushometers.
 - 3. Toilet seats.
 - 4. Protective shielding guards.
 - 5. Fixture supports.
 - 6. Water closets.
 - 7. Urinals.
 - 8. Lavatories.
 - 9. Sinks.
 - 10. Service sinks.
 - 11. Mop sinks.
- B. Related Sections include the following:
 - 1. Division 22 Section "Drinking Fountains and Water Coolers."

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities, conforming to the requirements of the North Carolina Building Code.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring, rough-in dimension drawings.
- C. Operation and maintenance data.
- D. *Efficiency Listing: All newly installed toilets, urinals, private lavatory faucets, and showerheads that are eligible for labeling must be "WaterSense" labeled.*

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; Public Law 101-336, "Americans with Disabilities Act"; and North Carolina Building Code for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 4. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 5. Vitreous-China Fixtures: ASME A112.19.2M.
 - 6. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 7. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.

2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Manual-Operation Flushometers: ASSE 1037.
 4. Plastic Tubular Fittings: ASTM F 409.
 5. Brass Waste Fittings: ASME A112.18.2.
 6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 1. Off-Floor Fixture Supports: ASME A112.6.1M.
 2. Pipe Threads: ASME B1.20.1.
 3. Plastic Toilet Seats: ANSI Z124.5.
 4. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS**2.1 LAVATORY FAUCETS**

- A. Basis of Design Product: As shown on Drawings.
- B. Comparable Products by: Chicago Faucets, Delta Faucet Company, Moen, Inc., Speakman Company T & S Brass and Bronze Works, Inc.
- C. Description: Single-control mixing, Single-control nonmixing, or Two-handle mixing valve as shown on Drawings. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
- D. Characteristics: Equivalent to Basis of Design Product, and as described on Drawings.

2.2 SINK FAUCETS

- A. Basis of Design Product: As shown on Drawings.
- B. Comparable Products by: Chicago Faucets, Kohler Co., Moen, Inc., Royal Brass Mfg. Co., T & S Brass and Bronze Works, Inc.
- C. Characteristics: Equivalent to Basis of Design Product, and as described on Drawings.

2.3 FLUSHOMETERS

- A. Basis of Design Product: As shown on Drawings.
- B. Comparable Products by: Delany Co., Sloan Valve Company, Zurn Plumbing Products Group; Commercial Brass Operation.
- C. Characteristics: Equivalent to Basis of Design Product, and as described on Drawings.

2.4 TOILET SEATS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following: American Standard Companies, Inc.; Bemis Manufacturing Company; Centoco Manufacturing Corp.; Church Seats; Eljer; Kohler Co.; Olsonite Corp.; Sanderson Plumbing Products, Inc.; Beneke Div.; Sperzel.
- B. Description: Toilet seat for water-closet-type fixture. Molded, solid plastic with antimicrobial agent. Configuration, size, hinge type, color, as described on Drawings, equivalent to Basis of Design Product. Heavy-duty commercial class.

2.5 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGuire Manufacturing Co., Inc.
 - b. TRUEBRO, Inc.

- c. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
- 2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- 2.6 **FIXTURE SUPPORTS**
 - A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Company.
 - 2. MIFAB Manufacturing Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
 - B. Water-Closet Supports,:
 - 1. Description: Combination carrier designed for accessible or standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
 - C. Urinal Supports,:
 - 1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
 - 2. Accessible-Fixture Support: Include rectangular steel uprights.
 - D. Lavatory Supports,:
 - 1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 - 2. Accessible-Fixture Support: Include rectangular steel uprights.
 - E. Sink Supports,:
 - 1. Description: Type II, sink carrier with hanger plate, bearing studs, and tie rod for sink-type fixture. Include steel uprights with feet.
- 2.7 **WATER CLOSETS**
 - A. 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. American Standard Companies, Inc.
 - b. Kohler Co.
 - c. Sloan
 - d. Zurn
 - B. Description: Equal to Basis of Design Product, and as otherwise described on Drawings.
- 2.8 **URINALS**
 - A. 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. American Standard Companies, Inc.
 - b. Kohler Co.
 - c. Sloan
 - d. Zurn
 - B. Description: Equal to Basis of Design Product, and as otherwise described on Drawings.
- 2.9 **LAVATORIES**
 - A. 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. American Standard Companies, Inc.
 - b. Kohler Co.
 - c. Sloan
 - d. Zurn
 - B. Description: Equal to Basis of Design Product, and as otherwise described on Drawings.
- 2.10 **SINKS**
 - A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Elkay
 - 2. Just

- 3. Sterling
- B. Description: Equal to Basis of Design Product, and as otherwise described on Drawings.
- 2.11 SERVICE SINKS
 - A. Floor-mounted, molded stone mop basins.
 - 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. Crane Plumbing, L.L.C./Fiat Products.
 - b. Florestone Products Co., Inc.
 - 2. Description: Equal to Basis of Design Product, and as otherwise described on Drawings.
 - 3. Accessories and Trim: As shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- L. Install toilet seats on water closets.
- M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- Q. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- R. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- S. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

SECTION 224000**PLUMBING FIXTURES**

- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 224700 - WATER COOLERS**PART 1 - GENERAL****1.1 SUMMARY**

1. This Section includes electric water coolers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.
- E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants" for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

PART 2 - PRODUCTS**2.1 Electric Water Coolers**

- A. Wall mounted barrier free electric water cooler with stainless steel basin, self-closing front and side mounted push bars, wall hanger and 1-1/4" tailpiece, characteristics as shown on Drawings. Color to be selected by Architect/Engineer from manufacturers standard color selection.
- B. Unit to be mounted outside and to be freeze resistant with remote chiller, and valve(s) in heated space (in building).
- C. Basis of Design Product: As shown on Drawings.
- D. Comparable products by Elkay, Oasis, Halsey-Taylor.
- E. Trap: 1-1/4"x1-1/4" 17 ga. cast brass trap.
- F. Stop/Supply: 1/2" ball valve with 1/2" riser (concealed).

2.2 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Josam Co.
 2. MIFAB Manufacturing, Inc.
 3. Smith, Jay R. Mfg. Co.
 4. Tyler Pipe; Wade Div.
 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 1. Type I: Hanger-type carrier with two vertical uprights.
 2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION**3.1 APPLICATIONS**

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Set freestanding and pedestal drinking fountains on floor.
- C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view.

3.2 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

SECTION 224700**WATER COOLERS**

- B. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
 - C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
 - D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
 - E. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
 - F. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."
- 3.3 CONNECTIONS
- A. Connect fixtures with water supplies, traps, and risers, and with soil, waste, and vent piping. Use size fittings required to match fixtures.
 - B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- 3.4 FIELD QUALITY CONTROL
- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.
- 3.5 ADJUSTING
- A. Adjust fixture flow regulators for proper flow and stream height.
 - B. Adjust water cooler temperature settings.
- END OF SECTION 224700

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DIVISION 23

MECHANICAL



A. GENERAL CONDITIONS: This Contractor's attention is directed to the requirements of Instructions to Bidders, General Conditions and Supplementary General Conditions as bound in the specifications which apply in full to the HVAC contract. Where the requirements of this Division conflict with other articles in these Specifications, the Contractor shall utilize the more stringent method.

B. SCOPE: Provide all labor, materials, tools, equipment, and transportation, and perform all operations necessary for and reasonably incidental to proper execution and completion of all "HVAC" work, whether specifically mentioned or not, all as indicated, specified herein, and/or implied thereby to carry out the apparent intent thereof. These drawings may be superseded by later revised or detailed drawings, specifications, or sketches prepared by the Designer, as needed for clarification, and this Contractor shall conform to all reasonable coordination requests. All items not specifically mentioned in the specifications or noted on the drawings, but which obviously are required to make the working installation complete, shall be included automatically.

For projects which are bid or awarded as Single Prime contracts, organization of the Specifications into divisions, sections, and articles, and arrangement of the Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be done by any trade, unless specifically shown or noted otherwise.

C. PERMITS & FEES: This Contractor shall secure all permits required for the completion of this contract. He shall obtain and deliver to the Owner all certificates of inspection issued by the authorities having jurisdiction.

D. VISIT TO JOB SITE: Before submitting a bid, this Contractor shall visit the job site for the purpose of thoroughly examining the site and conditions under which the work must be performed. The submission of a bona fide bid will be construed to mean that this Contractor understands and is satisfied with conditions under which the contract must be fulfilled. No extra compensation will be allowed for situations arising from failure of this Contractor to be thoroughly familiar with site conditions, including charges and requirements for connection to utilities as shown for this project.

E. WORKMANSHIP: Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved. Work shall be performed by experienced and skilled mechanics under the supervision of a competent foreman. Substandard workmanship will be cause for rejection of work and replacement by Contractor. The Contractor shall reimburse the Designer for all costs incurred by the Designer due to Contractor's substandard or non-conforming work.

F. DRAWINGS AND SPECIFICATIONS: The drawings show the location and arrangement of ducts, piping, grilles and diffusers, and equipment, together with details of connections of certain principal items.

The layout shown shall be followed as closely as circumstances will permit, but this Contractor shall lay out his work so as to avoid conflict with other Contractors and trades, and to avoid any unnecessary cutting or damage to walls, floors, and supporting structural members. He shall, therefore, carefully and accurately locate all sleeves and install at the proper time all necessary hangers, inserts, etc., which will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of above items.

This Contractor shall refer to architectural, plumbing, and electrical drawings and shall cooperate fully with other Contractors and trades while installing piping, ducts, and other equipment because of close space limits. In case of conflict, notify Designer before proceeding with installation. Refer to architectural drawings for exact building dimensions and location of partition walls, doors, chases, etc. HVAC drawings are not to be scaled for such dimensions.

The drawings and specifications complement each other and together are intended to give a complete description of the work. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown in plans, shall be furnished the same as if mentioned or shown in both places. If conflicts exist, then the most stringent method shown or described shall apply.

Any switches, controls, or equipment included in this contract work (drawings and/or specifications) that are not specifically shown on drawings shall be located for convenient use and access. Contractor shall coordinate all equipment arrangement and lay-out in field prior to beginning any actual installation of his work.

If Contractor notes any discrepancy, omission, or conflict found in plans or specifications, he shall call to the immediate attention of the Designer, prior to receipt of bids.

It is the intention that piping, air ducts and light fixtures are designed and laid out to clear each other. It

shall be the responsibility of this Contractor to coordinate his work with that of other trades to avoid any such conflicts. Any conflicts that occur after work of one trade is installed and was not prior coordinated shall be relocated or rearranged at the total expense of this Contractor, as directed by Designer. Any conflicts that cannot be corrected in field by relocation or elevation changes shall be reported to the Designer in writing prior to any installation.

The drawings are not intended to show each and every complete or accurate detail. The figures and writing on drawings shall be taken instead of scaling. It is this Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement. This Contractor shall take and be responsible for all field measurements. Exact locations and relations are to be defined in the field and shall be satisfactory to the Designer.

Because of the small scale of HVAC drawings it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings and accessories that may be required to meet the conditions.

G. TESTS: The right is reserved to conduct acceptance tests of all equipment, piping, ducts, or any other work furnished under these specifications to determine the fulfillment of special requirements. Such tests shall be conducted in the presence of authorized representatives of the Contractor, Owner, Engineer, and Architect at such time as the Designer may designate. This Contractor shall perform all tests, bear cost of same and make adjustments of equipment and wiring as may be deemed necessary by the Designer.

H. ALLOWANCE FOR ADDED WORK: Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall first be submitted and approved in writing. No claim for addition to the contract sum will be valid unless so ordered and approved by the Owner and Designer, prior to start of work. Any conflicts corrected by relocation or elevation changes do not constitute extra work.

I. INCIDENTAL CONSTRUCTION WORK: All blocking for openings for piping or ducts in concrete floors, masonry walls or partitions shall be provided by this Contractor. This Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other Contractors as shown upon, or reasonably implied by the drawings and specifications. He shall properly complete and finish up his work after other Contractors have finished as the Designer may direct.

All excavating required for the installation of this system shall be done by this Contractor. Backfill shall be accomplished as specified in appropriate section of specifications.

Chases are prohibited in masonry walls which are not to be plastered or paneled. Set piping, blocking, carriers, etc. indicated to be concealed before walls are constructed in order that walls may be constructed around them. This Contractor shall furnish all sleeves in floors, beams, walls, etc., for each such penetration as needed for installing his work and installation of sleeves by General Contractor. Unless otherwise noted, the General Contractor will provide openings and lintels as new construction progresses, but this Contractor shall fully designate his requirements prior to construction. Failure to furnish his requirements prior to building construction and failure to coordinate his work with the building construction shall make this Contractor responsible for removing, replacing and painting building construction as required for installation of his work.

J. SUPERVISION: This Contractor shall have in charge of the work at all times during construction a thoroughly competent foreman with extensive experience in the work to be performed under this contract. Anyone deemed not capable by the Designer shall be replaced immediately upon request, and after satisfactory foreman has been assigned, he shall not be withdrawn without the written consent of the Designer.

K. ELECTRICAL WORK BY OTHERS: Refer to the drawings for the details of locations of circuit breakers, junction boxes, disconnect switches, conduits and slack wire required where this contractor's electrical work terminates and electrical work by others begin.

The Electrical Contractor shall furnish and install all power circuits for equipment furnished by others. In Mechanical Rooms the wiring by the Electrical Contractor shall generally terminate in a power wiring gutter, line side of disconnect switches or starters, junction box, or electrical panel. From these points power wiring to the equipment furnished by the HVAC Contractor shall generally be by the HVAC Contractor. Power wiring to mechanical equipment outside equipment rooms will generally be run by the Electrical Contractor to line side of a disconnect switch or junction box in the vicinity (within 3'-0") of the plumbing equipment. Power wiring from that point to the equipment will be by the HVAC Contractor.

HVAC Contractor is to refer to the drawings for location and type of service connections to be provided under the electrical contract. Where service disconnect switches are required and not furnished as part of the equipment, they shall be furnished and installed by contractor that furnishes the equipment, unless indicated otherwise. Other Contractors shall furnish and install conduit, boxes, wiring and all items of control for equipment they furnish or Owner furnished equipment, **unless specifically** shown on electrical drawings.

L. EXISTING FACILITIES: In existing facilities, disruption of operations must be kept to a minimum and coordinated with Owner. Work in existing buildings must be cleaned up daily immediately after finishing that portion of work and equipment left in order for Owner to continue operations. When it is necessary to interrupt utility services in the fulfillment of this contract, such interruptions shall be kept to a minimum and coordinated with Owner. Once work has begun, it shall be pursued diligently until completed. Every precaution shall be taken to prevent damage to existing underground lines and structures and public utilities. Damage to existing water and sewer lines, culverts, service connections, underground cables, and similar surface and sub-surface structures shall be at the risk of this Contractor, whether or not locations thereof are shown on plans, and the repairing of such damage shall be by this Contractor and shall be completed without delay. Compensation for such repairs shall be based on normal and reasonable costs.

The locations of any existing underground utilities that are shown are in an approximate way only and have not been independently verified by the Owner or its representative. The Contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the Contractor's failure to exactly locate and preserve any and all underground utilities.

M. ADAPTATION OF WORK TO EXISTING CONDITIONS: It is reasonably implied that this Contractor is to furnish all labor and materials to provide Owner with a new and satisfactory system in these facilities. Contractor is to include necessary work for adaptation of equipment to conditions that may be found to produce conflicts during construction. When any such conditions are encountered, this Contractor is to consult with Designer and then modify installation as directed without additional costs, and to include any incidental materials required.

O. HVAC SYSTEM USE DURING CONSTRUCTION: The permanent HVAC system may be used during construction to control temperature and relative humidity when allowed by the General Conditions, Supplementary General Conditions, or elsewhere in the Contract Documents, and approved by the Designer. Such use shall be subject to compliance with SMACNA "IAQ Guideline for Occupied Buildings under Construction" and the following guidelines. The building permanent HVAC system is designed to provide comfort conditions in accordance with ASHRAE standards in the completed and occupied facility.

The system may or may not be designed to provide for dehumidification or other special control sequences. The Designer does not warrant use of the system during construction for drying out concrete slabs or similar construction operations; such use is solely at the discretion of the Contractor.

Submit the following for approval:

1. Construction indoor-air-quality management plan, describing Contractor's means and methods for intended use of the building permanent HVAC system.
2. Product data for temporary filtration media.

During construction, submit the following Construction Documentation:

1. Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
2. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
3. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.

If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period, 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. Replace all air filters as required, but not less than weekly, during operation and immediately prior to occupancy. Building shall be maintained in broom clean condition, with no dust-producing operations during operation of air handling equipment.

Building Flush Out

1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.

2. Air-Quality Testing: Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "LEED for Schools Reference Guide."

Use of the permanent HVAC system during Construction shall not in any way affect warranty start dates established in the General Conditions, Supplementary General Conditions, or elsewhere in the Specifications. Contractor shall clean ducts, air handling equipment, heating and cooling coils, grilles and diffusers, and any other equipment as necessary prior to Final Acceptance, in order to provide the Owner a complete operating system in new and clean condition.

P. LEED RESPONSIBILITY:

1. The HVAC Contractor and sub-tier Contractors shall bare the responsibility for applicable portions of work as they pertain to requirements for LEED certification, shall coordinate with other trades as required for LEED certification, and demonstrate proof of compliance for LEED certification.

2. The HVAC Contractor shall provide to the General Contractor a LEED Project Representative for the HVAC systems to participate with the LEED Project Management and Coordination to provide the following:

- a. Construction Indoor Air Quality (IAQ) Management Plan
- b. HVAC&R CFC Refrigerant Waste Disposal Plan

END OF SECTION 230000

PART 1 - PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Engineer's responsive action.
- B. Informational Submittals: Written information that does not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Designer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 21 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Designer will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Identification: Place a permanent label or title block on each submittal for identification.
 - 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 - 2. Provide a space on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
- E. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals. Summarize deviations on transmittal or List of Deviations included with submittal.
- F. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
- G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked "Furnish as Submitted" or "Furnish as Corrected."
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Use only final submittals with mark indicating "Furnish as Submitted" or "Furnish as Corrected" taken by Designer.

1.4 CONTRACTOR'S USE OF DESIGNER'S CAD FILES

A. General: At Contractor's written request, copies of Designer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:

1. Allow 21 days from Designer's receipt of written request for CAD files for delivery of files
2. Files will be delivered via email or compact disc.
3. Files will be delivered without RN&M Title Blocks, and without standard details, schedules, etc.
4. CAD files provided for Contractor's use are not to be construed as the Contract Documents. Use of CAD files for submittals or other uses are at the Contractor's risk.

B. **DISCLAIMER**

1. The drawings have been reproduced from a computer disk copy of an original file at Reece, Noland & McElrath, Inc., and are an instrument of service. The firm assumes no responsibility for additions, deletions, or any differences which may exist between electronic files and the original drawings. This material is furnished in our usual electronic format for file and resource only. The information contained on this disk or other media and on its plot are based upon file information and has not been field validated or verified with actual field conditions and the user is advised to refer to all actual field conditions prior to utilization, and to coordinate with other current contract documents applicable at time of use.
2. It is mutually understood that any possible use of this material as a reference resource is done so at the total risk of the user. We expressly disclaim that this material is suitable for any use except reference file of the present project construction; consequently we assume no liability for any other purpose using this material, or use by the owner or others that may gain access in the future.
3. No warranty either expressed or implied is given with respect to the accuracy of the information provided in this material and the user must assume all risks in connection with the use thereof.
4. It must be explicitly understood and agreed that once the CADD media leaves our hands, we have absolutely no control over that media, and that it could be utilized wrongfully, changed, or altered to produce drawings or other material bearing facsimiles of our name, our professional seals, our signatures, or that the material may deteriorate or be accidentally altered; additionally, the right given by us to you to use the material is a joint right – we retain the right to use the material for our own purposes; either of us shall have the right to reuse, alter, modify or delete the material without consequences to the other party. You and any user, agree to defend, indemnify, and hold Reece, Noland & McElrath, Inc. harmless from all claims, injuries, damages, losses, expenses, and attorney fees arising out of the use, modification or reuse of these materials.
5. Use of this material is at the sole risk of the user. Any other use of this material is not permitted without our review and expressed written permission. This material may not be reproduced without name, professional seal(s), signatures, logos, or title block data.
6. Use of this data indicates your acceptance of the above provisions. If you do not agree with them, you should return the materials and data to us without any use.
7. This material is protected under copyright laws and you must use them only as outlined above and treat like any other copyright material. Any use of this material is at the user's risk; furthermore, user agrees to indemnify and hold harmless Reece, Noland & McElrath, Inc. from all claims arising from the use, modifications, or reuse of these materials.

1.5 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.

- d. Manufacturer's catalog cuts.
 - e. Wiring diagrams showing factory-installed wiring.
 - f. Printed performance curves.
 - g. Operational range diagrams.
 - h. Compliance with specified referenced standards.
 - i. Testing by recognized testing agency.
 - 4. Number of Copies: Submit at least eight copies of Product Data, unless otherwise indicated. Designer will return all but three copies. Mark up and retain one returned copy as a Project Record Document.
 - C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Designer's CAD Drawings is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Notation of coordination requirements.
 - j. Notation of dimensions established by field measurement.
 - k. Relationship to adjoining construction clearly indicated.
 - l. Seal and signature of professional engineer if specified.
 - m. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
 - 3. Number of Copies: Submit two opaque (bond) copies of each submittal. Designer will return one copy.
 - D. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
 - E. Manufacturers and Materials Suppliers List: Submit a list of manufacturers of materials and materials/equipment suppliers, within 20 days of Contract Award.
 - 1. Number of Copies: Submit three copies of manufacturers and materials suppliers list, unless otherwise indicated. Designer will return two copies.
 - F. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design.
 - 1. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Designer will return two copies.
 - 2. Subcontract list to include all tiers of subcontractors.
 - 3. Submit subcontract list within 20 days of Contract Award.
- 1.6 INFORMATIONAL SUBMITTALS
- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Designer will not return copies.
 - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - 3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."

- B. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- D. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- E. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- F. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- G. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- H. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- I. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- J. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- K. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- L. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- M. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- N. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 23 Section "Operation and Maintenance Data."
- O. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- P. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.
- Q. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Statement on condition of substrates and their acceptability for installation of product.
 2. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.

R. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Designer.

1. Designer will not review submittals that include MSDSs and will return them for resubmittal.

1.7 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 2 - PART 2 - EXECUTION

2.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Designer.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

2.2 DESIGNER'S ACTION

A. General: Designer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Designer will review each submittal, make marks to indicate corrections or modifications required, and return it. Designer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. Furnish as Submitted
2. Furnish as Corrected: Incorporate comments marked on or attached to submittal.
3. Revise and Resubmit: Major items of the submittal do not comply, requiring a resubmittal.

C. Informational Submittals: Designer will review each submittal and will not return it, or will return it if it does not comply with requirements. Designer will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

F. The Contractor is responsible for compliance with the Contract Documents, dimensions, details, coordination, and satisfactory performance of materials and equipment provided and installed.

END OF SECTION 230010

PART 1 - GENERAL**1.1 DEFINITIONS**

- A. General: Basic Contract definitions are included in the General Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source, at no additional cost to the Owner.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION**

- A. All work performed shall be in accordance with the latest requirements of the current edition of the North Carolina State Building Code, and all other state and local codes, rules, regulations, ordinances, and standards.
- B. Contractor shall notify Designer in writing prior to receipt of bids if Contractor notes any discrepancy between laws, codes, ordinances, rules, regulations, and these specifications.
- C. In cases where the drawings or specifications exceed requirements of codes, standards, and ordinances, work shall be done in accordance with the requirements of the specifications.
- D. Any work installed in violation of codes, standards, and ordinances shall be reworked to be in compliance with codes, standards, and ordinances, at Contractor's expense.

END OF SECTION 230020

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. See Division 23 Section "Closeout Procedures" for submitting warranties for Contract closeout.
- C. See Divisions 23 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Basis-of-Design Product: Item identified by manufacturer's product name, make, and model number, used to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
 - 2. Comparable Product: Product that is listed by manufacturer's name in the Contract Documents, or added by Addendum, and demonstrated and approved through submittal process, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified or basis-of-design product. By listing a Comparable Product in the Contract Documents, the Designer does NOT represent that the Comparable Product has the same dimensions, physical properties, power and other connections, or other characteristics as the Basis-of-Design Product. In choosing to provide a Comparable Product, the Contractor is responsible for all changes to services, electrical and other connections, dimensions, coordination requirements with all trades, and any other differences between the Comparable Product and the Basis-of-Design product.
 - 3. Owner-preferred Alternate Product: Product that is listed by manufacturer's product name, make, and model number in the Contract Documents, and for which an Alternate Bid price is submitted. When an Alternate Bid item is accepted in the Contract, no substitutions or use of Comparable Products will be allowed.
 - 4. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor after award of Contract, because of extraordinary circumstances.

1.3 SUBMITTALS

- A. Comparable Product Requests: Submit three copies of each request for consideration, at least 10 days prior to receipt of bids, for products not listed in the Contract Documents. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for Comparable Products and the following, as applicable:
 - a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed product.
 - b. Detailed comparison of significant qualities of proposed product with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

2. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation. Designer will notify Contractor of approval or rejection of proposed comparable product request.
 - a. Form of Approval: Addition of the item to the list of Comparable Products by Addendum, prior to receipt of bids.
 - b. Use product specified if Designer cannot make a decision on use of a comparable product request within time allocated.
 - B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 2. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation of a request for substitution. Designer will notify Contractor of acceptance or rejection of proposed substitution.
 - a. Form of Acceptance: Change Order.
 - b. Use product specified if Designer cannot make a decision on use of a proposed substitution within time necessary to not affect project schedule.
 - C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 21 Section "Submittal Procedures." Show compliance with requirements.
- 1.4 QUALITY ASSURANCE
- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
- 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 5. Protect stored products from damage and liquids from freezing.
- 1.6 PRODUCT WARRANTIES
- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
 - B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
 - 3. Refer to Division 21 Sections for specific content requirements and particular requirements for submitting special warranties.
 - C. Submittal Time: Comply with requirements in Division 21 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, features, options, and other items needed for a complete installation and indicated use and effect, and as required or recommended by the manufacturer for a complete installation, whether or not specifically indicated on the drawings or specifications.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Designer will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:

1. Basis-of-Design Product: Where Drawings or Specifications name a product by manufacturer, make, and model number, and include a list of manufacturers (Comparable Products), provide the Basis-of-Design product or a Comparable Product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product identified by manufacturer, make, and model number (Basis-of-Design Product). Comply with provisions in Part 2 "Comparable Products" Article for consideration of products by unnamed manufacturers.
2. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, and textures" or a similar phrase, select a product that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Designer will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Designer will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Timing: Designer will consider requests for Comparable Products up to 10 days prior to receipt of bids, unless otherwise specified in General Conditions, Supplementary General Conditions, or Division 1 Sections.
- B. Contractor shall be responsible for all costs associated with implementation or inclusion of a Comparable Product, including reimbursement of Designer's costs and costs to modify work of other trades to accept the Comparable Product. This requirement applies equally to Comparable Products listed in the Contract Documents and those requested, approved, and added by Addendum prior to receipt of bids.
- C. Conditions: Designer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Designer will return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

2.3 PRODUCT SUBSTITUTIONS

- A. Timing: Designer will consider requests for substitution if received within 60 days after the Notice of Award.
- B. Contractor shall be responsible for all costs associated with implementation or inclusion of a Product Substitution, including reimbursement of Designer's costs and costs to modify work of other trades to accept the Product Substitution.
- C. Conditions: Designer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Designer will return requests without action, except to record noncompliance with these requirements:
 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.

4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.

PART 3 - EXECUTION**3.1 RESPONSIBILITIES OF CONTRACTOR**

- A. General: The responsibility for determining dimensions, utility requirements, fitting of work with other trades, sequencing and coordination of work, for Product Substitutions and Comparable Products rests solely with the Contractor.

END OF SECTION 230030

PART 1 - GENERAL**1.1 SUMMARY**

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. General installation of products.
 - 3. Progress cleaning.
 - 4. Starting and adjusting.
 - 5. Protection of installed construction.
 - 6. Correction of the Work.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 1. Before construction, verify the location at points of connection of underground electrical services.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work. Exact locations, arrangement, and coordination in the field are Contractor's responsibility.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings. Follow the obvious intent for symmetry, centering, and good practice in installation.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Designer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 4. Install conduits to run parallel and perpendicular to building lines.
 5. Coordinate locations of piping, ductwork, and equipment with casework, soffits, piping, structural elements, etc. prior to roughing in. No claims for additional cost will be entertained to relocate Contractor's failure to coordinate prior to installation.
 6. The drawings are diagrammatic in nature. Do not scale drawings for locations of devices, boxes, and equipment.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Designer.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
- 3.4 PROGRESS CLEANING
- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
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: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
 - H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
 - I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
 - J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- 3.5 STARTING AND ADJUSTING
- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
 - B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
 - C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."
- 3.6 PROTECTION OF INSTALLED CONSTRUCTION
- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
 - B. Comply with manufacturer's written instructions for temperature and relative humidity.
- 3.7 CORRECTION OF THE WORK
- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 23 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
 - B. Restore permanent facilities used during construction to their specified condition.
 - C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
 - D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
 - E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.
- END OF SECTION 230040**

PART 1 - GENERAL**1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Warranties.
 - 3. Final cleaning.
- B. See Division 23 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- C. See Division 23 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- D. See Division 23 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
- E. See Division 23 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 4. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, and similar final record information.
 - 5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 - 6. Complete startup testing of systems.
 - 7. Submit test records.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Advise Owner of changeover in power and other utilities.
 - 10. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 - 11. Complete final cleaning requirements, including touchup painting.
 - 12. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
 - 1. Submit certified copy of Designer's Substantial Completion inspection list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit documentation of training.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
- 1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)
 - A. Preparation: Submit one copy of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
- 1.5 WARRANTIES
 - A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
 - B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 - C. Provide additional copies of each warranty to include in operation and maintenance manuals.
- PART 2 - PRODUCTS
 - 2.1 MATERIALS
 - A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
- PART 3 - EXECUTION
 - 3.1 FINAL CLEANING
 - A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
 - B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

- g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. 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.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - m. Wipe surfaces of electrical equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to unusual operating conditions.
 - o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - p. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 230060

PART 1 - GENERAL**1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
- B. See Division 23 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- C. See Division 23 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS**2.1 RECORD DRAWINGS**

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - c. Indicate dimensions to locate underground and concealed lines from fixed reference points.
 - d. Indicate burial depth for underground lines.
 - 2. Mark the Contract Drawings completely and accurately.
 - 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 4. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "AS-BUILT MARKED PRINT" in a prominent location.
 - 1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "AS-BUILT MARKED PRINTS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Note related Change Orders and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

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

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

2.4 MISCELLANEOUS RECORD SUBMITTALS

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

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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

END OF SECTION 230080

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. General provisions.
 - 2. Scope.
 - 3. Permits and Fees.
 - 4. Visit to Job Site.
 - 5. Workmanship.
 - 6. Drawings and Specifications.
 - 7. Tests.
 - 8. Allowance for added work.
 - 9. Incidental construction work.
 - 10. Access Doors.
 - 11. Supervision.
 - 12. Electrical work by others.
 - 13. Existing facilities, utilities, etc.
 - 14. Adaptation of work to existing conditions.
 - 15. Renovations/alterations.
 - 16. Submittal procedures.
 - 17. Product requirements.
 - 18. Closeout procedures.
 - 19. Operation and Maintenance Manuals.
 - 20. As-built Documents.
 - 21. Demonstration and Training.
 - 22. Warranty.

PART 2 - NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL PROVISIONS

- A. This Contractor's attention is directed to the requirements of Instructions to Bidders, General Conditions and Supplementary General Conditions as bound in the specifications which apply in full to the HVAC work.
- B. Where the requirements of this Division conflict with other articles in these Specifications, the Contractor shall utilize the more stringent method.

3.2 SCOPE

- A. Provide all labor, materials, tools, equipment, and transportation, and perform all operations necessary for and reasonably incidental to proper execution and completion of all "HVAC" work, whether specifically mentioned or not, all as indicated, specified herein, and/or implied thereby to carry out the apparent intent thereof.
- B. These drawings may be superseded by later revised or detailed drawings, specifications, or sketches prepared by the Designer, as needed for clarification, and this Contractor shall conform to all reasonable coordination requests.
- C. All items not specifically mentioned in the specifications or noted on the drawings, but which obviously are required to make the working installation complete, shall be included automatically.
- D. For projects which are bid or awarded as Single Prime contracts, organization of the Specifications into divisions, sections, and articles, and arrangement of the Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be done by any trade, unless specifically shown or noted otherwise.

3.3 PERMITS AND FEES

- A. This Contractor shall secure all permits required for the completion of this contract. He shall obtain and deliver to the Owner all certificates of inspection issued by the authorities having jurisdiction.

3.4 VISIT TO JOB SITE

- A. Before submitting a bid, this Contractor shall visit the job site for the purpose of thoroughly examining the site and conditions under which the work must be performed.

- B. The submission of a bona fide bid will be construed to mean that this Contractor understands and is satisfied with conditions under which the contract must be fulfilled.
 - C. No extra compensation will be allowed for situations arising from failure of this Contractor to be thoroughly familiar with site conditions, including charges and requirements for connection to utilities as shown for this project.
- 3.5 WORKMANSHIP
- A. Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved.
 - B. Work shall be performed by experienced and skilled mechanics under the supervision of a competent foreman.
 - C. Substandard workmanship will be cause for rejection of work and replacement by Contractor.
 - D. The Contractor shall reimburse the Designer for all costs incurred by the Designer due to Contractor's substandard or non-conforming work.
- 3.6 DRAWINGS AND SPECIFICATIONS
- A. The drawings show the location and arrangement of fixtures, piping, and equipment, together with details of connections of certain principal items.
 - B. The layout shown shall be followed as closely as circumstances will permit, but this Contractor shall lay out his work so as to avoid conflict with other Contractors and trades, and to avoid any unnecessary cutting or damage to walls, floors, and supporting structural members.
 - C. This Contractor shall carefully and accurately locate all sleeves and install at the proper time all necessary hangers, inserts, etc., which will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of above items.
 - D. This Contractor shall refer to architectural, mechanical, and electrical drawings and shall cooperate fully with other Contractors and trades while installing piping, fixtures, and other equipment because of close space limits.
 - 1. In case of conflict, notify Designer before proceeding with installation.
 - 2. Refer to architectural drawings for exact building dimensions and location of partition walls, doors, chases, etc.
 - 3. HVAC drawings are not to be scaled for such dimensions.
 - E. The drawings and specifications complement each other and together are intended to give a complete description of the work.
 - 1. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown in plans, shall be furnished the same as if mentioned or shown in both places.
 - 2. If conflicts exist, then the most stringent method shown or described shall apply.
 - F. Any switches, controls, or equipment included in this contract work (drawings and/or specifications) that are not specifically shown on drawings shall be located for convenient use and access.
 - G. Contractor shall coordinate all equipment arrangement and lay-out in field prior to beginning any actual installation of his work.
 - H. If Contractor notes any discrepancy, omission, or conflict found in plans or specifications, he shall call to the immediate attention of the Designer, prior to receipt of bids.
 - I. It is the intention that piping, air ducts and light fixtures are designed and laid out to clear each other.
 - 1. It shall be the responsibility of this Contractor to coordinate his work with that of other trades to avoid any such conflicts.
 - 2. Any conflicts that occur after work of one trade is installed and was not prior coordinated shall be relocated or rearranged at the total expense of this Contractor, as directed by Designer.
 - 3. Any conflicts that cannot be corrected in field by relocation or elevation changes shall be reported to the Designer in writing prior to any installation.
 - J. The drawings are not intended to show each and every complete or accurate detail.
 - 1. The figures and writing on drawings shall be taken instead of scaling.
 - 2. It is this Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement.
 - 3. This Contractor shall take and be responsible for all field measurements.

4. Exact locations and relations are to be defined in the field and shall be satisfactory to the Designer.
- K. Because of the small scale of HVAC drawings it is not possible to indicate all offsets, fittings, and accessories which may be required.
 1. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings and accessories that may be required to meet the conditions.
- 3.7 TESTS
 - A. The Designer reserves the right to conduct acceptance tests of all equipment, piping, or any other work furnished under these specifications to determine the fulfillment of special requirements.
 1. Such tests shall be conducted in the presence of authorized representatives of the Contractor, Owner, Engineer, and Architect at such time as the Designer may designate.
 2. This Contractor shall perform all tests, bear cost of same and make adjustments of equipment and wiring as may be deemed necessary by the Designer.
- 3.8 ALLOWANCE FOR ADDED WORK
 - A. Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall first be submitted and approved in writing.
 1. No claim for addition to the contract sum will be valid unless so ordered and approved by the Owner and Designer, prior to start of work.
 2. Any conflicts corrected by relocation or elevation changes do not constitute extra work.
- 3.9 INCIDENTAL CONSTRUCTION WORK
 - A. All blocking for openings for piping in concrete floors, masonry walls or partitions shall be provided by this Contractor.
 1. This Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other Contractors as shown upon, or reasonably implied by the drawings and specifications.
 2. He shall properly complete and finish up his work after other Contractors have finished as the Designer may direct.
 - B. All excavating required for the installation of this system shall be done by this Contractor.
 1. Backfill shall be accomplished as specified in appropriate section of specifications.
 - C. Chases are prohibited in masonry walls which are not to be plastered or paneled.
 1. Set piping, blocking, carriers, etc. indicated to be concealed before walls are constructed in order that walls may be constructed around them.
 2. This Contractor shall furnish all sleeves in floors, beams, walls, etc., for each such penetration as needed for installing his work and installation of sleeves by General Contractor.
 - D. Unless otherwise noted, the General Contractor will provide openings and lintels as new construction progresses, but this Contractor shall fully designate his requirements prior to construction.
 1. Failure to furnish his requirements prior to building construction and failure to coordinate his work with the building construction shall make this Contractor responsible for removing, replacing and painting building construction as required for installation of his work.
- 3.10 ACCESS DOORS
 - A. Provide and install access doors in walls, ceilings, etc. as required for access to valves, dampers, fire dampers, controls, and other devices requiring access in ceilings, chases, soffits, etc.
 - B. Access doors in non-fire rated walls or ceilings shall be as follows:
 1. Nominal 24" x 24" minimum size.
 2. 16-gage steel frame with 14-gage door panel and galvanized steel drywall bead.
 3. Flush style with provision to conceal flange with drywall cement.
 4. Double-acting concealed spring hinges to allow opening to 175 degrees.
 5. Flush, Allen-head operated with steel cam.
 6. Gray prime-painted steel, for painting to match adjacent finished surfaces.

7. Basis of Design: Milcor Style DW; Comparable Products by Karp, Elmdor, Acudor.
- C. Access doors in fire-rated walls or ceilings shall be as follows:
 1. Nominal 24" x 24" minimum size.
 2. UL 1-1/2 hour, Class B fire rating.
 3. Prime-painted stainless steel: 16-gage frame with 20-gage door panel, for painting to match adjacent finished surfaces.
 4. 2" mineral fiber insulation between inner and outer panel.
 5. Continuous hinge, steel with stainless steel pin.
 6. Self-closing and self-latching panel closer.
 7. Flush mounted paddle latch and locking system with flush, key-operated cylinder lock with two keys.
 8. Basis of Design: Milcor Style UFR; Comparable Products by Karp, Elmdor, Acudor.
- 3.11 SUPERVISION
 - A. This Contractor shall have in charge of the work at all times during construction a thoroughly competent foreman with extensive experience in the work to be performed under this contract.
 1. Anyone deemed not capable by the Designer shall be replaced immediately upon request, and after satisfactory foreman has been assigned, he shall not be withdrawn without the written consent of the Designer.
- 3.12 ELECTRICAL WORK BY OTHERS
 - A. Refer to the drawings for the details of locations of circuit breakers, junction boxes, disconnect switches, conduits and slack wire required where this contractor's electrical work terminates and electrical work by others begins.
 - B. The Electrical Contractor shall furnish and install all power circuits for equipment furnished by others.
 - C. In Mechanical Rooms the wiring by the Electrical Contractor shall generally terminate in a power wiring gutter, line side of disconnect switches or starters, junction box, or electrical panel.
 1. From these points power wiring to the equipment furnished by the HVAC Contractor shall generally be by the HVAC Contractor.
 2. Power wiring to mechanical equipment outside equipment rooms will generally be run by the Electrical Contractor to line side of a disconnect switch or junction box in the vicinity (within 3'-0") of the HVAC equipment.
 3. Power wiring from that point to the equipment will be by the HVAC Contractor.
 - D. HVAC Contractor is to refer to the drawings for location and type of service connections to be provided under the electrical contract.
 1. Where service disconnect switches are required and not furnished as part of the equipment, they shall be furnished and installed by contractor that furnishes the equipment, unless indicated otherwise.
 2. Other Contractors shall furnish and install conduit, boxes, wiring and all items of control for equipment they furnish or Owner furnished equipment, unless specifically shown on electrical drawings.
- 3.13 EXISTING FACILITIES
 - A. In existing facilities, disruption of operations must be kept to a minimum and coordinated with Owner.
 1. Work in existing buildings must be cleaned up daily immediately after finishing that portion of work and equipment left in order for Owner to continue operations.
 2. When it is necessary to interrupt utility services in the fulfillment of this contract, such interruptions shall be kept to a minimum and coordinated with Owner.
 3. Once work has begun, it shall be pursued diligently until completed.
 - B. Every precaution shall be taken to prevent damage to existing underground lines and structures and public utilities.
 1. Damage to existing water and sewer lines, culverts, service connections, underground cables, and similar surface and sub-surface structures shall be at the risk of this Contractor, whether or not locations thereof are shown on plans, and the repairing of such damage shall be by this Contractor and shall be completed without delay.
 2. Compensation for such repairs shall be based on normal and reasonable costs.

- C. The locations of any existing underground utilities that are shown are in an approximate way only and have not been independently verified by the Owner or its representative.
 - 1. The Contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the Contractor's failure to exactly locate and preserve any and all underground utilities.
- 3.14 ADAPTATION OF WORK TO EXISTING CONDITIONS
 - A. It is reasonably implied that this Contractor shall furnish all labor and materials to provide Owner with a new and satisfactory system in these facilities.
 - 1. Contractor is to include necessary work for adaptation of equipment to conditions that may be found to produce conflicts during construction.
 - 2. When any such conditions are encountered, this Contractor is to consult with Designer and then modify installation as directed without additional costs, and to include any incidental materials required.
- 3.15 RENOVATIONS/ALTERATIONS
 - A. Before any work is started in existing building, HVAC Contractor shall make a thorough survey with Designer and a representative of the Owner of building in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by all three to Designer. This report shall list by rooms and spaces:
 - 1. Existing conditions and types of resilient flooring, doors, windows, wall and other surfaces not required to be altered throughout and affected areas of building.
 - 2. Existence and conditions and operation of items such as HVAC fixtures, water heaters, valves, etc., required by drawings to be either reused for relocated, or both.
 - 3. Any discrepancies between drawings and existing conditions at site.
 - 4. Areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and Designer.
 - B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of Designer and Owner's representative, to be in such condition that their use is impossible or impractical, shall be removed and a proposal submitted by Contractor to replace with new items in accordance with specifications which will be furnished by Designer.
 - C. Re-Survey: Fifteen days before expected partial or final inspection date, Contractor, Designer, Owner's representative, together shall make a thorough re-survey of the areas of buildings involved.
 - 1. They shall furnish a report on conditions then existing, of HVAC fixtures, equipment, etc. as compared with conditions of same as noted in first condition survey report.
 - 2. Re-survey report shall also list any damage caused by this Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of this Contractor to restore damage caused by Contractor's workmen in executing work of this Contract.
- 3.16 SUBMITTAL PROCEDURES
 - A. Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - 3. Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 - B. Contractor approval: Affix review stamp to cover sheet, with initials and date of Contractor's approval of submittals.
 - 1. By submitting Shop Drawings, Product Data, Samples and similar submittals, this Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria and details related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work, the Contract Documents and the Work of other trades.

- C. Comply with requirements in Division 01 Sections for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows.
 - 1. Time for review shall commence on Designer's receipt of submittal.
 - 2. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 3. Allow 21 days for initial review of each submittal.
 - a. Allow additional time if coordination with subsequent submittals is required.
 - b. Designer will advise Contractor when a submittal being processed must be delayed for coordination.
 - 4. Allow 15 days for review of each resubmittal.
- E. Identification: Identify submittals as required in Division 01 sections.
- F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
 - 1. Summarize deviations on transmittal or List of Deviations included with submittal.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling.
 - 1. Transmit each submittal using a transmittal form.
 - 2. Designer will discard submittals received from sources other than Contractor.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked "Furnish as Submitted" or "Furnish as Corrected."
 - 4. Where submittals contain specific questions or comments, provide a separate sheet with specific answers to each question or comment.
- J. At Contractor's written request, copies of Designer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
 - 1. Allow 21 days from Designer's receipt of written request for CAD files for delivery of files
 - 2. Files will be delivered via email or compact disc.
 - 3. Files will be delivered without RN&M Title Blocks, standard details, schedules, etc.
 - 4. CAD files provided for Contractor's use are not to be construed as the Contract Documents. Use of CAD files for submittals or other uses are at the Contractor's risk.
- K. Prepare and submit Action Submittals required by individual Specification Sections.
 - 1. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 2. Number of Copies: Submit at least eight copies of Product Data, unless otherwise indicated.
 - a. Designer will return all but three copies.
 - b. Retain or duplicate sufficient copies for inclusion in Operation and Maintenance Manuals.
 - 3. Shop Drawings: Prepare Project-specific information, drawn accurately to scale.
 - a. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Designer's CAD Drawings is otherwise permitted.
 - 5. Sheet Size: At least 8-1/2 by 11 inches but no larger than size of project drawings.
 - 7. Number of Copies: Two opaque (bond) copies of each submittal. Designer will return one copy.
 - 8. Manufacturers and Materials Suppliers List: Submit three copies of manufacturers and materials suppliers list within 20 days of Contract Award, unless otherwise indicated. Designer will return two copies.
 - 10. Subcontract List: Submit within 20 days of Contract Award three copies of list of proposed subcontractors. Designer will return two copies. Subcontract list to include all tiers of subcontractors.

- L. Contractor's Review and Approval: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents.
 - 1. Note corrections and field dimensions.
 - 2. Mark with approval stamp before submitting to Designer.
 - M. Designer's Action: Designer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
 - 1. Designer will review each submittal, make marks to indicate corrections or modifications required, and return it.
 - 2. Designer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - a. Furnish as Submitted
 - b. Furnish as Corrected: Incorporate comments marked on or attached to submittal.
 - c. Revise and Resubmit: Major items of the submittal do not comply, requiring a resubmittal.
 - N. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
 - O. Submittals not required by the Contract Documents may not be reviewed and may be discarded.
 - P. The Contractor is responsible for compliance with the Contract Documents, dimensions, details, coordination, and satisfactory performance of materials and equipment provided and installed.
- 3.17 PRODUCT REQUIREMENTS
- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Basis-of-Design Product: Item identified by manufacturer's product name, make, and model number, used to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, dimensions, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
 - 2. Comparable Product: Product that is listed in the Contract Documents, or added by Addendum, and demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified or basis-of-design product.
 - 3. Owner-preferred Alternate Product: Product that is listed in the Contract Documents, and for which an Alternate Bid price is submitted. When an Alternate Bid item is accepted in the Contract, no substitutions will be allowed.
 - 4. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor after award of Contract.
 - 5. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - B. Comparable Product Requests: Submit three copies of each request for consideration, at least 10 days prior to receipt of bids, for products not listed in the Contract Documents. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for Comparable Products and the following, as applicable:
 - a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed product.
 - b. Detailed comparison of significant qualities of proposed product with those of the Work specified. Significant qualities may include attributes such as performance,

- weight, size, durability, visual effect, and specific features and requirements indicated.
- c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
- 2. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation. Designer will notify Contractor of approval or rejection of proposed comparable product request.
 - a. Form of Approval: Addition of the item to the list of Comparable Products by Addendum, prior to receipt of bids.
 - b. Use product specified if Designer cannot make a decision on use of a comparable product request within time allocated.
- C. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, features, options, and other items needed for a complete installation and indicated use and effect, and as required or recommended by the manufacturer for a complete installation, whether or not specifically indicated on the drawings or specifications.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Designer will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
- D. Product Selection Procedures:
 - 1. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 - 2. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 - 3. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.
- E. Responsibility of the Contractor: The responsibility for determining dimensions, utility requirements, fitting of work with other trades, sequencing and coordination of work, for Product Substitutions and Comparable Products rests solely with the Contractor.
- F. Manufacturer's Warranties: Where specifications require manufacturer's warranties, the provisions of the Contract Documents take precedence over any manufacturer's "standard" warranty provisions, exclusions, etc.
 - 1. The start of manufacturer's warranties shall be the date of Substantial Completion of the project or phase of the project, notwithstanding any language or exclusion in any document submitted by the contractor or manufacturer.
- 3.18 CLOSEOUT PROCEDURES
 - A. Substantial Completion: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Complete startup testing of systems.
 - 3. Submit test records.
 - 4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 - 5. Complete final cleaning requirements, including touchup painting.
 - 6. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

7. Submit a written request for inspection for Substantial Completion. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
 8. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 9. Results of completed inspection will form the basis of requirements for Final Completion.
 - B. Final Completion: Before requesting final inspection for determining date of Final Completion, complete the following:
 1. Submit certified copy of Designer's Substantial Completion inspection list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit documentation of training.
 3. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
 4. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - C. Cleaning: This Contractor shall provide all systems and equipment in a new and clean condition.
 1. Clean all items furnished and installed in accordance with manufacturer's recommendations.
 2. Provide instruction to Owner in proper cleaning of all items provided as part of this Division.
 3. Cooperate with General Contractor in cleaning of building.
- 3.19 OPERATION AND MAINTENANCE MANUALS
- A. Submit four complete copies of Operation and Maintenance Manuals to Designer for review prior to request for inspection for Substantial Completion.
 - B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
 - C. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name, address, and telephone number of Contractor.
 6. Name and address of Architect.
 7. Name and address of Engineer.
 - D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - E. List of Material Suppliers and Subcontractors: List contact information for each material supplier and subcontractor.
 - F. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
 1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of

- equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
- G. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- H. Descriptions: Include the following: Product name and model number, Manufacturer's name, Equipment identification with serial number of each component, Equipment function, Operating characteristics, Limiting conditions, Performance curves, Engineering data and tests, complete nomenclature and number of replacement parts.
- I. Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
- J. Describe the sequence of operation, and diagram controls as installed.
- K. List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- L. Provide manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
- M. Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:
- N. Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- O. Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- P. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
- Q. Provide complete approved submittal data with all annotations.
- R. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
- 3.20 AS-BUILT DOCUMENTS
- A. As-built Marked Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings.
1. Mark Record Prints to show the actual installation where installation varies from that shown originally.
 2. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up As-built Marked Prints.
 3. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 4. Record data as soon as possible after installation.
 5. Record and check the markup before enclosing concealed installations.

6. Indicate dimensions to locate underground and concealed conduits and lines from fixed reference points.
 7. Indicate burial depth for underground lines.
 8. Indicate location of all valves and cross-reference to valve tag list.
 9. Mark the Contract Drawings completely and accurately.
 - a. Mark record sets with erasable, red-colored pencil.
 - b. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
 10. Maintain As-built Marked Prints in a clean, legible, up-to-date condition in the project office, and available to the Designer for inspection upon request throughout construction.
- B. Record Specifications: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Note related Change Orders and As-built Marked Prints where applicable.
- 3.21 DEMONSTRATION AND TRAINING
- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with Owner with at least seven days' advance notice.
 - C. Warranty service: Train Owner in repair and troubleshooting during each warranty service call.
 - D. For each training session, submit on letterhead name of trainer, date of training, names of Owner's personnel trained, and systems/equipment trained on.
 - E. For factory training, documentation to be on letterhead of organization conducting training.
- 3.22 WARRANTY
- A. This Contractor shall guarantee all materials, equipment, workmanship and each and every piece of apparatus which he furnished and which he installs under this contract against defects and failures of any nature for a period of one year from date on which the system is accepted.
 - B. Apparatus furnished by this Contractor shall be guaranteed to be satisfactory when operated under rated conditions in accordance with manufacturer's instructions and to be of size, function, and capacity specified on drawings or in the specifications.
 - C. Equipment manufacturers shall warrant equipment furnished for this project for same time span as installing contractors warranty period as set above and elsewhere in these specifications.
 1. Warranty start date shall be as established by the Designer. Refer to General Conditions, Supplementary General Conditions, and Division 1 specifications for establishment of warranty start dates.
 2. The provisions of the Contract Documents supersede and override any manufacturer's standard warranty provisions.
 - D. Upon notice from the Designer or Owner, Contractor shall immediately check system, make necessary repairs or adjustments as required; due to faulty workmanship, materials, faults, operation or equipment, without cost to the Owner, and instruct Owner in proper operation, adjustment, and care of systems.
 - E. During the one-year warranty period, the Contractor shall be responsible for all preventive maintenance, including routine lubrication, filter changing, inspections, and adjustments.
 1. Contractor shall provide all materials, consumables, equipment, supplies, filters, etc. required for preventive maintenance.
 2. Perform preventive maintenance in accordance with manufacturer's recommendations.
 3. During preventive maintenance, instruct Owner in proper preventive maintenance procedures.
 - F. The Contractor shall submit service call tickets, reports, or other documentation of each warranty service call to the Designer.

END OF SECTION 230500

PART 1 - GENERAL**1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment 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. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Equipment supports.

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. Available Manufacturers: B-Line, Fee and Mason, Grinnell, Kindorf, Michigan Hanger, Unistrut, or approved equal.
- 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-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: **100-psig**- minimum, compressive-strength insulation insert encased in sheet metal shield.

- B. Available Manufacturers: Carpenter & Paterson, Inc., ERICO/Michigan Hanger Co., PHS Industries, Inc., Pipe Shields, Inc., Rilco Manufacturing Company, Inc., Value Engineered Products, Inc.
 - C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
 - D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
 - E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
 - F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
 - G. Insert Length: Extend **2 inches** beyond sheet metal shield for piping operating below ambient air temperature.
- 2.6 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. Available Manufacturers: Hilti, Inc., ITW Ramset/Red Head, Masterset Fastening Systems, Inc., MKT Fastening, LLC., Powers Fasteners.
 - B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Available Manufacturers: B-Line Systems, Inc., Empire Industries, Inc., Hilti, Inc., ITW Ramset/Red Head, MKT Fastening, LLC., Powers Fasteners.
- 2.7 EQUIPMENT SUPPORTS
- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.
- 2.8 MISCELLANEOUS MATERIALS
- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: **5000-psi**, 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 noninsulated 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 noninsulated stationary pipes, **NPS 1/2 to NPS 8**.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, **NPS 1/2 to NPS 30**.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, **NPS 4 to NPS 36**, with steel pipe base stanchion support and cast-iron floor flange.

7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, **NPS 1 to NPS 30**, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
8. Complete Pipe Rolls (MSS Type 44): For support of pipes, **NPS 2 to NPS 42**, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- 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.**
 - 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. 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. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed **1-1/4 inches**.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

- N. 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. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
 - C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
 - D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
 - E. 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.
 - F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
 - G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - H. 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.
 - I. Install lateral bracing with pipe hangers and supports to prevent swaying.
 - J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2** and larger 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.
 - K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - L. 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.
 - M. 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.
- d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
- e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood inserts.
- 6. Insert Material: Length at least as long as protective shield.
- 7. 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 trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 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 230529

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume (VAV) systems.
 - c. Multizone systems.
 - 2. Hydronic Piping Systems:
 - a. Constant-flow systems.
 - b. Variable flow systems.
 - 3. HVAC and other equipment quantitative-performance settings, including chillers, boilers, cooling towers, water heaters, air handling units, DX units, heat pumps, pumps, etc.
 - 4. Kitchen hood airflow balancing.
 - 5. Existing systems TAB.
 - 6. Verifying that automatic control devices are functioning properly.
 - 7. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

- A. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- B. Daily Field Data reports: During testing and balancing operations, submit actual field data reports to Engineer daily via fax or email. Daily reports should include actual readings taken and any problems encountered during that day.
- C. Certified TAB Reports: Submit four copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- D. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems " or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

1.4 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- C. TAB will be conducted as a separate contract under the Owner. Refer to Project HVAC Specifications and Drawings for requirements of General Contractor/HVAC Contractor to support TAB operations.

1.5 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
- C. **[Convene and conduct a TAB coordination meeting, no more than two weeks prior to starting TAB activities on site. Attendees shall include Owner's representative,**

Engineer, General Contractor, HVAC subcontractor, controls installer, and any others necessary to support TAB activities. Agenda shall include: schedule for TAB activities, support and coordination required, status of deficiencies noted in TAB inspections specified in this Section, and any other items necessary to complete testing and balancing in accordance with this section.]

1.6 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- C. Adjustments: For one year after Owner occupancy, provide the services of a qualified TAB technician upon request of the Designer to take readings and make adjustments as necessary and directed by Designer for comfort conditions.

PART 2 - PRODUCTS/VENDORS

2.1 ACCEPTABLE TAB CONTRACTORS

- A. The following TAB agents are acceptable to Owner and Designer for providing TAB services:
 - 1. Palmetto Air and Water Balance, Inc. (Asheville, Charlotte, Raleigh NC and Greenville, SC)
 - 2. Watts Services (Morganton, NC)
 - 3. Hall Technology, Inc. (Leesville, SC)
 - 4. Test and Balance Corporation (Winston-Salem, NC)
 - 5. The Phoenix Agency (Winston-Salem, NC)
- B. The Designer will consider other TAB agents as acceptable under the following conditions:
 - 1. Request to consider another TAB agent is received from a Prime Bidder or HVAC Contractor intending to bid the project.
 - 2. Request to consider another TAB agent is submitted at least 10 days prior to receipt of bids.
 - 3. Proposed TAB agent is certified per this specification.
 - 4. Approval for a proposed TAB agent to bid the project will be communicated via Addendum prior to receipt of bids.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
 - F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
 - G. Examine system and equipment test reports.
 - H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 - I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
 - J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
 - K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
 - L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
 - M. Examine strainers for clean screens and proper perforations.
 - N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
 - O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
 - P. Examine system pumps to ensure absence of entrained air in the suction piping.
 - Q. Examine equipment for installation and for properly operating safety interlocks and controls.
 - R. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
 - S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.
- 3.2 PREPARATION
- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
 - B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, water treatment conducted, 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.
 9. Systems and equipment are labeled per Project Specifications.
- 3.3 INSPECTIONS DURING CONSTRUCTION/INSTALLATION
- A. SIXTY PERCENT DUCTWORK INSPECTION
1. Notify Designer of inspection schedule at least one week prior to inspection.
 2. Inspect installation of HVAC systems when sixty percent of ductwork is installed.
 3. Verify general installation of HVAC system, including piping, ducts, valves, dampers, control devices, etc.
 4. Verify access to control and balancing devices, including installation of access doors, panels, etc.
 5. Report deficiencies in writing within one week of inspection to HVAC contractor, general contractor, and Designer.
- B. NINETY PERCENT SYSTEM INSPECTION
1. Notify Designer of inspection schedule at least one week prior to inspection.
 2. Inspect installation of HVAC systems when ninety percent of HVAC system is installed.
 3. Verify general installation of HVAC system, including piping, ducts, valves, dampers, control devices, etc.
 4. Verify access to control and balancing devices, including installation of access doors, panels, etc.
 5. Report deficiencies in writing within one week of inspection to HVAC contractor, general contractor, and Designer.
- 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 Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. During TAB operations, submit field data to Engineer daily via fax or email. List systems/equipment tested, problems encountered, and deficiencies noted.
- E. Witness start-up and tests for all major HVAC equipment. Include copies of test reports, including manufacturer's start-up check lists included in manufacturer's installation instructions, in the Test-and-Balance report.
- 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 outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.

- J. Check condensate drains for proper connections, trap depth, and functioning.
 - K. Check for proper sealing of air-handling unit components.
 - L. Check for proper sealing of air duct system.
- 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 fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 5. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
 - B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
 - C. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
 - D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- 3.7 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 maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record the final fan performance data.
- 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 systems similar to 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 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 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 outside airflow. Adjust the fan and balance the return-air ducts and inlets 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 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 outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.8 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at full flow through the cooling coil if coil has that capacity.
- B. Adjust each zone damper to indicated airflow.

3.9 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 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 expansion tank liquid level.
 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.

3.10 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.

- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.
- 3.11 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS
 - A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.
- 3.12 PROCEDURES FOR MOTORS
 - A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
 - B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.
- 3.13 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. If 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 kilowatt.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
 - 6. Capacity: Calculate in tons of cooling.
 - 7. If 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 COOLING TOWERS
 - A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
 - 1. Measure condenser-water flow to each cell of the cooling tower.
 - 2. Measure entering- and leaving-water temperatures.
 - 3. Measure wet- and dry-bulb temperatures of entering air.
 - 4. Measure wet- and dry-bulb temperatures of leaving air.
 - 5. Measure condenser-water flow rate recirculating through the cooling tower.
 - 6. Measure cooling tower pump discharge pressure.
 - 7. Adjust water level and feed rate of makeup-water system.
- 3.15 PROCEDURES FOR CONDENSING UNITS
 - A. Verify proper rotation of fans.
 - B. Measure entering- and leaving-air temperatures.
 - C. Record compressor data.
- 3.16 PROCEDURES FOR BOILERS, WATER HEATERS, AND OTHER FUEL FIRED EQUIPMENT
 - A. If hydronic, measure entering- and leaving-water temperatures and water flow.
 - B. If steam, measure entering-water temperature and flow and leaving steam pressure, temperature, and flow.
 - C. Record the following data:

1. Equipment drawing designation;
 2. Equipment manufacturer, model number, and serial number;
 3. Rated input and output;
 4. Type of fuel and heat value (calorific value);
 5. Other data from the nameplate of the equipment.
- D. Record the following measurements:
1. Percent carbon dioxide
 2. Stack temperature (flue gas temperature at equipment outlet)
 3. Ambient temperature
 4. Over-fire draft (inches WG)
 5. Gas burner manifold pressure
 6. Fuel meter reading (see below)
 7. Boiler jacket temperature
- E. Fuel meter readings shall be determined as follows:
1. Natural Gas: The objective of this test is to determine gross MBH input.
 - a. Time the gas meter under each firing rate to determine the CFH (cubic feet per hour) delivered. CFH shall be calculated by the equation: CFH equals U value of timing dial for one rotation times 36,000 divided by time in seconds for one rotation of timing dial.
 - b. Measure or determine the gas pressure at the gas meter and apply the proper correction factor to the delivered CFH that was measured to determine the equivalent CFH at the rated gas pressure. This shall be determined by the following equations:
- $$F = (UPa + PgO)/(Pa + Pr)$$
- Where F = Correction Factor; Pa = Atmospheric pressure (psi); Pg = Gas pressure at meter (psi); Pr = Rated gas pressure And Rated CFH = Measured CFH x Correction Factor
2. Oil Fired: The oil pressure at the pump shall be measured and recorded. Oil flow rate shall be determined from manufacturer's data and nozzles installed.
 3. LP Gas Fired: The burner manifold pressure shall be measured and pressure read at tank, before and after each regulator under system full load conditioning for all gas fired equipment simultaneously. Gas flow rate shall be determined using manufacturers data as applicable.
- F. If burners have other than one firing rate, combustion tests shall be made in the following manner:
1. If step-firing (High-Low), readings shall be taken at each step.
 2. If modulating, reading shall be taken at high, at low, and at 50 percent firing rate.
- G. The following calculations shall be made from the measured data and recorded on the report:
1. Gross Input
 2. Net Stack Temperature
 3. Percent Excess Air
 4. Percent Flue Gas Loss
 5. Combustion Efficiency
 6. Gross Output (MBH) = Gross Input - Flue Gas Loss
- H. Flue gas loss shall be calculated from measured data using industry accepted methods.
- 3.17 PROCEDURES FOR HEAT-TRANSFER COILS
- A. Water Coils: Measure the following data for each coil:
1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.

7. Air pressure drop.
8. For coils with 3-way control valves, adjust bypass ball valve so that flow in bypass mode is the same as flow through the coil.
- B. Electric-Heating Coils: Measure the following data for each coil:
 1. Nameplate data.
 2. Airflow.
 3. Entering- and leaving-air temperature at full load.
 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 5. Calculated kilowatt at full load.
 6. Fuse or circuit-breaker rating for overload protection.
- C. Refrigerant Coils: Measure the following data for each coil:
 1. Dry-bulb temperature of entering and leaving air.
 2. Wet-bulb temperature of entering and leaving air.
 3. Airflow.
 4. Air pressure drop.
 5. Refrigerant suction pressure and temperature.
- 3.18 PROCEDURES FOR TEMPERATURE MEASUREMENTS
 - A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
 - B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
 - C. Measure outside-air, wet- and dry-bulb temperatures.
- 3.19 PROCEDURES FOR SOUND LEVEL TESTING
 - A. Conduct AABC standard sound tests for all air handlers and fans, and include test results in the Test-and-Balance report. If sound levels are above these listed, adjustments shall be made to bring the sound level within the range set forth.
 - B. If this cannot be done with the equipment as installed, recommendation shall be made by the Engineer to correct the sound level to within specified range. Additions of sound traps, insulation, isolation mounts, or dampers shall be made by the Mechanical Contractor under the direction of the Engineer at no extra cost.
 - C. Acceptable maximum sound levels are as follows:
 1. Halls and corridor areas: NC30 (40 dba on Scale A)
 2. Auditoriums, classrooms and offices NC-25, (35 dba on Scale A)
 3. Shop, gymnasium, and multipurpose areas NC40 (50 dba on Scale A).
- 3.20 PROCEDURES FOR COMMERCIAL KITCHEN HOODS
 - A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
 1. Install welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.
 - B. After balancing is complete, do the following:
 1. Measure and record the static pressure at the hood exhaust-duct connection.
 2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of **12 inches** between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
 3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.
 - C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
 1. Check duct slopes as required.

2. Verify that duct access is installed as required.
 3. Verify that point of termination is as required.
 4. Verify that duct air velocity is within the range required.
 5. Verify that duct is within a fire-rated enclosure.
 - D. Report deficiencies.
- 3.21 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS
- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the refrigerant charge.
 4. Check the condition of filters.
 5. Check the condition of coils.
 6. Check the operation of the drain pan and condensate drain trap.
 7. Check bearings and other lubricated parts for proper lubrication.
 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
 - B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
 1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
 - C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
 4. Air balance each air outlet.
- 3.22 TEMPERATURE-CONTROL VERIFICATION
- A. Verify that controllers are calibrated and commissioned.
 - B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
 - C. Record controller settings and note variances between set points and actual measurements.
 - D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
 - E. Check free travel and proper operation of control devices such as damper and valve operators.
 - F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
 - G. Check the interaction of electrically operated switch transducers.
 - H. Check the interaction of interlock and lockout systems.
 - I. Check main control supply-air pressure and observe compressor and dryer operations.
 - J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
 - K. Note operation of electric actuators using spring return for proper fail-safe operations.
- 3.23 TOLERANCES
- A. Set HVAC system airflow and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 2. Air Outlets and Inlets: 0 to minus 10 percent.

3. Heating-Water Flow Rate: 0 to minus 10 percent.
 4. Cooling-Water Flow Rate: 0 to minus 5 percent.
- 3.24 FINAL REPORT
- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
 - B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 1. Include a list of instruments used for procedures, along with proof of calibration.
 - C. Final Report Contents: In addition to certified field report data, include the following:
 1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
 - D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
 - E. System Diagrams: Include a copy of the design drawings, marked to note as-built/as-installed conditions, indicating the following:
 1. Quantities of outside, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Location and position of balancing devices.
 8. Actual airflows measured at each grille/diffuser.
 9. Inlet and outlet static pressures measured at each air handling unit.

10. Pump inlet and outlet pressures and flow rates.

11. Identification on system diagrams to be cross-referenced to tabulated data.

3.25 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.
- C. Opposite season testing: Perform additional testing, inspecting, and adjusting during the opposite season in which initial TAB procedures were performed.
- D. In all cases, notify Designer in advance of performing additional tests.

END OF SECTION 230593

PART 1 - GENERAL**1.1 SUMMARY****A. Section Includes:**

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS**A. Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.****B. Use material, weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA publications, unless noted otherwise:**

1. HVAC Duct Construction Standards, Metal and Flexible, 2nd Edition, 1995
2. HVAC Air Duct Leakage Test Manual, 1st Edition, 1985
3. HVAC Systems - Duct Design, 3rd Edition, 1990
4. Rectangular Industrial Duct Construction Standard, 1st Edition, 1980
5. Round Industrial Duct Construction Standards, 2nd Edition, 1999
6. Thermoplastic Duct (PVC) Construction Manual, 2nd Edition, 1995
7. Round Industrial Duct Construction Standards, 2nd Edition, 1999
8. Rectangular Industrial Duct Construction Standards, 1st Edition, 1980

C. Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.**1.3 SUBMITTALS****A. Include manufacturer's data and/or Contractor data for the following:**

1. Schedule of duct systems including material of construction, gauge, pressure class, system class, method of reinforcement, joint construction, fitting construction, and support methods, all with details as appropriate.
2. Duct sealant and gasket material.
3. Duct liner including data on thermal conductivity, air friction correction factor, and limitation on temperature and velocity.

B. Welding certificates.**1.4 QUALITY ASSURANCE****A. Welding Qualifications: Qualify procedures and personnel according to the following:**

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS**2.1 GENERAL****A. All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral ductwork and spiral duct take-offs 12" and below may be 26 gauge where allowed in SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2nd Edition, 1995.****B. Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net, inside of liner.**

2.2 DUCTWORK PRESSURE CLASS

- A. Minimum acceptable duct pressure class, for all ductwork except transfer ductwork, is 2 inch W.G. positive or negative, depending on the application. Transfer ductwork minimum acceptable duct pressure class is 1 inch W.G. positive or negative, depending on the application. Duct system pressure classes not indicated on the drawings to be as follows:

Supply duct upstream of VAV boxes	_____ in. calc. S.P.	_____ in. pressure class
Supply duct downstream of VAV terminals	_____ in. calc. S.P.	_____ in. pressure class
Transfer ducts	_____ in. calc. S.P.	_____ in. pressure class
Exhaust ducts	_____ in. calc. S.P.	_____ in. pressure class
Return ducts	_____ in. calc. S.P.	_____ in. pressure class
Relief ducts	_____ in. calc. S.P.	_____ in. pressure class
Dust Collection Exhaust	_____ in. calc. S.P.	_____ in. pressure class
Other duct systems	_____ in. calc. S.P.	_____ in. pressure class

2.3 MATERIALS

- A. Galvanized Steel Sheet: Use ASTM A 653 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces per square foot, both sides of sheet, G90 in accordance with ASTM A90.
- B. Uncoated Black Steel Sheet: First quality, soft steel sheet capable of welding or double seaming without fracture.
- C. Aluminum Sheet: Use ANSI/ASTM B209 aluminum sheet, alloy 3003H-14, capable of double seaming without fracture.
- D. Stainless Steel Sheet: Use ASTM A167, Type 304 or 316 stainless steel sheet as specified, 316L if welded ductwork, with No. 2B finish for concealed work and No. 3 finish for exposed work.
- E. Polyvinylchloride Coated Steel Sheet: Use hot-dipped galvanized steel sheet with prime coat and a polyvinyl chloride film on both sides. Thickness of coating to be a minimum of 4 mils on each side. United Sheet Metal Uni-Coat, made by United McGill Co., may be used at contractor's option.
1. Where any duct surface is scratched, marred, or otherwise damaged, paint with PVC aerosol spray.
 2. All couplings shall be slip-joint construction with a minimum 2 inches insertion length. Seal all couplings with sealants as specified.
- F. PREFABRICATED GREASE DUCTS: Dual wall construction with stainless steel inner liner, insulation and stainless steel (for exposed locations) or aluminized steel (for concealed locations) shell. Furnish all items which form a part of the assembly, including, tee sections, straight sections, elbows, end caps, cleanouts, expansion joints, fan/hood transitions, supports, flashing, counter flashing, and insulated roof thimble where required. Each section shall bear the factory applied Underwriters Laboratories Label.

2.4 HIGH PRESSURE DUCTWORK (Pressure class 3 inch and over)

- A. Manufacturers: Ajax, Semco, United Sheet Metal, or approved equal.
- B. Machine formed round and/or flat oval spiral lock seam duct constructed of galvanized steel.
- C. Rectangular high pressure duct using a transverse joint system as manufactured by Ductmate, Nexus, TDC, TDF, or approved equal, may be used at contractor's option. Duct to be flanged, gasketed and sealed.
- D. Contractor fabricated ductwork meeting specified construction standards is acceptable with prior approval of Architect/Engineer. Submit construction details, a description of materials to be used, type of service, reinforcing methods, and sealing procedures.
- E. Use a perforated inner liner on double wall high-pressure duct. Annular space between inner liner and outer duct to be filled with 1 inch glass fiber insulation.
- F. Use cemented slip joints with 2 inch minimum overlap, flanged connections, or welded/brazed connections, unless noted otherwise for special applications. Prime coat welded joints.

- G. Provide standard 90 degree conical tee takeoffs except for exhaust at velocities over 2000 feet per minute, use 45° lateral connections; straight taps or bullhead tees are not acceptable.
 - H. Internal bracing will not be accepted on ductwork below 48 inches.
 - I. Use turning vanes as specified in Section 23 33 12.
 - J. Provide bellmouth fittings or expanded fittings at each duct connection to air plenums.
 - K. Provide pressure relief fittings as indicated on the plans and/or details.
 - L. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.
- 2.5 LOW PRESSURE DUCTWORK (Maximum 2 inch pressure class)
- A. Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as modified below.
 - B. Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if the screw does not extend more than 1/2 inch into the duct.
 - C. Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in accordance with SMACNA publications, Type RE 3. Where space will not allow and the C value of the radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes as specified in Section 23 33 00. Square throat-radius heel elbows will not be acceptable. Straight taps or bullhead tees are not acceptable.
 - D. Where rectangular elbows are used, provide turning vanes in accordance with Section 23 33 00.
 - E. Provide expanded take-offs or 45 degree entry fittings for branch duct connections with branch ductwork airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps will not be accepted.
 - F. Button punch snaplock construction will not be accepted on aluminum ductwork.
 - G. Round ducts may be substituted for rectangular ducts if sized in accordance with ASHRAE table of equivalent rectangular and round ducts, with approval of Engineer. No variation of duct configuration or sizes permitted except by written permission of the Architect/Engineer.
 - H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- 2.6 KITCHEN HOOD EXHAUST DUCT CONSTRUCTION
- A. In concealed locations use minimum 16 gauge black steel or minimum 18 gauge stainless steel with all joints welded liquid tight or prefabricated grease duct, Underwriters Laboratory, Inc listed with aluminized steel shell
 - B. **Note:** Factory prefabricated duct may still require a 2-hr fire rated enclosure or fire stop insulation where concealed and serving a Type I hood (grease vapors or smoke). As of the date of the updated version of this specification section, grease duct manufacturers do not have a product that is UL listed for grease vapor and smoke application.
 - C. In exposed areas, use 18 gauge or heavier stainless steel with a number 3 finish and with all joints welded liquid tight or prefabricated Underwriters Laboratory, Inc listed duct with stainless steel shell. Grind and polish all welded joints and seams to a number 3 finish.
 - D. Provide expanded take-offs for branch duct connections or 45 degree entry fittings. Square edge 90 degree take-off fittings or straight taps will not be accepted.
 - E. Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits shall be used wherever possible. Shorter radius elbows may be used in areas with limited space with prior approval of the Architect/Engineer.
 - F. No turning vanes may be used in kitchen exhaust duct.
 - G. Supporting steel and hangers shall not be lighter than the duct gauge.

2.7 DISHWASHER EXHAUST DUCT CONSTRUCTION

- A. Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as indicated below.
- B. Use 18 gauge or heavier stainless steel with all seams and joints welded and ground smooth. In exposed areas, joints and seams to be polished to a #3 finish (minimum).
- C. Use elbows and tees as specified for the appropriate duct pressure class.
- D. Provide expanded take-offs for branch duct connections or 45 degree entry fittings. Square edge 90 degree take-off fittings or straight taps will not be accepted.

2.8 FUME EXHAUST DUCT CONSTRUCTION

- A. Use PVC coated steel or stainless steel duct and fittings. Use stainless steel for all exposed installations below suspended ceilings.
- B. Use 316 stainless steel for flanged gasketed connections.
- C. Use 18 gauge or heavier 316L stainless steel sheet for externally welded ductwork. Grind and polish joints and seams to a #3 finish minimum.

2.9 DUCT SEALANT

- A. Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Hardcast Peal & Seal, Lockformer cold sealant, Mon-Eco Industries, United Sheet Metal, or approved equal. Silicone sealants are not allowed in any type of ductwork installation.
- B. Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.

2.10 GASKETS

- A. 2 inch pressure class and lower: Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.
- B. 3 inch pressure class and higher: Butyl gaskets.
- C. FUME HOOD EXHAUST; Butyl gaskets.

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 by Designer prior to fabrication.
- B. Take field measurements to verify duct routing and coordination with all trades prior to fabrication.
- C. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- D. Install round ducts in maximum practical lengths.
- E. Install ducts with fewest possible joints.
- F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of **1 inch**, plus allowance for insulation thickness.
- J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- K. 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**.
- L. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

- M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."
- 3.2 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT
 - A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
 - B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of **[20 feet] [12 feet] <Insert dimension>** in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of **1-1/2 inches** from bottom of duct.
 - C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.
- 3.3 SEAM AND JOINT SEALING
 - A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.
 - B. Seal Classes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements."
- 3.4 HANGER AND SUPPORT INSTALLATION
 - A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
 - B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than **4 inches** thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than **4 inches** thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
 - C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 4-1**, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within **24 inches** of each elbow and within **48 inches** of each branch intersection.
 - D. Hangers Exposed to View: Threaded rod and angle or channel supports.
 - E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of **16 feet**.
 - F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- 3.5 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."
 - 1. Space lateral supports a maximum of **[40 feet] <Insert dimension>** o.c., and longitudinal supports a maximum of **[80 feet] <Insert dimension>** o.c.
 - 2. Brace a change of direction longer than **12 feet**.
 - 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.
- 3.6 CONNECTIONS
 - A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
 - B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.
- 3.7 DUCT SCHEDULE
 - A. Fabricate ducts with galvanized sheet steel except as follows:
 - 1. Commercial Kitchen Hood Exhaust Ducts: Comply with NFPA 96.
 - a. Exposed to View: Type 304, stainless-steel sheet, **[No. 4] [No. 3] <Insert finish> finish.**
 - b. Concealed: **[Type 304, stainless-steel sheet, No. 2D finish] [Carbon-steel sheet].**
 - c. Welded seams and joints.
 - 2. Dishwasher Hood Exhaust Ducts:
 - a. Type 304, stainless-steel sheet.
 - b. Exposed to View: **[No. 4] [No. 3] <Insert finish> finish.**
 - c. Concealed: **[No. 2D] <Insert finish> finish.**
 - d. Welded seams and flanged joints with watertight EPDM gaskets.
 - 3. Moist Environment Ducts: Aluminum.
 - B. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
 - 2. Stainless-Steel Ducts: Galvanized steel.
 - 3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.
 - C. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity **1000 fpm** or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity **1000 to 1500 fpm**:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity **1500 fpm** or Higher:

- 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity **1000 fpm** 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.
 - b. Round Elbows, [**12 Inches**] <Insert dimension> and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, [**14 Inches**] <Insert dimension> and Larger in Diameter: **[Standing seam] [Welded]**.
 - D. Branch Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity **1000 fpm** 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 233113

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

1.2 SUBMITTALS

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

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 and smoke-damper installations, including sleeves; and duct-mounted access doors.
 - e. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MANUAL VOLUME DAMPERS

A. Manufacturers: Ruskin, Vent Products, Air Balance, or approved equal.

B. Dampers must be constructed in accordance with SMACNA Fig. 2-12, Fig. 2-13, and notes relating to these figures, except as modified below.

C. Reinforce all blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections with mullions where width is over 48 inches. Use rivets or tack welds to secure individual components; sheet metal screws will not be accepted. Provide operators with locking devices and damper position indicators for each damper; use an elevated platform on insulated ducts. Provide end bearings or bushings for all volume damper rods penetrating ductwork constructed to a 3" w.c. pressure class or above.

2.2 TURNING VANES

A. Manufacturers: Aero Dyne, Anemostat, Barber-Colman, Hart & Cooley, or approved equal.

B. Construct turning vanes and runners for square elbows in accordance with SMACNA Fig. 2-3 and Fig. 2-4 except use only airfoil type vanes. Construct turning vanes for short radius elbows and elbows where one dimension changes in the turn in accordance with SMACNA Fig. 2-5 and Fig. 2-6.

2.3 FIRE DAMPERS

A. Manufacturers: Air Balance, Advanced Air, American Warming and Ventilating, Greenheck, Phillips-Aire, Prefco, Ruskin, Safe-Air or approved equal.

B. STATIC FIRE DAMPERS

1. Static fire damper assemblies must be UL 555 (6th edition) listed and labeled for static applications (where air systems do not operate during a fire) and meet requirements of NFPA 90A. Damper must be type B curtain type with blades out of

the air stream; dampers with blades in the air stream will not be accepted. Damper fire rating to be compatible with the rating of the building assembly in which the damper is used.

C. DYNAMIC FIRE DAMPERS

1. Dynamic fire damper assemblies must be UL 555 (6th edition) listed and labeled for dynamic applications (where air systems operate during a fire) and meet requirements of NFPA 90A. Dampers must be type B curtain type with curtain 100% out of air stream. Dampers larger than 30" by 30" or with velocity rating requirements of 3000 fpm or higher, may be multiblade type with blades located in the airstream. Velocity ratings and static pressure ratings as indicated on the drawings. Damper fire rating to be compatible with the rating of the building assembly in which the damper is used.

2.4 SMOKE DAMPERS AND COMBINATION FIRE/SMOKE DAMPERS

- A. Manufacturers: Ruskin, Johnson Controls, Air Balance, Advanced Air, American Warming and Ventilating, Greenheck, Safe-Air, Phillips-Aire, Prefco, or approved equal.
- B. Smoke damper assemblies to be UL 555S(4th edition) listed and labeled, and leakage rated at no higher than Class II under UL 555S(4th edition). Unless ratings are indicated elsewhere, dampers should be rated for minimum 2,000 fpm air velocity and 4" static pressure.
- C. Combination fire/smoke damper assemblies to be UL 555(6th edition) and UL 555S(4th edition) listed and labeled, and have a fire rating compatible with the rating of the building assembly in which the damper is used, and be leakage rated at no higher than Class II under UL 555S.
- D. Provide factory installed **[pneumatically] [electrically]** operated dampers with linkage arranged so that the damper is closed on loss of **[pneumatic air pressure] [power]**. For electric actuation, provide electric operated dampers with linkage and UL listed operators arranged so that the damper is closed on a loss of power. Where electric actuation is controlled by the DDC system use 0-10 VDC inputs, with stall protection, and with and zero and span adjustments for modulating or 24 VAC for two-position control. All electric actuators will be provided with overload protection to prevent motor from damage when stall condition is encountered. Locate all operators out of the air stream unless large damper size will not allow. Provide form "C" end switches to indicate damper position.
- E. Use airfoil shaped damper blades on the following system: **<List systems where normal duct velocity is 2000 fpm or greater>**

2.5 ACCESS DOORS

- A. Access door to be designed and constructed for the pressure class of the duct in which the door is to be installed. Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be steel full length continuous piano type. Doors in concealed spaces may be secured in place with cam sash latches. For both hinged and non hinged doors provide sufficient number of cam sash latches to provide air tight seal when door is closed. Do not use hinged doors in concealed spaces if this will restrict access. Use minimum 1" deep 24 gauge galvanized steel double wall access doors with minimum 24 gauge galvanized steel frames. For non-galvanized ductwork, use minimum 1" deep double wall access door with frame that shall use materials of construction identical to adjacent ductwork. Provide double neoprene gasket that shall provide seals from the frame to the door and frame to the duct. When access doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment. Access doors constructed with sheet metal screw fasteners will not be accepted.
- B. Use insulated, 1-1/2 hour UL 555 listed and labeled access doors in kitchen exhaust ducts.

2.6 FLEXIBLE DUCT

- A. Manufacturers: Anco Products, Clevaflex, Thermaflex, Flexmaster or approved equal.
- B. Factory fabricated, UL 181 listed as a class 1 duct, and having a flame spread of 25 or less and a smoke developed rating of 50 or under in accordance with NFPA 90A.
- C. Suitable for pressures and temperatures involved but not less than a 180°F service temperature and ±2 inch pressure class, depending on the application.

- D. Duct to be composed of polyester film, aluminum laminate or woven and coated fiberglass fabric bonded permanently to corrosion resistant coated steel wire helix. Two-ply, laminated, and corrugated aluminum construction may also be used.
 - E. Where duct is specified to be insulated, provide a minimum 1 inch fiberglass insulation blanket with maximum thermal conductance of 0.23 K (75 degrees F.) and vapor barrier jacket of polyethylene or metalized reinforced film laminate. Maximum perm rating of vapor barrier jacket to be 0.1 perm.
- 2.7 DUCT LINING
- A. Manufacturer: Manville, Owens-Corning, Knauf, or approved equal.
 - B. 1 inch thick, flexible, mat faced insulation made from inorganic glass fibers bonded with a thermosetting resin with thermal conductivity of .25 Btu inch / hour sq.ft. deg F.
 - C. Meet erosion testing per UL 181 or ASTM C 1071 for 5000 fpm maximum air velocity. ASTM C 411 maximum operating temperature rating of 250 deg F. ASTM E84 flame spread less than 25 and smoke developed less than 50.
 - D. Meet requirements of ASTM C 1338 and ASTM G21 for fungi resistance.
 - E. Install liner using adhesive conforming to ASTM C 916.
- 2.8 DUCT FLEXIBLE CONNECTIONS
- A. Material to be fire retardant, be UL 214 listed, and meet the requirements of NFPA 90A.
 - B. Connections to be a minimum of 3 inches wide, crimped into metal edging strip, and air tight. Connections to have adequate flexibility and width to allow for thermal expansion/contraction, vibration of connected equipment, and other movement.
 - C. Use coated glass fiber fabric for all applications. Material for inside applications other than corrosive environments, fume exhaust, or kitchen exhaust to be double coated with neoprene, air and water tight, suitable for temperatures between -10°F and 200°F, and have a nominal weight of 30 ounces per square yard. Material used for outdoor applications other than corrosive environments, fume exhaust, or kitchen exhaust to be double coated with Hypalon, air and water tight, suitable for temperatures between -10°F and 250°F, and have a nominal weight of 26 ounces per square yard.
 - D. For corrosive environments or fume exhaust applications indoors or outdoors, use a material coated with Teflon that is air and water tight, suitable for temperatures between -20°F and 500°F, and has a nominal weight of 14 ounces per square yard.
- 2.9 SOUND ATTENUATORS
- A. Manufacturers: Industrial Acoustics Company, Environmental Elements Corporation, Semco, Dynasonics, United McGill, Rink, or approved equal.
 - B. Construct of a 22 gauge galvanized steel outer casing, and 26 gauge galvanized, perforated steel inner liner. Seams and joints of outer casing to be air tight.
 - C. Fill annular space between outer casing and inner liner with acoustic fill that is inert, inorganic, and of a density sufficient to obtain the specified acoustic performance. Material must meet requirements of NFPA 90A with a flame spread index of 25 or less and smoke developed rating of 50 or less.
 - D. Acoustical and aerodynamic performance is indicated on schedules on the drawings.
- 2.10 HOODS FOR INTAKE AND EXHAUST
- A. Manufacturers: Acme, Ammerman, Carnes, Cook, Greenheck, Louvers and Dampers, Penn, or approved equal.
 - B. Use low silhouette type hoods or louvered penthouse type hoods with drainable blade louvers, as shown on drawings.
 - C. Construct hoods of aluminum (mill finish) or galvanized steel with a baked enamel finish; color to be selected by the Architect during the submittal stage.
 - D. For hoods and louvered penthouses maintain minimum 30 inches from bottom of air intake to finished roof.
 - E. Provide accessories as shown on drawings.
- 2.11 DUCT ACCESSORY HARDWARE
- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Downstream from manual volume dampers, control dampers, and equipment.
 - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 4. At each change in direction and at maximum 50-foot spacing.
 - 5. Upstream of turning vanes.
 - 6. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 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.
- K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- O. Connect diffusers or light troffer boots to low-pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- P. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- Q. Install duct test holes where required for testing and balancing purposes.
- 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.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire 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.

END OF SECTION 233300

PART 1 - GENERAL**1.1 SUMMARY**

- A. This Section includes
 - 1. Centrifugal Fans
 - 2. Utility Sets
 - 3. In-line Centrifugal Fans
 - 4. Vaneaxial Fans
 - 5. Cabinet Fans
 - 6. Power Roof Exhaust Fans
 - 7. Sidewall Centrifugal Fans
 - 8. Sidewall Propeller Fans
 - 9. Ceiling Exhaust Fans
 - 10. Ceiling Destratification Fans

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated.
- 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.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

1.4 DESIGN CRITERIA

- A. Test and certify all fans in accordance with the applicable AMCA test code.
- B. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.
- C. Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.
- D. Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, provide any motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to prevent uneven airflow or improve mixing.
- E. All internal insulation and other components exposed to the airstream are to meet the flame spread and smoke ratings contained in NFPA 90A.
- F. All roof mounted equipment to be provided with curbs or equipment stands in accordance with specifications.

PART 2 - PRODUCTS**2.1 GENERAL**

- A. Use fan size, class, type, arrangement, and capacity as scheduled.
- B. Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices, and accessories required for specified performance and proper operation. All single phase motors to have inherent thermal overload protection.
- C. Provide variable pitch sheaves for drives 3 hp and smaller, fixed pitch sheaves for drives 5 hp and larger. Design all drives for 150% of motor rating.
- D. Use OSHA approved belt guards that totally enclose the entire drive. Construct guards of expanded metal to allow for ventilation; provide tachometer openings at shaft locations.
- E. Statically and dynamically balance all fans so they operate without objectionable noise or vibration.
- F. Use AMCA Type A spark resistant construction for all fans handling flammable or grease laden vapors.

- G. Provide a corrosion resistant coating on all surfaces exposed to fume and other corrosive exhaust air. Coating to be as scheduled.
- 2.2 CENTRIFUGAL FANS
- A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Barry, Peerless, Buffalo, Carrier, Champion, Chicago Blower, Greenheck, New York Blower, Trane, Twin City, Cook.
 - B. Construct housing of welded steel with angle iron frame. Use spun or die formed inlet cones to provide a streamlined flow into the wheel. Use airfoil blades welded to spun wheel cones unless otherwise indicated. Bearings to be self-aligning grease packed pillow block type with grease seal and external grease fittings. Provide each fan housing with a capped drain connection and bolted and gasketed access door for inspection of fan wheel.
 - C. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation; apply a second coat of paint to all exterior surfaces.
 - D. Note that welded construction is specified, not lockseam construction.
 - E. Provide variable inlet vanes with bearing grease fittings extended to an accessible location for fans as scheduled.
 - F. Provide one inch galvanized mesh inlet screens for fans without inlet ductwork.
- 2.3 UTILITY SETS
- A. Basis of Design Product: As shown on Drawings. Equivalent Products by: ACME, Barry, Champion, Chicago Blower, Cook, Greenheck, New York Blower, Pace, Peerless, Trane, Twin City, or approved equal.
 - B. Construct housing of welded or lockseam fabricated steel with reinforcing to prevent housing distortion. Design motor supports to hold motor in place and provide drive adjustment. Bearings to be grease lubricated, self-aligning ball bearing type with grease seal. Provide each fan housing with a capped drain connection and bolted and gasketed access door for inspection of fan wheel. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.
 - C. Provide weather covers and weather-resistant enamel finish for fans installed outdoors.
 - D. Provide variable inlet vanes with bearing grease fittings extended to an accessible location for fans as scheduled.
 - E. Provide one inch galvanized mesh inlet screens for fans without inlet ductwork.
- 2.4 IN-LINE CENTRIFUGAL FANS
- A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Acme, Barry, Cook, Greenheck, New York Blower, Peerless, Penn, Twin City, or approved equal.
 - B. Construct housing of welded steel with reinforcing to prevent distortion.
 - C. Furnish with streamlined inlet cones and multiple straightening vanes following the fan wheel to minimize noise and reduce turbulence.
 - D. Provide each housing with a bolted and gasketed access door for inspection of drive and fan wheel.
 - E. Use non-overloading airfoil blade fans welded to the wheel cones.
 - F. Isolate belt drives from airstream with a belt tube.
 - G. Externally mount motors on an adjustable base.
 - H. Bearings to be grease lubricated, self-aligning ball bearing type with grease seal and external grease fitting.
 - I. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.
 - J. Design all vertically mounted fans to withstand the vertical thrust loads.
 - K. Provide variable inlet vanes for fans as scheduled. Vane bearings shall have grease fittings extended to an accessible location.
 - L. Provide one inch galvanized mesh inlet screens for fans without inlet ductwork.
- 2.5 VANEAXIAL FANS - CONTROLLABLE IN MOTION
- A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Buffalo, Joy, Woods, or approved equal.
 - B. Construct housing of welded steel with reinforcing to prevent housing distortion.
 - C. Use cast aluminum airfoil wheel blades and hub.

- D. Provide straightening vanes downstream of fan wheel to redirect air flow, minimize noise, and reduce turbulence.
 - E. Provide each housing with a bolted and gasketed access door for inspection of drive assembly and fan wheel.
 - F. Bearings to be grease lubricated, self-aligning pillow block ball bearing type with grease seal and grease fitting extended to the exterior of the fan casing.
 - G. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.
 - H. For controllable pitch fans, furnish a pneumatic actuator and a pilot positioner factory mounted, adjusted, and tested in factory. Design actuator and linkage assembly to position vanes uniformly so the fan is unloaded on loss of control air.
 - I. For belt drive units, provide a belt tube to isolate drives from the airstream. Externally mount motors on an adjustable base.
 - J. For direct drive units, use totally enclosed air-over motors with not less than Class B insulation. Extend any bearing lubrication points to the outside of the fan casing.
 - K. Design all vertically mounted fans to withstand static and vertical thrust loads for the application as indicated on the plans.
 - L. Provide accessories as shown on drawings.
- 2.6 VANEAXIAL FANS - MANUALLY ADJUSTABLE PITCH
- A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Barry, Buffalo, Chicago Blower, Greenheck, Joy, New York Blower, Woods, or approved equal.
 - B. Construct housing of welded steel with reinforcing to prevent housing distortion.
 - C. Use cast aluminum airfoil wheel blades and hub.
 - D. Provide straightening vanes downstream of fan wheel to redirect air flow, minimize noise, and reduce turbulence.
 - E. Provide each housing with a bolted and gasketed access door for inspection of drive assembly and fan wheel.
 - F. Bearings to be grease lubricated, self-aligning pillow block ball bearing type with grease seal and grease fitting extended to the exterior of the fan casing.
 - G. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.
 - H. Manually adjustable blades to be secured to hub by means of bolts. Design connection to allow for field adjustment of the blade positions and a means to verify that all blades are in the same position.
 - I. For belt drive units, provide a belt tube to isolate drives from the airstream. Externally mount motors on an adjustable base.
 - J. For direct drive units, use totally enclosed air-over motors with not less than Class B insulation. Extend any bearing lubrication points to the outside of the fan casing.
 - K. Design all vertically mounted fans to withstand static and vertical thrust loads for the application as indicated on the plans.
 - L. Provide accessories as shown on drawings.
- 2.7 CABINET FANS
- A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Buffalo, Carrier, McQuay, Trane, York, or approved equal.
 - B. Use double width, double inlet airfoil centrifugal fans unless scheduled otherwise.
 - C. Construct air tight casing and frame of galvanized or rust inhibited prime coated steel with removable panels to allow access to internal parts.
 - D. Thermally insulate casing with not less than one inch of glass fiber or other closed cell insulation secured to the casing with waterproof adhesive and/or stic clips; coat the exposed surface to minimize erosion.
 - E. Bearings to be self-aligning grease packed pillow block type with grease seal; they may be mounted internally or externally but internally mounted bearings must be provided with extended grease lines to a point outside the unit.
 - F. Provide filter section or a filter rack within fan cabinet suitable for installation of panel filters as scheduled or specified.

- G. Provide variable inlet vanes with bearing grease fittings extended to an accessible location for fans as scheduled.
- 2.8 POWER ROOF EXHAUST FANS
- A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Carnes, Greenheck, Penn, Jenn-Air, Cook, ACME, or approved equal.
 - B. Provide upblast or downblast units, as scheduled, with aluminum housing, non-overloading type centrifugal wheel, inlet cone, factory mounted and wired motor and disconnect switch, and bird screen.
 - C. Upblast units to have motor, bearings, and drives completely enclosed and isolated from the exhaust air stream with ventilation provided by outside air.
 - D. Units handling grease laden vapors to be U.L. listed for conveying such vapors, operating continuously at 300 degrees F.
- 2.9 SIDEWALL CENTRIFUGAL FANS
- A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Carnes, Greenheck, Cook, Jenn-Air, ACME, Penn, or approved equal.
 - B. Dome type with spun aluminum housing, non-overloading centrifugal wheel, factory mounted and wired motor and disconnect switch housed in a separate ventilated compartment, belt or direct drive as scheduled, accessories as scheduled.
- 2.10 SIDEWALL PROPELLER FANS
- 2.11 Basis of Design Product: As shown on Drawings. Equivalent Products by: Greenheck, Penn, ACME, Cook.
- A. Constructed of steel with angle iron reinforcing and motor support frame, die formed propeller blades with a welded reinforcing gusset on the backside for added rigidity, belt or direct drive as scheduled.
 - B. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation; apply a second coat of paint to all exterior surfaces.
 - C. Provide factory fabricated wall sleeves.
 - D. Provide accessories as scheduled.
- 2.12 CEILING EXHAUST FANS
- A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Carnes, Greenheck, Penn, Jenn-Air, Cook, ACME.
 - B. Centrifugal blower wheel, steel housing with acoustical lining, integral exhaust grille, adjustable mounting brackets to allow for any ceiling thickness, permanently lubricated motor, integral junction box with permanently lubricated and thermally protected motor factory wired.
 - C. Provide wall, eave, or roof discharge assembly, as indicated on the drawings.
 - D. Provide accessories as scheduled.
- 2.13 DESTRATIFICATION FANS
- A. Basis of Design Product: As shown on Drawings. Equivalent Products by: Emerson-Chromalox, Envirofan, Hunter.
 - B. U.L. listed, all metal construction, baked enamel finish with factory standard color selected by Architect. Motors to be totally enclosed, impedance protected, single speed, of split capacitor design with permanently lubricated ball bearings.
 - C. Provide solid state variable speed controls as scheduled.
 - D. Motors to be reversible for summer/winter operation.
- PART 3 - EXECUTION
- 3.1 INSTALLATION
- A. Install centrifugal fans level and plumb.
 - B. Support floor-mounting units using restrained spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
 - C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

- D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
 - E. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of **1 inch**. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - F. Install units with clearances for service and maintenance.
 - G. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- 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. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
 - B. Install ducts adjacent to fans to allow service and maintenance.
 - C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.
 - D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- 3.3 FIELD QUALITY CONTROL
- A. Perform the following field tests and inspections and prepare test reports:
 - 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. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
 - 10. Remove and replace malfunctioning units and retest as specified above.
 - B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 233416

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round ceiling diffusers.
2. Rectangular and square ceiling diffusers.
3. Louver face diffusers.
4. Linear bar diffusers.
5. Linear slot diffusers.
6. Adjustable bar registers and grilles.
7. Fixed face registers and grilles.
8. Linear bar grilles.

B. Related Sections:

1. Division 23 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to 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, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified, if requested.

PART 2 - PRODUCTS

2.1 GENERAL: Basis of Design and Comparable Products as shown on Drawings.

2.2 CEILING DIFFUSERS

A. Round Ceiling Diffuser:

1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel or Aluminum.
3. Finish: Baked enamel, white.
4. Face Style: Three cone.
5. Mounting: Duct connection.
6. Pattern: Fixed.
7. Dampers: Radial opposed blade.

B. Rectangular and Square Ceiling Diffusers:

1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel or Aluminum.
3. Finish: Baked enamel, white **<Insert finish>**.
4. Face Size: As shown on Drawings.
5. Face Style: Three cone.
6. Mounting: As required by ceiling type. Refer to Reflected Ceiling Plans.
7. Pattern: Fixed.
8. Dampers: Radial opposed blade.

C. Louver Face Diffuser:

1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Steel or Aluminum.
3. Finish: Baked enamel, white **<Insert finish>**.
4. Face Size: As shown on Drawings.
5. Mounting: As required by ceiling type. Refer to Reflected Ceiling Plans.
6. Pattern: Four-way core style.
7. Dampers: Radial opposed blade.
8. Accessories:
 - a. Square to round neck adaptor.

2.3 CEILING LINEAR SLOT OUTLETS

A. Linear Bar Diffuser:

1. Devices shall be specifically designed for variable-air-volume flows.
 2. Material: Steel or Aluminum.
 3. Finish: Baked enamel, white.
 4. Core Design – See Grille / Diffuser Schedule.
 5. Two-Way Deflection Vanes: Extruded construction fixed louvers with removable core.
 6. Frame: See Grille / Diffuser Schedule
 7. Mounting Frame: See Grille / Diffuser Schedule.
 8. Mounting: See Grille / Diffuser Schedule.
 9. Damper Type: Adjustable opposed-blade assembly.
 10. Accessories: See Grille / Diffuser Schedule.
- B. Linear Slot Diffuser:
1. Devices shall be specifically designed for variable-air-volume flows.
 2. Material - Shell: Steel or Aluminum, insulated.
 3. Material - Pattern Controller and Tees: Aluminum.
 4. Finish - Face and Shell: Baked enamel, black.
 5. Finish - Pattern Controller: Baked enamel, black.
 6. Finish - Tees: Baked enamel, white.
 7. Slot Width: See Grille / Diffuser Schedule.
 8. Number of Slots: See Grille / Diffuser Schedule.
 9. Length: See Grille / Diffuser Schedule.
 10. Accessories: See Grille / Diffuser Schedule.
- 2.4 REGISTERS AND GRILLES
- A. Adjustable Bar Register:
1. Material: Steel or Aluminum.
 2. Finish: Baked enamel, white.
 3. Face Blade Arrangement: See Grille / Diffuser Schedule.
 4. Core Construction: Integral.
 5. Rear-Blade Arrangement: See Grille / Diffuser Schedule
 6. Frame: See Grille / Diffuser Schedule.
 7. Mounting Frame: See Grille / Diffuser Schedule.
 8. Mounting: See Grille / Diffuser Schedule.
 9. Damper Type: Adjustable opposed blade.
 10. Accessories:
 - a. See Grille / Diffuser Schedule.
- B. Adjustable Bar Grille:
1. Material: Steel or Aluminum.
 2. Finish: Baked enamel, white.
 3. Face Blade Arrangement: See Grille / Diffuser Schedule.
 4. Core Construction: Integral.
 5. Rear-Blade Arrangement: See Grille / Diffuser Schedule
 6. Frame: See Grille / Diffuser Schedule.
 7. Mounting Frame: See Grille / Diffuser Schedule.
 8. Mounting: See Grille / Diffuser Schedule.
 9. Damper Type: Adjustable opposed blade.
 10. Accessories:
 - a. See Grille / Diffuser Schedule.
- C. Fixed Face Register **<Insert drawing designation>**:
1. Material: Steel or Aluminum.
 2. Finish: Baked enamel, white.
 3. Face Blade Arrangement: See Grille / Diffuser Schedule.
 4. Core Construction: Integral.
 5. Rear-Blade Arrangement: See Grille / Diffuser Schedule
 6. Frame: See Grille / Diffuser Schedule.
 7. Mounting Frame: See Grille / Diffuser Schedule.
 8. Mounting: See Grille / Diffuser Schedule.

- 9. Damper Type: Adjustable opposed blade.
- 10. Accessories:
 - a. See Grille / Diffuser Schedule.
- D. Fixed Face Grille:
 - 1. Material: Steel or Aluminum.
 - 2. Finish: Baked enamel, white.
 - 3. Face Blade Arrangement: See Grille / Diffuser Schedule.
 - 4. Core Construction: Integral.
 - 5. Rear-Blade Arrangement: See Grille / Diffuser Schedule
 - 6. Frame: See Grille / Diffuser Schedule.
 - 7. Mounting Frame: See Grille / Diffuser Schedule.
 - 8. Mounting: See Grille / Diffuser Schedule.
 - 9. Damper Type: Adjustable opposed blade.
 - 10. Accessories:
 - a. See Grille / Diffuser Schedule.
- E. Linear Bar Grille:
 - 1. Material: Steel or Aluminum.
 - 2. Finish: Baked enamel, white.
 - 3. Face Blade Arrangement: See Grille / Diffuser Schedule.
 - 4. Core Construction: Integral.
 - 5. Rear-Blade Arrangement: See Grille / Diffuser Schedule
 - 6. Frame: See Grille / Diffuser Schedule.
 - 7. Mounting Frame: See Grille / Diffuser Schedule.
 - 8. Mounting: See Grille / Diffuser Schedule.
 - 9. Damper Type: Adjustable opposed blade.
 - 10. Accessories:
 - a. See Grille / Diffuser Schedule.
- 2.5 SOURCE QUALITY CONTROL
 - A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- PART 3 - EXECUTION
- 3.1 INSTALLATION
 - A. Install diffusers, registers, and grilles level and plumb.
 - B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Designer for a determination of final location.
 - C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- 3.2 ADJUSTING
 - A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.
- END OF SECTION 233713

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cabinet unit heaters with centrifugal fans and **[hot-water] [electric-resistance heating]** coils.
2. Propeller unit heaters with **[hot-water] [electric-resistance heating]** coils.
3. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- 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. Plans, elevations, sections, and details.
 2. Location and size of each field connection.
 3. Equipment schedules to include rated capacities, furnished specialties, and accessories.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Airtherm; a Mestek Company.
 2. Berko Electric Heating; a division of Marley Engineered Products.
 3. Carrier Corporation.
 4. Chromalox, Inc.; a division of Emerson Electric Company.
 5. Dunham-Bush, Inc.
 6. Engineered Air Ltd.
 7. Indeeco.
 8. International Environmental Corporation.
 9. Markel Products; a division of TPI Corporation.
 10. Marley Electric Heating; a division of Marley Engineered Products.
 11. McQuay International.
 12. Ouellet Canada Inc.
 13. QMark Electric Heating; a division of Marley Engineered Products.
 14. Rosemex Products.
 15. Trane.
 16. USA Coil & Air.
- B. Description: A factory-assembled and -tested unit complying with ARI 440.
 1. Comply with UL 2021.
- C. Coil Section Insulation: Glass-fiber insulation; surfaces exposed to airstream shall be **[aluminum-foil facing] [erosion-resistant coating]** to prevent erosion of glass fibers.
 1. Thickness: **[1/2 inch] [1 inch] [1-1/2 inches]**.
 2. Thermal Conductivity (k-Value): **0.26 Btu x in./h x sq. ft. at 75 deg F** mean temperature.
 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
- D. Cabinet: Steel with **[factory prime coating, ready for field painting] [baked-enamel finish with manufacturer's standard paint, in color selected by Architect] [baked-enamel finish with manufacturer's custom paint, in color selected by Architect]**.

1. Vertical Unit, Exposed Front Panels: Minimum **[0.0528-inch-]** **[0.0677-inch-]** thick, **[galvanized,]** sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
2. Horizontal Unit, Exposed Bottom Panels: Minimum **[0.0528-inch-]** **[0.0677-inch-]** thick, **[galvanized,]** sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
3. Recessing Flanges: Steel, finished to match cabinet.
4. Control Access Door: Key operated.
5. Base: Minimum **0.0528-inch-** thick steel, finished to match cabinet, **[4 inches]** **[6 inches]** **<Insert dimension>** high with leveling bolts.
6. Extended Piping Compartment: **[8-inch-]** **<Insert dimension>** wide piping end pocket.
7. False Back: Minimum **0.0428-inch-** thick steel, finished to match cabinet.
- E. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 1. Washable Foam: 70 percent arrestance and 3 MERV.
 2. Glass Fiber Treated with Adhesive: 80 percent arrestance and 5 MERV.
 3. Pleated: 90 percent arrestance and 7 MERV.
- F. Hot-Water Coil: 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.
- G. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
- H. Fan and Motor Board: Removable.
 1. Fan: Forward curved, **[high static,]** double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- I. Factory, Hot-Water Piping Package: **[ASTM B 88, Type L]** **[ASTM B 88, Type M]** copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet and outlet.
 1. Hose Kits: Minimum **400-psig** working pressure, and operating temperatures from **33 to 211 deg F**. Tag hose kits to equipment designations.
 - a. Length: **[24 inches]** **[36 inches]** **<Insert dimension>**.
 - b. Minimum Diameter: Equal to cabinet unit heater connection size.
 2. Two-Piece, Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and **600-psig** minimum CWP rating and blowout-proof stem.
 3. Calibrated-Orifice Balancing Valves: Bronze body, ball type, **125-psig** working pressure, **250 deg F** maximum operating temperature; with calibrated orifice or venture, connection for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
 4. Y-Pattern, Hot-Water Strainers: Cast-iron body (ASTM A 126, Class B); **125-psig** minimum working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum **NPS 1/2** threaded pipe and full-port ball valve in strainer drain connection.
 5. Wrought-Copper Unions: ASME B16.22.
- J. Control devices and operational sequences are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."
- K. Basic Unit Controls:
 1. Control voltage transformer.

2. **[Wall-mounting] [Unit-mounted]** thermostat with the following features.
 - a. Heat-off switch.
 - b. Fan on-auto switch.
 - c. Manual fan speed switch.
 - d. Adjustable deadband.
 - e. **[Concealed] [Exposed]** set point.
 - f. **[Concealed] [Exposed]** indication.
 - g. **Deg F** indication.
 3. **[Wall-mounting] [Unit-mounted]** temperature sensor.
 4. Unoccupied period override push button.
 5. Data entry and access port.
 - a. Input data includes room temperature, and occupied and unoccupied periods.
 - b. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.
 - L. **[DDC]** Terminal Controller:
 1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
 2. Unoccupied Period Override: **[Two]** **<Insert number>** hours.
 3. Unit Supply-Air Fan Operations:
 - a. Occupied Periods: Fan runs continuously.
 - b. Unoccupied Periods: Fan cycles to maintain setback room temperature.
 4. Heating Coil Operations:
 - a. Occupied Periods: **[Open control valve] [Modulate control valve] [Energize electric-resistance coil]** to provide heating if room temperature falls below thermostat set point.
 - b. Unoccupied Periods: Start fan and **[open control valve] [modulate control valve] [energize electric-resistance coil]** if room temperature falls below setback temperature.
 5. Controller shall have volatile-memory backup.
 - M. Electrical Connection: Factory wire motors and controls for a single field connection.
 - N. Capacities and Characteristics: As shown on Drawings.
- 2.2 PROPELLER UNIT HEATERS
- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Airtherm; a Mestek Company.
 2. Engineered Air Ltd.
 3. McQuay International.
 4. Rosemex Products.
 5. Ruffneck Heaters; a division of Lexa Corporation.
 6. Trane.
 - B. Description: An assembly including casing, coil, fan, and motor in **[vertical] [and] [horizontal]** discharge configuration with adjustable discharge louvers.
 - C. Comply with UL 2021.
 - D. Cabinet: Removable panels for maintenance access to controls.
 - E. Cabinet Finish: Manufacturer's **[standard] [custom]** baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
 - F. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.
 - G. Hot-Water Coil: Test and rate hot-water propeller unit heater coils according to ASHRAE 33. Copper tube, minimum **0.025-inch** wall thickness, 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 **325 deg F**, with manual air vent. Test for leaks to **350 psig** underwater.
 - H. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than **0.16 inch**. Element ends shall

be enclosed in terminal box. Fin surface temperature shall not exceed **550 deg F** at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
 2. Wiring Terminations: Stainless-steel or corrosion-resistant material.
 - I. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
 - J. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 1. Motor Type: Permanently lubricated.
 - K. Control Devices: **[Unit-mounted] [Wall-mounting]** thermostat.
 - L. Capacities and Characteristics: As shown on Drawings.
- 2.3 WALL AND CEILING HEATERS
- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Berko Electric Heating; a division of Marley Engineered Products.
 2. Chromalox, Inc.; a division of Emerson Electric Company.
 3. Indeeco.
 4. Markel Products; a division of TPI Corporation.
 5. Marley Electric Heating; a division of Marley Engineered Products.
 6. Ouellet Canada Inc.
 7. QMark Electric Heating; a division of Marley Engineered Products.
 8. Trane.
 - B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
 - C. Cabinet:
 1. Front Panel: **[Stamped-steel louver] [Extruded-aluminum bar grille]**, with removable panels fastened with tamperproof fasteners.
 2. Finish: Baked enamel over baked-on primer with manufacturer's **[standard] [custom]** color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
 - D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.
 - E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. **[Provide integral circuit breaker for overcurrent protection.]**
 - F. Fan: Aluminum propeller directly connected to motor.
 1. Motor: Permanently lubricated, **[multispeed]**. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - G. Controls: Unit-mounted thermostat. **[Low-voltage relay with transformer kit.]**
 - H. Electrical Connection: Factory wire motors and controls for a single field connection **[with disconnect switch]**.
 - I. Capacities and Characteristics: As shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install unit heaters to comply with NFPA 90A.
- B. Suspend cabinet unit heaters from structure with elastomeric hangers **[and seismic restraints]**. Vibration isolators **[and seismic restraints]** are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Suspend propeller unit heaters from structure with all-thread hanger rods and **[elastomeric hangers] [spring hangers] [spring hangers with vertical-limit stop]**. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

- D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
 - E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater.
 - F. Install new filters in each fan-coil unit within two weeks of Substantial Completion.
 - G. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - H. Install piping adjacent to machine to allow service and maintenance.
 - I. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
 - J. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
 - K. Comply with safety requirements in UL 1995.
 - L. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - M. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- 3.2 FIELD QUALITY CONTROL
- A. 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 motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - B. Remove and replace malfunctioning units and retest as specified above.
- END OF SECTION 238239

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed, **[extruded-aluminum]** **[and]** **[formed-metal]** louvers.
2. Wall vents (brick vents).

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural **[and seismic]** performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.
 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
 2. Wind Loads: Determine loads based on a uniform pressure of **[20 lbf/sq. ft.]** **[30 lbf/sq. ft.]** **<Insert design wind pressure>**, acting inward or outward.
- C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to **[SEI/ASCE 7]** **<Insert requirement>**.
 1. Design earthquake spectral response acceleration, short period (Sds) for Project is **<Insert value>**.
 2. Component Importance Factor is **[1.5]** **[1.0]**.
- D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
- C. Samples: For each type of metal finish required.
- D. Delegated-Design Submittal: For louvers indicated to comply with structural **[and seismic]** performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Test Reports: Based on tests performed according to AMCA 500-L.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: **ASTM B 221**, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: **ASTM B 209**, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, **[G60]** **[G90]** zinc coating, mill phosphatized.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, **[No. 4 finish]** **[No. 6 finish]**.
- E. Fasteners: Use types and sizes to suit unit installation conditions.
 1. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 2. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 3. For fastening stainless steel, use 300 series stainless-steel fasteners.
 4. For color-finished louvers, use fasteners with heads that match color of louvers.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

- B. Join frame members to each other and to fixed louver blades with fillet **[welds concealed from view] [welds, threaded fasteners, or both, as standard with louver manufacturer]** unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.
- 2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS
- A. Horizontal Storm-Resistant Louver:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Construction Specialties, Inc.
 - h. Greenheck Fan Corporation.
 - i. Industrial Louvers, Inc.
 - j. NCA Manufacturing, Inc.
 - k. Nystrom Building Products.
 - l. Reliable Products, Inc.
 - m. Ruskin Company; Tomkins PLC.
 - n. United Enertech Corp.
 2. Louver Depth: **[5 inches]** <Insert depth>.
 3. Frame and Blade Nominal Thickness: Not less than **0.060 inch** for blades and **0.080 inch** for frames.
 4. Louver Performance Ratings:
 - a. Free Area: Not less than **[5.0 sq. ft.] [6.0 sq. ft.] [7.0 sq. ft.]** <Insert free area> for **48-inch-** wide by **48-inch-** high louver.
 - b. Air Performance: Not more than **[0.10-inch wg]** <Insert pressure> static pressure drop at **[600-fpm] [700-fpm] [800-fpm]** <Insert velocity> free-area **[exhaust] [intake]** velocity.
 - c. Wind-Driven Rain Performance: Not less than **[99] [95] [80]** <Insert rating> percent effectiveness when subjected to a rainfall rate of **[3 inches per hour and a wind speed of 29 mph] [8 inches per hour and a wind speed of 50 mph]** at a core-area intake velocity of **[300 fpm] [400 fpm] [500 fpm]** <Insert velocity>.
 5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- B. Vertical Storm-Resistant Louver:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Cesco Products; a division of Mestek, Inc.
 - h. Construction Specialties, Inc.
 - i. Greenheck Fan Corporation.
 - j. Industrial Louvers, Inc.
 - k. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - l. NCA Manufacturing, Inc.
 - m. Nystrom Building Products.
 - n. Reliable Products, Inc.
 - o. Ruskin Company; Tomkins PLC.
 - p. United Enertech Corp.

2. Louver Depth: **[6 inches] [8 inches] <Insert depth>**.
 3. Frame and Blade Nominal Thickness: Not less than **0.060 inch** for blades and **0.080 inch** for frames.
 4. Louver Performance Ratings:
 - a. Free Area: Not less than **[5.0 sq. ft.] [6.0 sq. ft.] [7.0 sq. ft.] <Insert free area>** for **48-inch-** wide by **48-inch-** high louver.
 - b. Air Performance: Not more than **[0.10-inch wg] <Insert pressure>** static pressure drop at **[600-fpm] [700-fpm] [800-fpm] <Insert velocity>** free-area **[exhaust] [intake]** velocity.
 - c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of **[3 inches per hour and a wind speed of 29 mph] [8 inches per hour and a wind speed of 50 mph]** at a core-area intake velocity of **[300 fpm] [400 fpm] [500 fpm] <Insert velocity>**.
 5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- C. Horizontal, Drainable-Blade Louver:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Carnes Company, Inc.
 - h. Cesco Products; a division of Mestek, Inc.
 - i. Construction Specialties, Inc.
 - j. Dowco Products Group; Safe-Air of Illinois, Inc.
 - k. Greenheck Fan Corporation.
 - l. Industrial Louvers, Inc.
 - m. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - n. Metal Form Manufacturing Inc.
 - o. NCA Manufacturing, Inc.
 - p. Nystrom Building Products.
 - q. Reliable Products, Inc.
 - r. Ruskin Company; Tomkins PLC.
 - s. United Enertech Corp.
 - t. Vent Products Company, Inc.
 2. Louver Depth: **[4 inches] [6 inches] <Insert depth>**.
 3. Frame and Blade Nominal Thickness: Not less than **0.060 inch** for blades and **0.080 inch** for frames.
 4. Louver Performance Ratings:
 - a. Free Area: Not less than **[7.0 sq. ft.] [7.5 sq. ft.] [8.0 sq. ft.] [8.5 sq. ft.] <Insert free area>** for **48-inch-** wide by **48-inch-** high louver.
 - b. Point of Beginning Water Penetration: Not less than **[900 fpm] [950 fpm] [1000 fpm] [1050 fpm] [1100 fpm] <Insert velocity>**.
 - c. Air Performance: Not more than **[0.10-inch wg] <Insert pressure>** static pressure drop at **[700-fpm] [750-fpm] [800-fpm] [850-fpm] <Insert velocity>** free-area **[exhaust] [intake]** velocity.
 - d. Air Performance: Not more than **[0.15-inch wg] <Insert pressure>** static pressure drop at **[900-fpm] [950-fpm] [1000-fpm] <Insert velocity>** free-area **[exhaust] [intake]** velocity.
 5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- D. Horizontal, Nondrainable-Blade Louver:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Air Balance Inc.; a Mestek company.

- b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating, Inc.; a Mestek company.
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Carnes Company, Inc.
 - h. Cesco Products; a division of Mestek, Inc.
 - i. Construction Specialties, Inc.
 - j. Dowco Products Group; Safe-Air of Illinois, Inc.
 - k. Greenheck Fan Corporation.
 - l. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - m. Metal Form Manufacturing Inc.
 - n. NCA Manufacturing, Inc.
 - o. Nystrom Building Products.
 - p. Reliable Products, Inc.
 - q. Ruskin Company; Tomkins PLC.
 - r. United Enertech Corp.
 - s. Vent Products Company, Inc.
2. Louver Depth: **[2 inches] [4 inches] [6 inches]** <Insert depth>.
 3. Blade Profile: **[Plain blade without] [Blade with]** center baffle.
 4. Frame and Blade Nominal Thickness: Not less than **0.080 inch**.
 5. Louver Performance Ratings:
 - a. Free Area: Not less than **[7.5 sq. ft.] [8.0 sq. ft.] [8.5 sq. ft.]** <Insert free area> for **48-inch-** wide by **48-inch-** high louver.
 - b. Point of Beginning Water Penetration: Not less than **[700 fpm] [750 fpm] [800 fpm] [850 fpm] [900 fpm] [950 fpm]** <Insert velocity>.
 - c. Air Performance: Not more than **[0.10-inch wg]** <Insert pressure> static pressure drop at **[650-fpm] [700-fpm] [750-fpm]** <Insert velocity> free-area **[exhaust] [intake]** velocity.
- 2.4 FIXED, FORMED-METAL LOUVERS
- A. Horizontal, Drainable-Blade Louver:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. American Warming and Ventilating, Inc.; a Mestek company.
 - e. Arrow United Industries; a division of Mestek, Inc.
 - f. Cesco Products; a division of Mestek, Inc.
 - g. Construction Specialties, Inc.
 - h. Dowco Products Group; Safe-Air of Illinois, Inc.
 - i. Greenheck Fan Corporation.
 - j. Industrial Louvers, Inc.
 - k. Metal Form Manufacturing Inc.
 - l. NCA Manufacturing, Inc.
 - m. Ruskin Company; Tomkins PLC.
 - n. United Enertech Corp.
 - o. Vent Products Company, Inc.
 2. Louver Depth: **[4 inches] [6 inches]** <Insert depth>.
 3. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than **[0.052 inch for frames and 0.040 inch for blades] [0.052 inch]**.
 4. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than **0.050 inch**.
 5. Louver Performance Ratings:
 - a. Free Area: Not less than **[7.0 sq. ft.] [7.5 sq. ft.] [8.0 sq. ft.] [8.5 sq. ft.]** <Insert free area> for **48-inch-** wide by **48-inch-** high louver.

- b. Point of Beginning Water Penetration: Not less than [800 fpm] [850 fpm] [900 fpm] [950 fpm] [1000 fpm] <Insert velocity>.
 - c. Air Performance: Not more than [0.10-inch wg] <Insert pressure> static pressure drop at [700-fpm] [750-fpm] [800-fpm] [850-fpm] <Insert velocity> free-area [exhaust] [intake] velocity.
 - d. Air Performance: Not more than [0.15-inch wg] <Insert pressure> static pressure drop at [900-fpm] [950-fpm] [1000-fpm] <Insert velocity> free-area velocity.
 - 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
 - B. Horizontal, Nondrainable-Blade Louver:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airlite Company, LLC (The).
 - d. American Warming and Ventilating, Inc.; a Mestek company.
 - e. Arrow United Industries; a division of Mestek, Inc.
 - f. Cesco Products; a division of Mestek, Inc.
 - g. Construction Specialties, Inc.
 - h. Dowco Products Group; Safe-Air of Illinois, Inc.
 - i. Greenheck Fan Corporation.
 - j. Industrial Louvers, Inc.
 - k. Metal Form Manufacturing Inc.
 - l. NCA Manufacturing, Inc.
 - m. Ruskin Company; Tomkins PLC.
 - n. United Enertech Corp.
 - o. Vent Products Company, Inc.
 - 2. Louver Depth: [4 inches] [6 inches] <Insert depth>.
 - 3. Blade Profile: [Plain blade without] [Blade with] center baffle.
 - 4. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than [0.052 inch for frames and 0.040 inch for blades] [0.052 inch].
 - 5. Frame and Blade Material and Nominal Thickness: Stainless-steel sheet, not less than 0.050 inch.
 - 6. Louver Performance Ratings:
 - a. Free Area: Not less than [6.5 sq. ft.] [7.0 sq. ft.] [7.5 sq. ft.] [8.0 sq. ft.] <Insert free area> for 48-inch- wide by 48-inch- high louver.
 - b. Point of Beginning Water Penetration: Not less than [550 fpm] [600 fpm] [650 fpm] [700 fpm] <Insert velocity>.
 - c. Air Performance: Not more than [0.10-inch wg] <Insert pressure> static pressure drop at [550-fpm] [600-fpm] [650-fpm] [700-fpm] <Insert velocity> free-area [exhaust] [intake] velocity.
- 2.5 LOUVER SCREENS
- A. General: Provide screen at each exterior louver.
 - B. Louver Screen Frames: Same kind and form of metal as indicated for louver to which screens are attached.
 - C. Louver Screening:
 - 1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.
 - 2. Bird Screening: Stainless steel, 1/2-inch- square mesh, 0.047-inch wire.
 - 3. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch thick.
 - 4. Bird Screening: Galvanized steel, 1/2-inch- square mesh, 0.041-inch wire.
- 2.6 WALL VENTS (BRICK VENTS)
- A. Extruded-Aluminum Wall Vents:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following: Air Flow Company, Inc.
 - a. Airlite Company, LLC (The).

- b. Arrow United Industries; a division of Mestek, Inc.
 - c. Construction Specialties, Inc.
 - d. Dowco Products Group; Safe-Air of Illinois, Inc.
 - e. Greenheck Fan Corporation.
 - f. Hohmann & Barnard, Inc.
 - g. Industrial Louvers, Inc.
 - h. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - i. Metal Form Manufacturing Inc.
 - j. Nystrom Building Products.
 - k. Reliable Products, Inc.
 - l. Ruskin Company; Tomkins PLC.
 - m. Sunvent Industries; Division of Sylro Sales Corp.
 - n. United Enertech Corp.
 - o. **<Insert manufacturer's name>**.
- 2. Extruded-aluminum louvers and frames, not less than **0.125-inch** nominal thickness, assembled by welding; with **18-by-14-** mesh, aluminum insect screening on inside face; incorporating weep holes, continuous drip at sill, and integral waterstop on inside edge of sill; of load-bearing design and construction.
- B. Cast-Aluminum Wall Vents:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following: Air Flow Company, Inc.
 - a. Airolite Company, LLC (The).
 - b. Greenheck Fan Corporation.
 - c. Hohmann & Barnard, Inc.
 - d. Ruskin Company; Tomkins PLC.
 - e. Sunvent Industries; Division of Sylro Sales Corp.
 - 2. One-piece, cast-aluminum louvers and frames; with **18-by-14-** mesh, aluminum insect screening on inside face; incorporating integral waterstop on inside edge of sill; of load-bearing design and construction.
- 2.7 ALUMINUM FINISHES
 - A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
 - B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: **[Champagne] [Light bronze] [Medium bronze] [Dark bronze] [Black]**
<Insert color>.
 - C. High-Performance Organic Finish: **[2] [3] [4]**-coat fluoropolymer finish complying with **[AAMA 2604] [AAMA 2605]** and containing not less than **[50] [70]** percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range]**
<Insert color and gloss>.
- 2.8 GALVANIZED-STEEL SHEET FINISHES
 - A. Finish louvers after assembly.
 - B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A 780.
 - C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of **1 mil** for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of **2 mils**.
 - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range]**
<Insert color and gloss>.

2.9 STAINLESS-STEEL SHEET FINISHES

- A. Repair sheet finish by grinding and polishing irregularities, weld spatter, scratches, and forming marks to match surrounding finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.
- E. Protect galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint.

END OF SECTION 239000

WCU
Norton Intramural Fields
22-24232-01A

DIVISION 26

ELECTRICAL



PART 1 - GENERAL**1.1 SUMMARY**

- A. This Section includes the following:
 - 1. General provisions.
 - 2. Scope.
 - 3. Permits and Fees.
 - 4. Visit to Job Site.
 - 5. Workmanship.
 - 6. Drawings and Specifications.
 - 7. Tests.
 - 8. Allowance for added work.
 - 9. Incidental construction work.
 - 10. Access Doors.
 - 11. Supervision.
 - 12. Electrical work by others.
 - 13. Existing facilities, utilities, etc.
 - 14. Adaptation of work to existing conditions.
 - 15. Renovations/alterations.
 - 16. Submittal procedures.
 - 17. Product requirements.
 - 18. Closeout procedures.
 - 19. Operation and Maintenance Manuals.
 - 20. As-built Documents.
 - 21. Demonstration and Training.
 - 22. Warranty.

PART 2 - NOT APPLICABLE**PART 3 - EXECUTION****3.1 GENERAL PROVISIONS**

- A. This Contractor's attention is directed to the requirements of Instructions to Bidders, General Conditions and Supplementary General Conditions as bound in the specifications which apply in full to the ELECTRICAL work.
- B. Where the requirements of this Division conflict with other articles in these Specifications, the Contractor shall utilize the more stringent method.

3.2 SCOPE

- A. Provide all labor, materials, tools, equipment, and transportation, and perform all operations necessary for and reasonably incidental to proper execution and completion of all "ELECTRICAL" work, whether specifically mentioned or not, all as indicated, specified herein, and/or implied thereby to carry out the apparent intent thereof.
- B. These drawings may be superseded by later revised or detailed drawings, specifications, or sketches prepared by the Designer, as needed for clarification, and this Contractor shall conform to all reasonable coordination requests.
- C. All items not specifically mentioned in the specifications or noted on the drawings, but which obviously are required to make the working installation complete, shall be included automatically.
- D. For projects which are bid or awarded as Single Prime contracts, organization of the Specifications into divisions, sections, and articles, and arrangement of the Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be done by any trade, unless specifically shown or noted otherwise.

3.3 PERMITS AND FEES

- A. This Contractor shall secure all permits required for the completion of this contract. He shall obtain and deliver to the Owner all certificates of inspection issued by the authorities having jurisdiction.

3.4 VISIT TO JOB SITE

- A. Before submitting a bid, this Contractor shall visit the job site for the purpose of thoroughly examining the site and conditions under which the work must be performed.
- B. The submission of a bona fide bid will be construed to mean that this Contractor understands and is satisfied with conditions under which the contract must be fulfilled.
- C. No extra compensation will be allowed for situations arising from failure of this Contractor to be thoroughly familiar with site conditions, including charges and requirements for connection to utilities as shown for this project.

3.5 WORKMANSHIP

- A. Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved.
- B. Work shall be performed by experienced and skilled mechanics under the supervision of a competent foreman.
- C. Substandard workmanship will be cause for rejection of work and replacement by Contractor.
- D. The Contractor shall reimburse the Designer for all costs incurred by the Designer due to Contractor's substandard or non-conforming work.

3.6 DRAWINGS AND SPECIFICATIONS

- A. The drawings show the location and arrangement of fixtures, piping, and equipment, together with details of connections of certain principal items.
- B. The layout shown shall be followed as closely as circumstances will permit, but this Contractor shall lay out his work so as to avoid conflict with other Contractors and trades, and to avoid any unnecessary cutting or damage to walls, floors, and supporting structural members.
- C. This Contractor shall carefully and accurately locate all sleeves and install at the proper time all necessary hangers, inserts, etc., which will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of above items.
- D. This Contractor shall refer to architectural, mechanical, and electrical drawings and shall cooperate fully with other Contractors and trades while installing piping, fixtures, and other equipment because of close space limits.
 - 1. In case of conflict, notify Designer before proceeding with installation.
 - 2. Refer to architectural drawings for exact building dimensions and location of partition walls, doors, chases, etc.
 - 3. ELECTRICAL drawings are not to be scaled for such dimensions.
- E. The drawings and specifications complement each other and together are intended to give a complete description of the work.
 - 1. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown in plans, shall be furnished the same as if mentioned or shown in both places.
 - 2. If conflicts exist, then the most stringent method shown or described shall apply.
- F. Any switches, controls, or equipment included in this contract work (drawings and/or specifications) that are not specifically shown on drawings shall be located for convenient use and access.
- G. Contractor shall coordinate all equipment arrangement and lay-out in field prior to beginning any actual installation of his work.
- H. If Contractor notes any discrepancy, omission, or conflict found in plans or specifications, he shall call to the immediate attention of the Designer, prior to receipt of bids.
- I. It is the intention that piping, air ducts and light fixtures are designed and laid out to clear each other.
 - 1. It shall be the responsibility of this Contractor to coordinate his work with that of other trades to avoid any such conflicts.
 - 2. Any conflicts that occur after work of one trade is installed and was not prior coordinated shall be relocated or rearranged at the total expense of this Contractor, as directed by Designer.
 - 3. Any conflicts that cannot be corrected in field by relocation or elevation changes shall be reported to the Designer in writing prior to any installation.
- J. The drawings are not intended to show each and every complete or accurate detail.
 - 1. The figures and writing on drawings shall be taken instead of scaling.
 - 2. It is this Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement.
 - 3. This Contractor shall take and be responsible for all field measurements.
 - 4. Exact locations and relations are to be defined in the field and shall be satisfactory to the Designer.
- K. Because of the small scale of ELECTRICAL drawings it is not possible to indicate all offsets, fittings, and accessories which may be required.
 - 1. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings and accessories that may be required to meet the conditions.

3.7 TESTS

- A. The Designer reserves the right to conduct acceptance tests of all equipment, piping, or any other work furnished under these specifications to determine the fulfillment of special requirements.
 - 1. Such tests shall be conducted in the presence of authorized representatives of the Contractor, Owner, Engineer, and Architect at such time as the Designer may designate.
 - 2. This Contractor shall perform all tests, bear cost of same and make adjustments of equipment and wiring as may be deemed necessary by the Designer.

3.8 ALLOWANCE FOR ADDED WORK

- A. Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall first be submitted and approved in writing.
 - 1. No claim for addition to the contract sum will be valid unless so ordered and approved by the Owner and Designer, prior to start of work.
 - 2. Any conflicts corrected by relocation or elevation changes do not constitute extra work.

3.9 INCIDENTAL CONSTRUCTION WORK

- A. All blocking for openings for piping in concrete floors, masonry walls or partitions shall be provided by this Contractor.
 - 1. This Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other Contractors as shown upon, or reasonably implied by the drawings and specifications.
 - 2. He shall properly complete and finish up his work after other Contractors have finished as the Designer may direct.
- B. All excavating required for the installation of this system shall be done by this Contractor.
 - 1. Backfill shall be accomplished as specified in appropriate section of specifications.
- C. Chases are prohibited in masonry walls which are not to be plastered or paneled.
 - 1. Set piping, blocking, carriers, etc. indicated to be concealed before walls are constructed in order that walls may be constructed around them.
 - 2. This Contractor shall furnish all sleeves in floors, beams, walls, etc., for each such penetration as needed for installing his work and installation of sleeves by General Contractor.
- D. Unless otherwise noted, the General Contractor will provide openings and lintels as new construction progresses, but this Contractor shall fully designate his requirements prior to construction.
 - 1. Failure to furnish his requirements prior to building construction and failure to coordinate his work with the building construction shall make this Contractor responsible for removing, replacing and painting building construction as required for installation of his work.

3.10 ACCESS DOORS

- A. Provide and install access doors in walls, ceilings, etc. as required for access to junction boxes, terminal cabinets, controls, and other devices requiring access in ceilings, chases, soffits, etc.
- B. Access doors in non-fire rated walls or ceilings shall be as follows:
 - 1. Nominal 24" x 24" minimum size.
 - 2. 16-gage steel frame with 14-gage door panel and galvanized steel drywall bead.
 - 3. Flush style with provision to conceal flange with drywall cement.
 - 4. Double-acting concealed spring hinges to allow opening to 175 degrees.
 - 5. Flush, Allen-head operated with steel cam.
 - 6. Gray prime-painted steel, for painting to match adjacent finished surfaces.
 - 7. Basis of Design: Milcor Style DW; Comparable Products by Karp, Elmdor, Acudor.
- C. Access doors in fire-rated walls or ceilings shall be as follows:
 - 1. Nominal 24" x 24" minimum size.
 - 2. UL 1-1/2 hour, Class B fire rating.
 - 3. Prime-painted stainless steel: 16-gage frame with 20-gage door panel, for painting to match adjacent finished surfaces.
 - 4. 2" mineral fiber insulation between inner and outer panel.
 - 5. Continuous hinge, steel with stainless steel pin.
 - 6. Self-closing and self-latching panel closer.
 - 7. Flush mounted paddle latch and locking system with flush, key-operated cylinder lock with two keys.
 - 8. Basis of Design: Milcor Style UFR; Comparable Products by Karp, Elmdor, Acudor.

3.11 SUPERVISION

- A. This Contractor shall have in charge of the work at all times during construction a thoroughly competent foreman with extensive experience in the work to be performed under this contract.
 - 1. Anyone deemed not capable by the Designer shall be replaced immediately upon request, and after satisfactory foreman has been assigned, he shall not be withdrawn without the written consent of the Designer.

3.12 ELECTRICAL WORK BY OTHERS

- A. Refer to the drawings for the details of locations of circuit breakers, junction boxes, disconnect switches, conduits and slack wire required where this contractor's electrical work terminates and electrical work by others begins.
- B. The Electrical Contractor shall furnish and install all power circuits for equipment furnished by others.
- C. In Mechanical Rooms the wiring by the Electrical Contractor shall generally terminate in a power wiring gutter, line side of disconnect switches or starters, junction box, or electrical panel.
 - 1. From these points power wiring to the equipment furnished by the ELECTRICAL Contractor shall generally be by the ELECTRICAL Contractor.
 - 2. Power wiring to mechanical equipment outside equipment rooms will generally be run by the Electrical Contractor to line side of a disconnect switch or junction box in the vicinity (within 3'-0") of the ELECTRICAL equipment.
 - 3. Power wiring from that point to the equipment will be by the ELECTRICAL Contractor.
- D. ELECTRICAL Contractor is to refer to the drawings for location and type of service connections to be provided under the electrical contract.
 - 1. Where service disconnect switches are required and not furnished as part of the equipment, they shall be furnished and installed by contractor that furnishes the equipment, unless indicated otherwise.
 - 2. Other Contractors shall furnish and install conduit, boxes, wiring and all items of control for equipment they furnish or Owner furnished equipment, unless specifically shown on electrical drawings.

3.13 EXISTING FACILITIES

- A. In existing facilities, disruption of operations must be kept to a minimum and coordinated with Owner.
 - 1. Work in existing buildings must be cleaned up daily immediately after finishing that portion of work and equipment left in order for Owner to continue operations.
 - 2. When it is necessary to interrupt utility services in the fulfillment of this contract, such interruptions shall be kept to a minimum and coordinated with Owner.
 - 3. Once work has begun, it shall be pursued diligently until completed.
- B. Every precaution shall be taken to prevent damage to existing underground lines and structures and public utilities.
 - 1. Damage to existing water and sewer lines, culverts, service connections, underground cables, and similar surface and sub-surface structures shall be at the risk of this Contractor, whether or not locations thereof are shown on plans, and the repairing of such damage shall be by this Contractor and shall be completed without delay.
 - 2. Compensation for such repairs shall be based on normal and reasonable costs.
- C. The locations of any existing underground utilities that are shown are in an approximate way only and have not been independently verified by the Owner or its representative.
 - 1. The Contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the Contractor's failure to exactly locate and preserve any and all underground utilities.

3.14 ADAPTATION OF WORK TO EXISTING CONDITIONS

- A. It is reasonably implied that this Contractor shall furnish all labor and materials to provide Owner with a new and satisfactory system in these facilities.
 - 1. Contractor is to include necessary work for adaptation of equipment to conditions that may be found to produce conflicts during construction.
 - 2. When any such conditions are encountered, this Contractor is to consult with Designer and then modify installation as directed without additional costs, and to include any incidental materials required.

3.15 RENOVATIONS/ALTERATIONS

- A. Before any work is started in existing building, ELECTRICAL Contractor shall make a thorough survey with Designer and a representative of the Owner of building in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by all three to Designer. This report shall list by rooms and spaces:
 - 1. Existing conditions and types of resilient flooring, doors, windows, wall and other surfaces not required to be altered throughout and affected areas of building.
 - 2. Existence and conditions and operation of items such as ELECTRICAL fixtures, water heaters, valves, etc., required by drawings to be either reused for relocated, or both.
 - 3. Any discrepancies between drawings and existing conditions at site.
 - 4. Areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and Designer.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of Designer and Owner's representative, to be in such condition that their use is impossible or impractical, shall be removed and a proposal submitted by Contractor to replace with new items in accordance with specifications which will be furnished by Designer.
- C. Re-Survey: Fifteen days before expected partial or final inspection date, Contractor, Designer, Owner's representative, together shall make a thorough re-survey of the areas of buildings involved.
 - 1. They shall furnish a report on conditions then existing, of ELECTRICAL fixtures, equipment, etc. as compared with conditions of same as noted in first condition survey report.
 - 2. Re-survey report shall also list any damage caused by this Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of this Contractor to restore damage caused by Contractor's workmen in executing work of this Contract.

3.16 SUBMITTAL PROCEDURES

- A. Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - 3. Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Contractor approval: Affix review stamp to cover sheet, with initials and date of Contractor's approval of submittals.
 - 1. By submitting Shop Drawings, Product Data, Samples and similar submittals, this Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria and details related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work, the Contract Documents and the Work of other trades.
- C. Comply with requirements in Division 01 Sections for list of submittals and time requirements for scheduled performance of related construction activities.
- D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows.
 - 1. Time for review shall commence on Designer's receipt of submittal.
 - 2. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 3. Allow 21 days for initial review of each submittal.
 - a. Allow additional time if coordination with subsequent submittals is required.
 - b. Designer will advise Contractor when a submittal being processed must be delayed for coordination.
 - 4. Allow 15 days for review of each resubmittal.
- E. Identification: Identify submittals as required in Division 01 sections.
- F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
 - 1. Summarize deviations on transmittal or List of Deviations included with submittal.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling.

1. Transmit each submittal using a transmittal form.
 2. Designer will discard submittals received from sources other than Contractor.
 - I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked "Furnish as Submitted" or "Furnish as Corrected."
 4. Where submittals contain specific questions or comments, provide a separate sheet with specific answers to each question or comment.
 - J. At Contractor's written request, copies of Designer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
 1. Allow 21 days from Designer's receipt of written request for CAD files for delivery of files
 2. Files will be delivered via email or compact disc.
 3. Files will be delivered without RN&M Title Blocks, standard details, schedules, etc.
 4. CAD files provided for Contractor's use are not to be construed as the Contract Documents. Use of CAD files for submittals or other uses are at the Contractor's risk.
 - K. Prepare and submit Action Submittals required by individual Specification Sections.
 1. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 2. Number of Copies: Submit at least eight copies of Product Data, unless otherwise indicated.
 - a. Designer will return all but three copies.
 - b. Retain or duplicate sufficient copies for inclusion in Operation and Maintenance Manuals.
 3. Shop Drawings: Prepare Project-specific information, drawn accurately to scale.
 - a. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Designer's CAD Drawings is otherwise permitted.
 5. Sheet Size: At least 8-1/2 by 11 inches but no larger than size of project drawings.
 7. Number of Copies: Two opaque (bond) copies of each submittal. Designer will return one copy.
 8. Manufacturers and Materials Suppliers List: Submit three copies of manufacturers and materials suppliers list within 20 days of Contract Award, unless otherwise indicated. Designer will return two copies.
 10. Subcontract List: Submit within 20 days of Contract Award three copies of list of proposed subcontractors. Designer will return two copies. Subcontract list to include all tiers of subcontractors.
 - L. Contractor's Review and Approval: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents.
 1. Note corrections and field dimensions.
 2. Mark with approval stamp before submitting to Designer.
 - M. Designer's Action: Designer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
 1. Designer will review each submittal, make marks to indicate corrections or modifications required, and return it.
 2. Designer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - a. Furnish as Submitted
 - b. Furnish as Corrected: Incorporate comments marked on or attached to submittal.
 - c. Revise and Resubmit: Major items of the submittal do not comply, requiring a resubmittal.
 - N. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
 - O. Submittals not required by the Contract Documents may not be reviewed and may be discarded.
 - P. The Contractor is responsible for compliance with the Contract Documents, dimensions, details, coordination, and satisfactory performance of materials and equipment provided and installed.
- 3.17 PRODUCT REQUIREMENTS
- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent. All electrical equipment must be listed/labeled by third party

agencies accredited by NCBCC to label electrical and mechanical equipment, and marked for intended use.

1. Basis-of-Design Product: Item identified by manufacturer's product name, make, and model number, used to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, dimensions, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
 2. Comparable Product: Product that is listed in the Contract Documents, or added by Addendum, and demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified or basis-of-design product.
 3. Owner-preferred Alternate Product: Product that is listed in the Contract Documents, and for which an Alternate Bid price is submitted. When an Alternate Bid item is accepted in the Contract, no substitutions will be allowed.
 4. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor after award of Contract.
 5. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
- B. Comparable Product Requests: Submit three copies of each request for consideration, at least 10 days prior to receipt of bids, for products not listed in the Contract Documents. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Documentation: Show compliance with requirements for Comparable Products and the following, as applicable:
 - a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed product.
 - b. Detailed comparison of significant qualities of proposed product with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 2. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation. Designer will notify Contractor of approval or rejection of proposed comparable product request.
 - a. Form of Approval: Addition of the item to the list of Comparable Products by Addendum, prior to receipt of bids.
 - b. Use product specified if Designer cannot make a decision on use of a comparable product request within time allocated.
- C. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, features, options, and other items needed for a complete installation and indicated use and effect, and as required or recommended by the manufacturer for a complete installation, whether or not specifically indicated on the drawings or specifications.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Designer will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
- D. Product Selection Procedures:

1. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 2. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 3. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.
 - E. Responsibility of the Contractor: The responsibility for determining dimensions, utility requirements, fitting of work with other trades, sequencing and coordination of work, for Product Substitutions and Comparable Products rests solely with the Contractor.
 - F. Manufacturer's Warranties: Where specifications require manufacturer's warranties, the provisions of the Contract Documents take precedence over any manufacturer's "standard" warranty provisions, exclusions, etc.
 1. The start of manufacturer's warranties shall be the date of Substantial Completion of the project or phase of the project, notwithstanding any language or exclusion in any document submitted by the contractor or manufacturer.
- 3.18 CLOSEOUT PROCEDURES
- A. Substantial Completion: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 2. Complete startup testing of systems.
 3. Submit test records.
 4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 5. Complete final cleaning requirements, including touchup painting.
 6. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
 7. Submit a written request for inspection for Substantial Completion. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
 8. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 9. Results of completed inspection will form the basis of requirements for Final Completion.
 - B. Final Completion: Before requesting final inspection for determining date of Final Completion, complete the following:
 1. Submit certified copy of Designer's Substantial Completion inspection list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit documentation of training.
 3. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
 4. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - C. Cleaning: This Contractor shall provide all systems and equipment in a new and clean condition.
 1. Clean all items furnished and installed in accordance with manufacturer's recommendations.
 2. Provide instruction to Owner in proper cleaning of all items provided as part of this Division.
 3. Cooperate with General Contractor in cleaning of building.
- 3.19 OPERATION AND MAINTENANCE MANUALS
- A. Submit four complete copies of Operation and Maintenance Manuals to Designer for review prior to request for inspection for Substantial Completion.
 - B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
 - C. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 1. Subject matter included in manual.

2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name, address, and telephone number of Contractor.
 6. Name and address of Architect.
 7. Name and address of Engineer.
- D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- E. List of Material Suppliers and Subcontractors: List contact information for each material supplier and subcontractor.
- F. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
- G. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- H. Descriptions: Include the following: Product name and model number, Manufacturer's name, Equipment identification with serial number of each component, Equipment function, Operating characteristics, Limiting conditions, Performance curves, Engineering data and tests, Complete nomenclature and number of replacement parts.
- I. Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
- J. Describe the sequence of operation, and diagram controls as installed.
- K. List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- L. Provide manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
- M. Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:
- N. Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

- O. Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
 - P. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - Q. Provide complete approved submittal data with all annotations.
 - R. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
- 3.20 AS-BUILT DOCUMENTS
- A. As-built Marked Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings.
 - 1. Mark Record Prints to show the actual installation where installation varies from that shown originally.
 - 2. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up As-built Marked Prints.
 - 3. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - 4. Record data as soon as possible after installation.
 - 5. Record and check the markup before enclosing concealed installations.
 - 6. Indicate dimensions to locate underground and concealed conduits and lines from fixed reference points.
 - 7. Indicate burial depth for underground lines.
 - 8. Indicate location of all valves and cross-reference to valve tag list.
 - 9. Mark the Contract Drawings completely and accurately.
 - a. Mark record sets with erasable, red-colored pencil.
 - b. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
 - 10. Maintain As-built Marked Prints in a clean, legible, up-to-date condition in the project office, and available to the Designer for inspection upon request throughout construction.
 - B. Record Specifications: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Note related Change Orders and As-built Marked Prints where applicable.
- 3.21 DEMONSTRATION AND TRAINING
- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with Owner with at least seven days' advance notice.
 - C. Warranty service: Train Owner in repair and troubleshooting during each warranty service call.
 - D. For each training session, submit on letterhead name of trainer, date of training, names of Owner's personnel trained, and systems/equipment trained on.
 - E. For factory training, documentation to be on letterhead of organization conducting training.
- 3.22 WARRANTY
- A. This Contractor shall guarantee all materials, equipment, workmanship and each and every piece of apparatus which he furnished and which he installs under this contract against defects and failures of any nature for a period of one year from date on which the system is accepted.
 - B. Apparatus furnished by this Contractor shall be guaranteed to be satisfactory when operated under rated conditions in accordance with manufacturer's instructions and to be of size, function, and capacity specified on drawings or in the specifications.
 - C. Equipment manufacturers shall warrant equipment furnished for this project for same time span as installing contractors warranty period as set above and elsewhere in these specifications.
 - 1. Warranty start date shall be as established by the Designer. Refer to General Conditions, Supplementary General Conditions, and Division 1 specifications for establishment of warranty start dates.

2. The provisions of the Contract Documents supersede and override any manufacturer's standard warranty provisions.
- D. Upon notice from the Designer or Owner, Contractor shall immediately check system, make necessary repairs or adjustments as required; due to faulty workmanship, materials, faults, operation or equipment, without cost to the Owner, and instruct Owner in proper operation, adjustment, and care of systems.
- E. During the one-year warranty period, the Contractor shall be responsible for all preventive maintenance, including routine lubrication, filter changing, inspections, and adjustments.
 1. Contractor shall provide all materials, consumables, equipment, supplies, etc. required for preventive maintenance.
 2. Perform preventive maintenance in accordance with manufacturer's recommendations.
 3. During preventive maintenance, instruct Owner in proper preventive maintenance procedures.
- F. The Contractor shall submit service call tickets, reports, or other documentation of each warranty service call to the Designer.

END OF SECTION 220500

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

1.2 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:
 - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
 - 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
 - a. Penetrations located outside wall cavities.
 - b. Penetrations located outside fire-resistance-rated shaft enclosures.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
 - 1. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.
 - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems bearing classification marking of qualified testing and inspecting agency.
- B. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application on Drawings or that are produced by one of the following manufacturers:
 - 1. Grace, W. R. & Co. - Conn.
 - 2. Hilti, Inc.
 - 3. Johns Manville.
 - 4. Nelson Firestop Products.
 - 5. 3M; Fire Protection Products Division.
 - 6. Tremco; Sealant/Weatherproofing Division.
 - 7. USG Corporation.

2.2 FIRESTOPPING

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.

PART 3 - EXECUTION

3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 FIELD QUALITY CONTROL

- A. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

END OF SECTION 260100

SECTION 260513 – MEDIUM VOLTAGE CABLE

PART 1 - GENERAL

1.1 SUMMARY

- A. Related Documents:
 - 1. Drawings and general provisions of the Subcontract apply to this Section.
 - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section Includes:
 - 1. Single conductor, medium voltage power cable.
 - 2. Cable - Grounding.
 - 3. Medium voltage cable splicing and terminations.
 - 4. Testing of medium voltage cable, splices and terminations.
- C. Related Sections:
 - 1. Division 01 Section "General Requirements."
 - 2. Division 01 Section "Special Procedures."
 - 3. Division 23 Section "Storm Drainage Manholes, Frames, and Covers".
 - 4. Division 26 Section "Common Work Results for Electrical".
 - 5. Division 26 Section "Electrical Conduit".
 - 6. Division 26 Section "Cable Trays for Electrical Systems"
 - 7. Division 26 Section "Secondary Unit Substations".
 - 8. Division 26 Section "Medium Voltage Outdoor Metal Clad Switchgear".
 - 9. Division 26 Section "SF6 Gas Insulated Loadbreak Switch".

1.2 REFERENCES

- A. General:
 - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
 - 3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
 - 4. Refer to Division 26 Section "Common Results for Electrical" for codes and standards, and other general requirements.
- B. ASTM International:
 - 1. ASTM B-3, B-8, and B-496 - American Society for Testing Materials.
- C. NFPA 70 - National Electrical Code.
- D. AEIC CS8 - Association of Edison Illuminating Companies.
- E. ICEA Publication No. S-93-639 NEMA WC7 - Insulated Cable Engineers Association.
- F. IEEE 48 - Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations.
- G. NEMA WC 8 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- H. NETA – National Electrical Testing Association
- I. Underwriters' Laboratories, Inc. (UL 1072).

1.3 SUBMITTALS

- A. Submit under provisions of Division 26 Section "Common Results for Electrical - Review of Materials" and Division 01 Section "General Requirements."
- B. The manufacturer's proposal shall include the following information:
 - 1. Diameter of cable.
 - 2. Weight of cable in pound per foot.
 - 3. Complete description of cable, insulation production compound code number.
 - 4. Trade name.
 - 5. Written warranty.
 - 6. Recommend splicing and termination methods.
 - 7. Recommended bending radius.
 - 8. Maximum length of cable on standard reel.
 - 9. Net price of cable per 1,000 feet (305 m) delivered.
 - 10. Additional price of reels, refundable on return to manufacturer.
 - 11. Delivery date.
- C. Confirmation that the cable meets the requirements of Paragraph 2.2.F.1 shall be supplied with quotations.
- D. Manufacturer's Documentation: After approval by the University of cable to be used, the cable manufacturer shall furnish through the Subcontractor to the University the following:
 - 1. Three copies of Certified Test Reports on tests required in Paragraphs 2.2.F.2 and 2.2.F.3 shall be provided for each cable.
 - 2. Proof that cable has been manufactured within six months of its installation.
 - 3. Two copies of the manufacturer's splicing and termination procedures for approval.
- E. Calculations: The Subcontractor shall provide pulling tension and sidewall pressure calculations for pulling in both directions of each cable pull. Include drawings of actual duct layouts indicating duct lengths, size and material and bend radius and degrees of arc between pulling points.
- F. Product literature and samples of materials for circuit labeling.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Company experienced in manufacturing Products specified in this Section with minimum of [25] years.
- B. Cable Splicer Qualifications:
 - 1. Workers' Competency: Submit high voltage cable splicer certification of competency and experience 30 days before splices or terminations are made in high voltage cables. Splicer experience during the immediate past three years shall include performance in splicing and terminating cables of the types and classification being provided under this Subcontract. In lieu of a certification of competency, a Subcontractor may demonstrate the qualifications of a proposed cable splicer through formal training and relevant experience in splicing cables of the type and class under this Subcontract.
 - 2. A notarized listing of relevant projects completed by the proposed splicer during the past three years and completed formal training must be submitted to demonstrate qualifications.
 - 3. Before assigning cable splicer to work covered by this specification, the Subcontractor shall provide the University with the names of the cable splicers to be employed, together with satisfactory proof that each splicer has had at least three years experience in splicing high-voltage cables and is experienced with the type and rating of cables to be spliced. In addition, each cable splicer may be required to make an approved dummy splice in the presence of the Project Manager in accordance with manufacturer's instructions, before the splicer is accepted to splice cable covered by this Specification.
 - 4. Material for dummy splices shall be furnished by the Subcontractor.
- C. Factory Inspection by University: Following cable fabrication, the University reserves the right to have a factory inspection and witness testing of the cable. The Subcontractor shall notify the University in writing at least three weeks prior to factory tests. The University will provide the Subcontractor with a written waiver if a factory inspection and witness testing of the cable is not to be performed by the University.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. General Cable, Kerite Co., Okonite Co., LS Cables., or equal.

2.2 15KV CABLE

A. A. CABLE CONSTRUCTION

1. Conductors shall be soft drawn, Type MV-105, Class "B", concentric compact or compressed, stranded copper, single conductor shielded cable. The shielding process shall be one of the following: either a, b, or c:
 - a. A true triple extrusion (done simultaneously, in a common extrusion head which does not expose the EPR insulation to the atmosphere). The cable shielding shall consist of, semiconducting strand shield, EPR insulation and semi-conducting insulation shield.
 - b) A true triple tandem extrusion process, where the semi-conducting strand shield, the insulation and the semi-conducting insulation shield are EPR.
 - c) Double extrusion process for the non-conducting cable shield and the insulation; the nonconducting cable shield shall be continuously tested for 2kv DC test while the shield is over the conductor and prior to the EPR insulation & the insulation shield being applied.
2. Insulation shall be an ethylene propylene rubber compound rated at (105 deg C) for normal operation, (140 deg C) for emergency overload conditions, and (250 deg C) for short circuit conditions.
 - a. Other synthetic rubber based insulations are acceptable if they meet the above operating temperatures and are unaffected by ozone and electric discharge and proven by the insulation's ability to withstand continuous exposure to electrical discharge for more than 2,000 hours when energized at a test potential equal to 250 volts/mil of insulation thickness. The test procedure shall be that described in part 6 of ICEA S-93-639.
3. The insulation material shall meet the electrical and physical requirements specified in Part 3, ICEA S-93-639.
4. The average insulation thickness shall be not less than 220 mils; the minimum thickness at any point shall not be less than 90 percent of the specified average thickness.

B. Insulation Shielding:

1. The insulating shield shall consist of semiconducting non-metallic, extruded covering, in conformance with Paragraph 4.1.1.1, ICEA S-93-639, directly over the insulation and a non-magnetic metal tape, in conformance with Paragraph 4.1.1.2, ICEA S-93-639, directly over the semiconducting covering. Substitution of a non-metallic semiconducting tape for the extruded covering is not acceptable.
 - a. Cables using the extruded energy suppression and stress control material for the strand shield may use the same material instead of the semiconducting material for the 15kV insulation shield.
2. The extruded covering shall be at least 2.5 mils thick and shall be in intimate contact with the insulation, but shall be removable without damaging the insulation; leaving no residue that cannot be readily removed.
3. The metal tape shall be of 5.0 mil tinned copper or of other nonmagnetic metal of equivalent conductance. 25% nominal overlay. The tape shall be electrically continuous without joints, soldering, or brazing.

C. Overall Jacket:

The overall jacket or sheath shall be oil, acid, alkali, and sunlight-resistant PVC compound which shall be rated for use in conduit or aerial construction. Cable identification shall be printed on this jacket using indelible ink. The cable identification shall indicate "the manufacturer, the plant number, cable size, year of manufacture, insulation thickness, insulation type, voltage rating, KV% insulation level& sequential footage number."

D. Electrical and Physical Tests:

1. Cable thickness shall meet or exceed AEIC and ICEA requirements and shall have 133%
2. insulation. The primary cable ratings shall be:
3. a) 5,000 Volts; nominal 115 mils thickness,
4. b) 15,000 volts; nominal 220 mils thickness, or
5. c) 25,000 volts; nominal 345 mils thickness.

- E. Cable shall pass the flame test in accordance with the IEEE 1202, CSA FT4 & ICEA T-29-520.

- F. 8. The cable shall meet or exceed the following standards: ICEA S-93-639, NEMA WC 74, AEIC

- G. CS-8, ASTM B-496, UL-1072 (type MV-105) for all cables, IEEE 383 for cables 1/0 AWG and larger.

- H. 9. The Quality Assurance Program and the ISO certification shall be provided to State
- I. Construction Office upon request.
- J. 10. Qualification Test Report for the cable insulation system (conductor-shield, insulation, and
- K. insulation-shield) shall be provided to State Construction Office upon request.
- L. 11. The cable supplied must have been manufactured within 12 months prior to date of order
- M. placement.
Test methods and frequency of tests (for tests in F-2 and F-3 above) shall be as prescribed in Part 6 ICEA S-93-639.
- N. Cable Identification: The following information shall be indicated, by means of a surface legend printed in compatible ink of contrasting color, at intervals not to exceed 24 inches (600 mm) over the entire length of the cable:
 - 1. Manufacturer's name.
 - 2. Conductor material.
 - 3. Conductor size.
 - 4. Maximum rated voltage.
 - 5. Insulation material.
 - 6. Letter designating cable type.
 - 7. Shielded or non-shielded.
 - 8. Date of manufacture.
- O. Reel Identification: Each reel shall have printed on the reel or a weatherproof (metal or plastic) tag firmly attached indicating:
 - 1. Manufacturer's name.
 - 2. Conductor material.
 - 3. Conductor size.
 - 4. Insulation type and thickness.
 - 5. Jacket thickness.
 - 6. Temperature rating.
 - 7. Length of cable.
 - 8. Manufacturer's type.
 - 9. Voltage class.
 - 10. Purchaser's purchase order number and item number.
 - 11. Cable weight.
 - 12. Reel weight.
 - 13. Shielded or non-shielded.
 - 14. Date of manufacture.
- P. Shipment: The cable shall be shipped in continuous lengths as specified by the Subcontractor. The shipment shall be made on carefully inspected non-returnable reels if possible. Cable ends shall be securely fastened to the reel using polypropylene rope ties. Metal ties shall not be used. Cable ends shall be completely sealed against moisture and contaminants. The cable on the reel shall be protected with plyboard or tekboard lagging held securely in place with steel banding.
- Q. Conductor and Shield Continuity: Each length of completed cable shall be tested for conductor and shield continuity.
- R. Reports: Certified copies of Production Tests specified in Paragraph 2.2.F shall be furnished for each shipment of cable.

2.3 CABLE TERMINATIONS

- A. Manufacturers:
 - 1. Raychem; Hot Splices; 3MI; or equal.

- B. Description: IEEE 48; Class 1, molded rubber cable termination in kit form with stress cone, ground clamp, non-tracking rubber skirts, utilizing molded elastomer, wet process porcelain, pre-stretched, and heat-shrinkable terminations utilizing factory preformed components to the maximum extent practicable, rather than tape build-up. Terminations shall have a basic impulse level as required for the system voltage level.

2.4 CABLE SPLICES

- A. Manufacturers:
 - 1. Raychem; Hot Splices; 3M; or equal.
- B. Description: IEEE 404 and 592; splice kits may be of the heat-shrinkable type, of the pre-molded splice and connector type, the conventional taped type, or the resin pressure-filled overcast tape type.

2.5 CIRCUIT LABELS

- A. Manufacturers:
 - 1. Almetek Industries, Type E-Z -Tag; Seton,; or equal.
- B. Description: Cable circuit labels shall be 1-1/2 (38 mm) high, polyethylene, with black on yellow characters, in a polyethylene holder, attached to the cable by two nylon self locking ties.

2.6 FIREPROOFING TAPE

- A. Manufacturers:
 - 1. 3M; Plymouth; STI or equal.
- B. Description: The tape shall be noncorrosive to cable sheath, shall be self-extinguishing, and shall not support combustion. The tape shall not deteriorate when subjected to oil, water, gases, salt water, sewage, or fungus.

PART 3 - EXECUTION

3.1 15KV CABLE INSTALLATION

- A. Carefully protect cable from mechanical damage. Provide suitable mechanical protection for reels.
- B. Pull cable directly from reels into the ducts. It may not be laid on the ground or otherwise handled for cutting or sorting. Pulling lubricant, UL-listed and compatible with the cable being pulled, as manufactured by IDEAL, Y-ER-EAS, or equal, shall be generously applied. Pulling tension (lbs) not to exceed 0.008 times the circular-mil cross-sectional area of the conductor. Cables shall not be pulled through more than one intermediate manhole on one pull. Cable ends shall be sealed against moisture after pulling. Pull ropes shall be non-metallic to prevent cutting of duct materials.
- C. Pulling tension and side wall pressure shall not exceed the manufacturer's allowable values. Pulling tension shall be continuously monitored during a pull by use of a dynamometer. The dynamometer shall have been calibrated within a year of its use on the project. If the pulling tension or sidewall pressure is exceeded during a pull, the cable shall be considered damaged and shall be replaced by the Subcontractor
- D. Installation of Cables in Manholes and Handholes: Cable shall not be installed utilizing the shortest route, but shall be routed along those walls providing the longest route and the maximum spare cable lengths. Cables shall be formed closely parallel to the walls, shall not interfere with duct entrances, and shall be supported on brackets and cable insulators, spaced at a maximum of four feet. In existing manholes and handholes where new ducts are to be terminated or where new cables are to be installed, the existing installation of cables, cable supports, and grounding shall be modified as required for a neat and workmanlike installation with cables properly arranged and supported.

- E. Split wire-basket cable grips shall be used to restrain conductors in manholes, handholes, and pull boxes on downhill duct runs.
- F. Splicing of cable within manholes shall be as recommended by the cable manufacturer. The Subcontractor shall furnish for approval two (2) copies of the manufacturer's splicing and termination procedures. Splices shall be suitable for continuous immersion in water and shall be made only in accessible locations in manholes or handholes. Maintain existing phase rotation after splicing in the new sections of cables.
- G. Splicing shall be done by a qualified subcontractor specializing in high-voltage splicing and testing, using experienced cable splicers having experience specified in the Quality Assurance article above.
- H. Splices in Shielded Cables: Splices in shielded cables shall include covering the spliced area with metallic tape, or like material, to the original cable shield and by connecting it to the cable shield on each side of the splice. Provide a No. 12 AWG or larger solid copper ground connection brought out in a watertight manner and grounded to a 3/4 inch by 10 foot (18mm by 3m) ground rod as part of the splice installation. Wire shall be trained to the sides of the enclosure in a manner to avoid interference with the working area.
- I. The 4/0 AWG bare copper-conductor ground wire shall be bonded to existing and new ground rods in manholes.
- J. Fireproofing (arc proofing) of cables in manholes, handholes, and vaults: Medium voltage cables, in manholes and handholes, shall be fireproofed. Strips of fireproofing tape, approximately 1/16 inch (1.5 mm) thick by 3 inches wide (75 mm), shall be wrapped tightly around each cable spirally in a half-lapped wrapping, or in two butt-jointed wrappings with the second wrapping covering the joints in the first. To prevent unraveling, the fireproofing tape shall be random wrapped, the entire length of the fireproofing, with pressure sensitive glass cloth tape. The fireproofing tape shall consist of a flexible, conformable fabric having one side coated with flame retardant, flexible, polymeric coating and/or a chlorinated elastomer not less than 0.050 inch thick (1.3 mm) and shall weigh not less than 2.5 pounds per square yard (1.436 k/m²). The tape shall be applied with the coated side toward the cable and shall extend one inch into ducts.

3.2 12KV CABLE LABELING

- A. 12kV circuits shall have each phase tagged (A, B, or C) at termination points and on either side of each splice in a man hole, using plastic tie-tags.
- B. At each manhole, handhole or pull box, 12kV circuit labels, as shown on the drawings, shall be attached to each cable group. As the cable enters it shall be labeled to identify the source. As the cable leaves it shall be labeled to identify its destination. At approximately the center of the cable group it shall be identified with its feeder circuit designation.

3.3 TEST LABORATORY

- A. The Subcontractor shall provide the services of a recognized independent testing laboratory for the purpose of performing inspections and tests on the cable installation. The testing laboratory shall meet federal OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907. Membership in the National Electrical Testing Association constitutes proof of meeting such criteria. The testing laboratory shall submit proof of the above qualifications through the Subcontractor to the University. The testing laboratory shall provide material, equipment, labor, and technical supervision to perform such tests and inspections. The tests and inspections shall determine the suitability, of the cable installation for energization.

3.4 15kV CABLE TESTING IMMEDIATELY AFTER INSTALLATION

The cable shall be tested at the factory. The Contractor shall be required to furnish a Certified Manufacturer's Test Report for the "Master Reel" of each cable length shipped, for approval by the Engineer. The test report shall include:

- a) A high voltage test (AC)

b) Corona test.

2. The manufacturer's certified test report shall include all the data. Copy of the test report shall be included in the final documents provided to the Owner.

3. After installation, but prior to energizing the system, the Contractor shall also conduct a "Very Low Frequency with dissipation factor, Tangent Delta" (VLF tan delta) withstand test of the system in accordance with IEEE 400 and the Design Engineer's specified testing procedure, as witnessed and "signed-off" by the Design Engineer. See ANSI/NETA Maintenance Testing Specifications. Copies of this test report shall be sent to the Owner, to the Engineer, and available at Beneficial or Final inspection by State Construction Office. Include the test report in the Operations and Maintenance Manual for owner's future reference.

3.6 Warranty

1. The cable manufacturer shall warrant to the Owner that each reel of cable is free from defects in material, design and workmanship and will provide reliable performance for a twenty-five (25) year life from the date of project final acceptance.
2. The warranty assumes the cable is installed, spliced, terminated, and maintained in accordance with manufacturer's recommendations.
3. Prior to cable termination or splicing, Contractor shall submit the qualifications of personnel directly responsible for completing this work to the Engineer. Upon approval by the Engineer in writing, Contractor may proceed with this portion of the work.
4. Defective cable shall be replaced, to include material and labor, at no cost to the Owner.
 - a) When the manufacturer and the Owner mutually determine a portion of or all the cable is defective, the cable manufacturer shall furnish replacement of said cable without charge.
 - b) The replacement cable shall comply with these requirements and be delivered to the original delivery point free of any charge to the Owner or the State of North Carolina.
5. Cable shop drawings shall include said described warranty from the cable manufacturer properly signed and having the manufacturer's corporate seal affixed thereto

END OF SECTION 260513

SECTION 260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.
- C. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- J. Class 2 Control Circuits: Type THHN-THWN, in raceway Power-limited cable, concealed in building finishes, or Power-limited tray cable, in cable tray.

SECTION 260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Make splices 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 and tap conductor for aluminum conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least **6 inches** of slack.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 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. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory 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, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: [Copper-clad] steel; [3/4 inch by 10 feet] in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Bury at least 30 inches below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.

2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
 10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- 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 Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a **1/4-by-2-by-12-inch** grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- G. 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.
- 3.3 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 Division 26 Section "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 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 so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
 - E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, 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.
- 3.4 FIELD QUALITY CONTROL
- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
 - a. Measure ground resistance not less 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.
 - B. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: **[10]** ohms.
 - 2. Power and Lighting Equipment or System with Capacity 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).
 - C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Designer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.3 SUBMITTALS

- A. Product Data: For steel slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Equipment supports.
- C. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 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, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 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. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- 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 non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, [**zinc-coated**] [**stainless**] steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of 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; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 5. Toggle Bolts: All-steel springhead type.
 6. Hanger Rods: Threaded steel.
- 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES
- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
 - B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.
- PART 3 - EXECUTION
- 3.1 APPLICATION
- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
 - B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be **1/4 inch** in diameter.
 - C. 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**] [**single-bolt conduit clamps**] [**single-bolt conduit clamps using spring friction action for retention in support channel**].
 - D. Spring-steel clamps designed for supporting single conduits without bolts may be used for **1-1/2-inch** and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.
- 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, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in 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. To Steel: **[Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts] [Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69] [Spring-tension clamps].**
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS
 - A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
 - B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
 - 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 Division 03 Section "Miscellaneous Cast-in-Place Concrete."
 - C. Anchor equipment to concrete base.
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
- 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 Division 09 painting Sections 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 260529

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this section includes conduits, surface raceways, multi-outlet assemblies, auxiliary gutters, wall duct, and boxes for electrical systems including wall and ceiling outlet boxes, floor boxes, and junction boxes.

1.2 SUBMITTALS

- A. Surface Raceway System - submit product data and catalog sheets for all components.
- B. Boxes - provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT AND FITTINGS

- A. Conduit: Heavy wall, galvanized steel, schedule 40, threaded.
- B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.2 PVC COATED RIGID METAL CONDUIT

- A. PVC Externally Coated Conduit: Rigid heavy wall, schedule 40, steel conduit with external 40 mil (0.1 mm) PVC coating. Conduit must be hot dipped galvanized inside and out including threads. The PVC coating bond to the galvanized steel conduit shall be stronger than the tensile strength of the coating itself.
- B. Fittings and Conduit Bodies: Threaded type, material to match conduit. PVC coated fittings and couplings shall have specially formed sleeves to tightly seal to conduit PVC coating. The sleeves shall extend beyond the fitting or coupling a distance equal to the pipe outside steel diameter or two inches (50 mm) whichever is greater.

2.3 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

- A. Conduit: Galvanized steel, threaded.
- B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.4 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. Conduit: Steel, galvanized tubing.
- B. Fittings: All steel, set screw, water tight, concrete tight. No push-on or indenter types permitted.
- C. Conduit Bodies: All steel threaded conduit bodies.

2.5 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: steel, galvanized, spiral strip.
- B. Fittings and Conduit Bodies: All steel, galvanized, or malleable iron.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.

2.7 RIGID NONMETALLIC CONDUIT AND FITTINGS

- A. Conduit: Schedule 40 PVC minimum, Listed, sunlight resistant, rated for 90° C conductors.
- B. Fittings and Conduit Bodies: NEMA TC 2, Listed.

2.8 SURFACE METAL RACEWAY

- A. Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.
- B. Size: As shown on Drawings.
- C. Finish: Color selection by Architect.
- D. Fittings: Couplings, elbows, and connectors designed for use with raceway system.
- E. Boxes and Extension Rings: Designed for use with raceway systems.

2.9 SURFACE NONMETAL RACEWAY

- A. Description: Nonmetallic channel with fitted cover, suitable for use as surface raceway.
- B. Size: As shown on Drawings.
- C. Finish: Color selection by Architect.

- D. Fittings: Couplings, elbows, and connectors designed for use with raceway system.
- E. Boxes and Extension Rings: Designed for use with raceway systems.
- 2.10 AUXILIARY GUTTERS (Wireways)
 - A. Description: General purpose, Oil-tight and dust- tight, or Rain-tight type wireway without knockouts.
 - B. Size: Cross-section and length as indicated on drawings.
 - C. Cover: Hinged cover with full gasketing, where required by application.
 - D. Connector: [Slip-in construction;] [Flanged;] [hinged cover.] [screw applied cover.]
 - E. Fittings: Lay-in type with [removable top, bottom, and side; captive screws.] [drip shield.]
 - F. Finish: Rust inhibiting primer coat with gray enamel finish.
- 2.11 OUTLET BOXES
 - A. Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.
 - B. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.
 - C. Concrete Ceiling Boxes: Concrete type.
 - D. Cast Boxes: Cast ferroalloy, or aluminum type deep type, gasketed cover, threaded hubs.
- 2.12 FLOOR BOXES
 - A. Floor Boxes for Installation in Cast-In-Place Concrete Floors: As shown and detailed on Drawings.
- 2.13 PULL AND JUNCTION BOXES
 - A. Pull boxes and junction boxes shall be minimum 4 inch square (100 mm) by 2 1/8th inches (54 mm) deep for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit or larger, pull and junction boxes shall be sized per NEC but not less than 4 11/16 inch square (117 mm).
 - B. For telecommunication, fiber optic, security, and other low voltage cable installations the NEC box size requirements shall apply. All boxes, used on telecommunication, security, other low voltage and fiber optic systems with conduits of 1 1/4" and larger, shall be sized per the NEC conduit requirements. For determining box size, the conduit is the determining factor not the wire size.
 - C. Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.
 - D. Sheet Metal Boxes Larger Than 12 Inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover.
 - E. Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron or aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
 - F. Fiberglass or Concrete Handholes with weatherproof cover of non-skid finish shall be used for underground installations.
 - G. Box extensions and adjacent boxes within 48" of each other are not allowed for the purpose of creating more wire capacity.
 - H. Junction boxes 6" x 6" or larger size shall be without stamped knock-outs.
 - I. Wireways shall not be used in lieu of junction boxes.
- 2.14 GENERAL
 - A. All steel fittings and conduit bodies shall be galvanized.
 - B. No cast metal, split or gland type fittings permitted.
 - C. Condulets larger than 2 inch are (50 mm) not permitted except as approved or detailed.
 - D. All condulet covers must be fastened to the condulet body with screws and be of the same manufacture.
 - E. Wireways and gutters shall not be used in lieu of pull boxes and condulets.
 - F. All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. EMT is permitted to be used in sizes 4" and smaller for power and telecommunication systems. See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.
- B. Size power conductor raceways for conductor type installed. Conduit size shall be 1/2 inch minimum except as specified elsewhere. **Caution: Per the NEC, the allowable conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.**
- C. Size conduit for all other wiring, including but not limited to data, control, security, fire alarm, telecommunications, signal, video, etc. shall be sized per number of conductors pulled and their cross-section. 40% fill shall be maximum for all new conduit fills.
- D. Arrange conduit to maintain headroom and present a neat appearance.
- E. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- F. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.
- G. Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- H. Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.
- I. Support and fasten metal conduit at a maximum of 8 feet on center, and as required by NEC.
- J. Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, etc., unless so approved or detailed.
- K. In general, all conduits shall be concealed except where noted on the drawings or approved by the Architect/Engineer. Contractor shall verify with Architect/Engineer all surface conduit installations except in mechanical rooms.
- L. Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.
- M. No continuous conduit run shall exceed 100 feet without a junction box.
- N. MC Cable and Flexible Metal Conduit to be independently supported.

3.2 CONDUIT INSTALLATION

- A. Cut conduit square using a saw or pipecutter; de-burr cut ends.
- B. Conduit shall not be fastened to the corrugated metal roof deck.
- C. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- D. Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations (sheet metal boxes 4 & 11/16th" square and larger, shall contain NO pre-punched or concentric knockouts).
- E. All conduit terminations (except for terminations into conduit bodies) shall use connectors or conduit hubs with one locknut or shall use double locknuts (one each side of box wall) and insulating bushing. Provide bushings for the ends of all conduits not terminated in box walls. Refer to Division 26 Sections for grounding bushing requirements.
- F. Install no more than the equivalent of three 90 degree bends between boxes.
- G. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size unless sweep elbows are required.
- H. Conduit shall be bent according to manufacturers' recommendations. Torches or open flame shall not be used to aid in bend of PVC conduit.
- I. Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.

- J. Provide 1/8 inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.
 - K. Install expansion-deflection joints where conduit crosses building expansion joints. Note: expansion-deflection joints are not required where conduit crosses building control joints if the control joint does not act as an expansion joint. Install expansion fitting in PVC conduit runs as recommended by the manufacturer.
 - L. Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.
 - M. Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers, unheated and heated spaces, buildings, etc., provide Listed conduit seals to prevent the passage of moisture and water vapor through the conduit.
 - N. Route conduit through roof openings for piping and ductwork where possible.
 - O. Ground and bond conduit per other Division 26 Sections.
 - P. PVC conduit shall transition to galvanized rigid metal conduit before it enters a concrete pole base, foundation, wall (where exposed) or up through a concrete floor. Transition shall be under the slab or under grade, with a rigid 90-degree bend or elbow.
 - Q. Use PVC-coated rigid steel factory elbows for bends in plastic conduit larger than 2". PVC elbows are allowed in PVC conduit runs 2" and smaller.
 - R. All conduit installed underground (exterior to building) shall be buried a minimum of 24" below finished grade, whether or not the conduit is concrete encased.
 - S. PVC conduit shall be cleaned with solvent, and dried before application of glue. The temperature rating of glue/cement shall match weather condition. Apply full even coat of cement/glue to entire area that will be inserted into fitting. The entire installation shall meet manufacturers' recommendations.
 - T. Medium voltage conduit may be installed in interior locations other than electrical vaults only with special permission from Architect/Engineer.
- 3.3 CONDUIT INSTALLATION SCHEDULE
- A. Conduit other than that specified below for specific applications shall not be used.
 - B. Underground Installations within five feet of foundation fall: Rigid steel conduit.
 - C. Underground Installations more than five feet from foundation fall: Rigid steel conduit. Plastic-coated rigid steel conduit. Schedule 40 PVC conduit. Install in concrete duct bank as detailed on Drawings.
 - D. Under Slab on Grade Installations: Schedule 40 PVC conduit. Where conduit turns up through slab and is exposed, elbow shall be rigid steel conduit.
 - E. Exposed Outdoor Locations: Rigid steel conduit.
 - F. Concealed in Concrete and Block Walls: Rigid steel conduit. Schedule 40 PVC conduit.
 - G. Wet Interior Locations: Rigid steel conduit.
 - H. Concealed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
 - I. Exposed Dry Interior Locations: Rigid steel conduit.
 - J. Motor and equipment connections: Flexible PVC coated metal conduit (wet, damp, or dry locations). Flexible metal conduit (dry locations only). Minimum length shall be one foot; maximum length shall be three feet. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
 - K. Light fixtures: Direct box or conduit connection for surface mounted and recessed fixtures. Flexible metal conduit (fixture whip) from a J-box for recessed lay-in light fixtures. Conduit size shall be 3/8" minimum diameter and six foot maximum length. Conduit length shall allow movement of fixture for maintenance purposes. Contractor may use Type MC metal-clad cable in lieu of conduit/wire for fixture whips, size and wire size as specified above.
 - L. Medium Voltage Applications (Interior Locations): Rigid steel conduit.

3.4 SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY
INSTALLATION

- A. Use flat-head screws to fasten channel to surfaces every twenty-four (24) inches. Mount plumb and level.
- B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- C. Maintain grounding continuity between raceway components to provide a continuous grounding path per Division 26 Sections.
- D. Fastener Option: Use clips and straps suitable for the purpose.

3.5 NONMETALLIC SURFACE RACEWAY INSTALLATION

- A. Use flat headed screws with appropriate anchors to fasten channel to surfaces secured every twenty-four (24) inches. Mount plumb and level. All surface mounted devices shall be fastened to the wall utilizing flat head screws along with appropriate anchors. No device shall be adhered to the wall surface using two-faced tape or any means other than as described above.
- B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- C. In areas where the walls cannot be fished, the station cable serving these outlets shall be covered with raceways. No exposed wire shall be permitted within offices, laboratories, and conference rooms or like facilities.
- D. The non-metallic raceway shall have a screw applied base. Both the base and cover shall be manufactured of rigid PVC materials.
- E. The raceway shall originate from a surface mounted box mounted adjacent to and at the same height as existing electrical boxes in the room, be attached to the wall and terminate above the ceiling.
- F. All fittings including, but not limited to, extension boxes, elbows, tees, fixture bodies shall match the color of the raceway.
- G. The raceway and all systems devices shall be UL listed and exhibit nonflammable self extinguishing characteristics, tested to specifications of UL94V-0.
- H. The raceway and all systems devices shall adhere to the EIA/TIA Category 5e bend radius standard.

3.6 AUXILIARY GUTTERS (Wireways) INSTALLATION

- A. Bolt auxiliary gutter to wall using two-piece hangers or steel channels fastened to the wall or in self-supporting structure.
- B. Gasket each joint in oil-tight gutter.
- C. Mount rain-tight gutter in horizontal position only.
- D. Maintain grounding continuity between raceway components to provide a continuous grounding path under Division 26 Sections.
- E. Provide terminal blocks for wiring terminations in auxiliary gutters and wireways.

3.7 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. No outlet shall be located where it will be obstructed by other equipment, piping, lockers, benches, casework, etc.
- D. Boxes shall not be fastened to the metal roof deck.
- E. Contractor shall study drawings pertaining to other trades, discuss location of outlets with workmen installing other piping, equipment, casework, furnishing, etc., and fit all electrical outlets to job conditions. In case of conflicts, notify Designer prior to installation.
- F. The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.
- G. Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18 inch by 24 inch access doors.

- H. Locate and install to maintain headroom and to present a neat appearance.
- I. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

3.8 OUTLET BOX INSTALLATION

- A. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24 inch separation in acoustic-rated walls.
- B. Power: Recessed (1/4" maximum) outlet boxes in masonry, concrete or tile construction shall be masonry type, minimum 4 inch square. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.
- C. Low Voltage: Recessed (1/4" maximum) outlet boxes in masonry, concrete or tile construction shall be masonry type, minimum 4 11/16 inch square. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.
- D. Provide knockout closures for unused openings.
- E. Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches of box.
- F. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide non-metallic barriers to separate wiring of different voltage systems.
- G. Install boxes in walls without damaging wall insulation.
- H. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- I. Ceiling outlets shall be 4 inch octagon or 4 inch square, minimum 2-1/8 inch deep except that concrete boxes and plates will be approved where applicable. Position outlet boxes to locate luminaires as shown on reflected ceiling plans. All ceiling outlets shall be equipped with 3/8 inch fixture studs.
- J. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- K. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- L. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- M. Provide cast ferroalloy or aluminum outlet boxes in exterior and wet locations.
- N. Surface wall outlets shall be 4 inch square with raised covers for one and two gang requirements. For three gang or larger requirements, use gang boxes with non-overlapping covers.

3.9 FLOOR BOX INSTALLATION

- A. Set boxes level and flush with finish flooring material.

3.10 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install approved access panels in non-accessible ceilings where boxes are installed.
- B. Support pull and junction boxes independent of conduit.

END OF SECTION 260533

PART 1 - GENERAL**1.1 SUMMARY**

- A. This Section includes performance requirements for delegated design of vibration and seismic controls.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading: Refer to Structural Drawings for Seismic Design Category, Building Use Group, and Seismic design parameters.

1.3 SUBMITTALS

- A. Product Data: For all products provided.
- B. 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.
- C. Welding certificates.
- D. Qualification Data: For professional engineer.
- E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved 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

- A. Products shall be selected by engineer providing delegated design services.

PART 3 - EXECUTION**3.1 APPLICATIONS**

- A. Multiple Pipe Supports: Secure pipes 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 Delegated Design 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.

3.2 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 inches**.
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
- 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 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: 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.
 - 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 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 and stainless steel anchors for exterior applications.
 - 3.3 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 22 Section "Domestic Water Piping" for piping flexible connections.
 - 3.4 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 postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least 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. If 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, certified by Professional Engineer who provided Delegated Design.
 - 3.5 ADJUSTING
 - A. Adjust isolators after piping system is at operating weight.
 - B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
 - C. Adjust active height of spring isolators.
 - D. Adjust restraints to permit free movement of equipment within normal mode of operation.
- END OF SECTION 260548

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Identification for conductors and communication and control cable.
 - 2. Warning labels and signs.
 - 3. Equipment identification labels.
 - 4. Ceiling identification labels.

1.2 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.
- E. Fasteners for Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
- F. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. 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 (915 mm)."

2.3 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with color code as described below. Minimum letter height shall be 3/8 inch.

2.4 CEILING IDENTIFICATION LABELS

- A. Permanent, self-adhesive 3/4" diameter colored labels

PART 3 - EXECUTION

3.1 APPLICATION

- A. Auxiliary Electrical Systems Conductor and Cable Identification: Use marker tape to identify field-installed alarm, control, signal, sound, intercommunications, voice, and data wiring connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and cable pull points. Identify by system and circuit designation.

2. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - B. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs or metal-backed, butyrate warning signs. Identify system voltage using color code as described below. Apply to exterior of door, cover, or other access.
 1. 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.
 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
 - C. 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 systems unless equipment is provided with its own identification. MATCH OWNER'S LABELING STANDARD
 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment. Unless otherwise indicated, provide a single line of text with **1/2-inch-** high letters on **1-1/2-inch-** high label; where 2 lines of text are required, use labels **2 inches** high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment.
 - c. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.
 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Electrical switchgear and switchboards.
 - c. Transformers.
 - d. Motor-control centers.
 - e. Disconnect switches.
 - f. Enclosed circuit breakers.
 - g. Motor starters.
 - h. Push-button stations.
 - i. Power transfer equipment.
 - j. Contactors.
 - D. Ceiling identification labels
 1. Install ceiling identification labels on ceiling grid below junction boxes, switches, and other items that require adjustment.
 2. Install prior to installation of ceiling tile.
- 3.2 INSTALLATION
- A. Verify identity of each item before installing identification products.
 - B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
 - C. Apply identification devices to surfaces that require finish after completing finish work.
 - D. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
 - E. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 1. Color shall be factory applied.

2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White
 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray
 4. Isolated Circuits:
 - a. Hot: Orange
 - b. Neutra: Brown
- F. Color-Coding for Equipment Identification: Use the colors listed below for equipment.
1. Blue surface with white core for 120/208 volt equipment.
 2. Black surface with white core for 277/480 volt equipment.
 3. Bright red surface with white core for all equipment related to fire alarm system.
 4. Dark red (burgundy) surface with white core for all equipment related to security.
 5. Green surface with white core for all equipment related to "emergency" systems.
 6. Orange surface with white core for all equipment related to telephone systems.
 7. Brown surface with white core for all equipment related to data systems.
 8. White surface with black core for all equipment related to paging systems.
 9. Purple surface with white core for all equipment related to TV systems.
- G. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match the surface color scheme outlined above. This includes covers above lift-out and other type accessible ceilings.
- H. All J-box covers to be identified with circuit number.
- END OF SECTION 260553

SECTION 261213 – LIQUID-FILLED MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Related Documents:
 - 1. Drawings and general provisions of the Subcontract apply to this Section.
 - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section Includes:
 - 1. Liquid filled distribution and power transformers.
 - 2. Liquid filled, outdoor, pad mounted distribution transformers.
 - 3. Transformers shall include all standard and optional accessories as listed in this specification.

1.2 REFERENCES

- A. General:
 - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
 - 3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
 - 4. Refer to Division 26 Section "Common Results for Electrical" for codes and standards, and other general requirements.
- B. ANSI – American National Standards Institute:
 - 1. ANSI/NFPA 70 National Electrical Code.
 - 2. ANSI/IEEE C57.12.00 General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - 3. ANSI C57.12.10 Requirements for Transformers 230000 Volts and Below; 833/958 Through 8333/10417 kVA, Single-Phase, and 750/862 Through 60000/80000/100000 kVA, Three-Phase (includes supplement ANSI C57.10.10a).
 - 4. ANSI C57.12.13 Conformance Requirements for Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations.
 - 5. ANSI C57.12.26 Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors.
 - 6. ANSI C57.12.27 Conformance Requirements for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations.
 - 7. ANSI C57.12.70 Terminal Markings and Connections for Distribution and Power Transformers.
 - 8. ANSI/IEEE C57.12.90 Test Code for Liquid-Immersed Distribution and Power Transformers.
 - 9. ANSI/IEEE 386 Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.
- C. ASTM International:
 - 1. ASTM D877 Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
- D. NEMA – National Electrical Manufacturers Association:
 - 1. NEMA TR 1 Transformers, Regulators and Reactors.
 - 2. NEMA TR 11 Small Power Transformers with 65 C Average Winding Rise and Distribution Characteristics.
 - 3. NEMA 260 Safety Labels for Padmounted Switchgear and Transformers Sited in Public Areas.

1.3 SUBMITTALS

- A. Submit under provisions of Division 26 Section "Common Results for Electrical - Review of Materials" and Division 01 Section "General Requirements."

- B. Submit five (5) copies of certified test data:
 - 1. Factory test data, including but not limited to the following:
 - a. Resistance measurements of all windings
 - b. Ratio tests
 - c. Polarity and phase relation tests
 - d. No-load loss at rated voltage
 - e. Impedance
 - f. Voltage and load loss at rated current
 - g. Dielectric tests
 - 2. Previous test data on similar unit, in lieu of factory tests on actual units furnished, including but not limited to the following:
 - a. Impulse tests
 - b. Temperature rise tests
 - c. Sound tests
 - d. Power factor tests
 - e. Bushing tests
 - f. Short circuit tests
- C. Submit five (5) copies of manufacturer's installation instructions.
- D. Submit approved Material Safety Data Sheet (MSDS) for cooling liquid.
- E. Operation and Maintenance Data:
 - 1. Submit five (5) operation and maintenance manuals.
 - 2. Include five (5) copies of procedures and for sampling and maintaining fluid, cleaning unit, and replacing components.
 - 3. Furnish a list of, and prices for, any recommended special tools and spare parts to permit proper maintenance and repair of the transformer.

1.4 QUALITY ASSURANCE

- A. Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL) as listed in Division 26 Specification "Common Work Results for Electrical."
- B. Electrical equipment and materials shall be new and within one year of manufacture, complying with the latest codes and standards. No used, re-built, refurbished and/or re-manufactured electrical equipment and materials shall be furnished on this project.
- C. Design and test transformers in accordance with the applicable ANSI/IEEE, NEMA and ASTM standards listed in the References Article.
- D. Manufacturer's Qualifications: Company specializing in distribution transformers with 10 years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect products under provisions of Division 01 Section "General Requirements."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Westinghouse.
- B. Siemens Transmission & Distribution.
- C. General Electric.
- D. Square D.

2.2 LIQUID-FILLED PAD MOUNTED TRANSFORMERS

- A. Liquid-filled Transformers: ANSI C57.12.26; three-phase, pad mounted, self-cooled transformer unit.
- B. Capacity: As shown on drawings
- C. Primary Voltage: 12.47 kV, delta connected; provide standard primary taps, with externally-operated, no-load tap changer. The tap changer shall have a handle with provision for padlocking.
- D. Secondary Voltage: [480/277] volts, wye connected, solidly grounded.
- E. Impedance: [5.75] percent.
- F. Basic Impulse Level: 95 kV, HV; 30 kV, LV .
- G. Cooling and Temperature Rise; ANSI C57.12.22; Class OA. [55 deg C], self-cooled.
- H. The "compartment type" pad mounted transformer shall be three-phase, less flammable liquid insulated, tamper resistant, 65 degree C temperature rise rated, 60 hertz frequency, with wye connected primary and secondary, and voltage as applicable for the project. Transformer insulating fluid shall be "R-Temp" or any LISTED "less flammable liquid" similar to BIOTEMP, or FR3, with a fire point of not less than 300-degree C when tested according to ASTM D92. The less-flammable insulated transformer installation shall comply with the installation criteria of the NCBCC approved third-party testing agency (U.L.) per NEC 450-23.
- I. The transformer tank shall be of a sealed-tank construction as specified in ANSI Standard C57.12.26. The tank shall be a minimum of 12-gauge sheet steel, and strong enough to withstand a pressure of 7 psi without permanent distortion and 15 psi without rupturing or displacing of transformer components. A removable main cover may be provided over a bolted-on, tamperproof handhold. Handholds shall be provided for access to high voltage isolation links, three-phase switches, neutral connections, etc. The high and low voltage compartments shall be located side by side, separated by a steel barrier. When facing the transformer, the low voltage compartments shall be on the right. Terminal compartments shall be full height, air-filled, with individual doors. The high voltage door fastenings shall not be accessible until the low voltage door has been opened.
- J. 6. Transformer tank grounding provisions shall be in accordance with ANSI standards. The grounding provisions shall be capped before painting the unit.
- K. 7. The core and coil assembly shall be of a five-legged wound core type design to provide adequate short-circuit strength and heat dissipation. Transformers connected wye-wye shall be built with five-legged core-type design to avoid the tank heating problems sometimes associated with wye-wye connections. When required, corrugated cooling panels shall be provided on the back and sides of the oil-filled tank to maintain a safe operating temperature. Internal leads shall be insulated, trained, and anchored to prevent phase-to-phase flashover.
- L. 8. Transformers are to be equipped with four (4) taps rated approximately 2-1/2 percent, with two (2) above and two (2) below normal. The tap changer shall be externally hook stick operated and located in the high voltage compartment. The tap changer shall be designed and marked for de-energized operation. As part of the transformer installation, perform a turns ratio test between windings at all tap positions with the final tap setting to be set at the secondary system rated voltage at full load or as directed by the Engineer.
- M. 9. The high voltage terminations and equipment shall be of the dead front construction.
- N. 10. Two high voltage bushings per phase shall be provided to permit operating a loop feed dead front transformer from a looped primary cable system. The high voltage bushings shall be one-piece type for use with load-break elbow terminators. As an optional method, provide a radial feed transformer, where applicable, with one bushing well and one load-break feed-thru insert per phase. Construction shall conform to ANSI/IEEE Standard 386. Bushings shall be externally clamped and externally removable. High and low voltage winding lead lengths shall be long enough to permit field replacement of bushings or bushing wells. All gasketed joints are to afford a sealed tank in accordance with industry standards. Gasket material must be durable and reusable. Parking stands shall be provided for mounting accessory equipment.
- O. 11. Lightning arrester mounting provisions in live front units only: For live front units only, provide three (MOV rating based upon kV class) distribution class lightning arresters for surge protection. Arresters are to be mounted in the high voltage compartment per ANSI/IEEE Standard 386.

- P. 12. Transformer overcurrent protection shall be a combination of oil-immersed current-limiting fuses in series with bayonet oil-immersed, overload sensing, expulsion fuses coordinated to provide full range protection with the expulsion fuse clearing low-current faults and the current limiting fuses clearing high-current faults up to 50,000 amperes. The fuse assembly shall have an interrupting rating of (3500A at 8.3 KV) or (1800 A at 15.5 KV) single phase, and a load break rating of 125A at 80% power-factor for (8.3 KV or 15.5 KV) single phase. The bayonet fuses must be accessible through the primary compartment. They must be externally removable and field replaceable using a hot stick. This operation must be accomplished without having to remove the transformer compartment top. A welded-on oil drip shield must be located under the bayonet fuse to protect the primary connections.
- Q. 13. The low voltage bushing shall be molded epoxy and capable of withstanding a load in a vertical direction of 800 inch-lbs. without causing a deflection sufficient to produce a leak. The bushings shall be externally clamped, blade type spade terminals with four (4)-hole NEMA standard spacing for transformers up to 500 KVA. Transformers above 500 KVA shall be equipped with six (6)-hole NEMA spacing. The bushings shall be arranged for vertical take-off.
- R. 14. For wye-wye connected transformers, the high voltage neutral shall be connected internally to the low voltage neutral with provisions for opening this connection for testing. The neutral bushing shall be fully insulated but connected to an adjacent ground pad (on the tank) with a detachable strap sized to carry the maximum fault current available from the transformer.
- S. Accessories: The following accessory equipment shall be provided in accordance with ANSI C57.12.26:
1. Magnetic liquid level gage with alarm contacts.
 2. Top oil dial type thermometer with alarm contacts.
 3. Pressure relief device. Pressure-relief device suitable for the transformer as recommended by transformer manufacturer that will automatically relieve pressure and effectively keep the transformer sealed with no leakage of air or oil or any permanent distortion. Any pressure-relief device must exclude moisture from the transformer and have a life equal to the transformer.
 4. Provisions for lifting and jacking.
 5. Base suitable for skidding and rolling in any direction.
 6. Hand hole in cover.
 7. Drain valve and sampling device and bottom filter press connection.
 8. Top filling connection and filter press connection.
 9. Grounding pads at base of tank.
- T. [Primary Terminations: Bushing wells to ANSI/IEEE 386; provide [six for [loop] feed.] Include bushings for insulated loadbreak connectors.]
- U. [Primary Terminations: Porcelain insulator with clamp-type connector.]
- V. Secondary Terminations: Spade lugs.
- W. Sound level shall be in accordance with NEMA TR 1 standard.
- X. Finish Color: ANSI Z55.1, No. 61, (light gray) utilizing a phosphatizing and initial cleaning treatment followed by a baked on epoxy primer and finish coats having a thickness of 3 to 5 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pads are ready to receive work.
- B. Verify that required utilities are available, in proper location and ready for use.
- C. Observe all restrictions imposed by safety tags and locks.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Install safety labels to NEMA 260.

3.3 FIELD QUALITY CONTROL

- A. Test dielectric liquid to ASTM D877, using 25,000 volts minimum breakdown voltage, after installation and before being energized.
- B. Test transformer to ANSI/IEEE C57.12.90.
- C. Provide the University with 5 certified copies of all field test reports.

3.4 ADJUSTING

- A. Adjust primary taps so that secondary voltage is within [2] percent of rated voltage.

3.5 ACCEPTANCE

- A. Final acceptance shall depend upon the satisfactory performance of the transformer under test. Transformers shall not be energized until all test data and records are approved by the University.

END OF SECTION 261213

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 - 1. Distribution transformers.
 - 2. Buck-boost transformers.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Indicate dimensions and weights.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Field quality-control test reports.
- E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Basis of Design Product: As shown on Drawings.
- B. Comparable products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 2. General Electric Company.
 - 3. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: **[Copper]**.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Cores: One leg per phase.
- D. Enclosure: [Ventilated], NEMA 250, Type 2.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Enclosure: [Ventilated], NEMA 250,.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- F. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: [Gray].
- G. Taps for Transformers Smaller Than 3 kVA: **[One 5 percent tap above normal full capacity]**.
- H. Taps for Transformers 7.5 to 24 kVA: [One 5 percent tap above and one 5 percent tap below normal full capacity].
- I. Taps for Transformers 25 kVA and Larger: [Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity].
- J. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of **[115]** deg C rise above 40 deg C ambient temperature.
- K. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Comply with US DOE 10 CFR 431
 - 3. Tested according to NEMA TP 2.
- L. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
 - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - 2. Indicate value of K-factor on transformer nameplate.

- M. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
- N. Wall Brackets: Manufacturer's standard brackets.

2.4 BUCK-BOOST TRANSFORMERS

- A. Description: Self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer. Transformers shall comply with NEMA ST 1 and shall be listed and labeled as complying with UL 506 or UL 1561.
- B. Enclosure: Ventilated, NEMA 250, Type 2.
 - 1. Finish Color: [Gray].

2.5 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate. Nameplates are specified in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 - 1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Hangers and Supports for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - a. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - b. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
 - c. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

3.3 ADJUSTING

- A. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

END OF SECTION 262200

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards 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."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.
- C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Field quality-control reports.
- E. Panelboard schedules for installation in panelboards.
- F. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of final acceptance.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted 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 Areas: NEMA 250, Type 4X.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Directory Card: Inside panelboard door, mounted in transparent card holder.

- C. Incoming Mains Location: Top and bottom, as shown on Drawings.
 - D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
 - E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: [**Hard-drawn copper, 98 percent conductivity**].
 - 2. Main and Neutral Lugs: [**Mechanical**] type.
 - 3. Ground Lugs and Bus Configured Terminators: [**Mechanical**] type.
 - 4. Feed-Through Lugs: [**Mechanical**] type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: [**Mechanical**] type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - F. Service Equipment Label: NRTL labeled for use as service equipment for all panelboards.
 - G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 - H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by an NRTL.
 - I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
 - J. Provide surge protection devices on all emergency panelboards per NEC 700.8. Refer to electrical specification section: 264313 Transient-Voltage Surge Suppression for details.
- 2.2 DISTRIBUTION PANELBOARDS
- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product 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. Panelboards: NEMA PB 1, power and feeder distribution type.
 - C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - D. Mains: Circuit breaker, Fused switch, or Lugs only, as indicated on drawings.
 - E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: [**Bolt-on**] circuit breakers.
 - F. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
 - G. Branch Overcurrent Protective Devices: Fused switches.
- 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS
- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product 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. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
 - C. Mains: Circuit breaker or lugs only.
 - D. Branch Overcurrent Protective Devices: [**Bolt-on**] circuit breakers, replaceable without disturbing adjacent units.
 - E. Contactors in Main Bus: NEMA ICS 2, Class A, [**mechanically**] held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. External Control-Power Source: [**120-V branch circuit**].
 - F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
- 2.1 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES. (SERVICE ENTRANCE MAIN BREAKER TO BE GFI PROTECTED PER NEC 230.95)
 - A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product 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. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with **[interrupting capacity]** to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t 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 two-pole configurations with Class A ground-fault protection (6-mA trip).
 - 6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - 7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 - 8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: **[Mechanical]** style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: **[Integrally mounted]** relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Communication Capability: **[Circuit-breaker-mounted]** communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 - f. Shunt Trip: **[120]** -V trip coil energized from separate circuit, set to trip at **[75]** percent of rated voltage.
 - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in **[on or off]** position.
 - h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- 2.2 ACCESSORY COMPONENTS AND FEATURES
 - A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to [NECA 407] [NEMA PB 1.1].
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. 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 (27-GRC) empty conduits into raised floor space or below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- I. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- 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. 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.
- 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. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 STUDIES

- A. Electrical Contractor to provide a complete short circuit and selective coordination study from the service entrance to all end devices. The study shall be provided by the switchgear manufacturer and utilize time current curves provided by manufacturer for the specific project. The study shall be made available for engineer's review and included with shop drawings **PRIOR TO SENDING PANELBOARD SUBMITTAL**.

- B. The selective coordination study shall meet the requirements described by NEC Articles 700.32, 701.27, 708.54, and 620.62.
- C. The minimum NEC requirement for the selective coordination study is applicable to the systems described in NEC Articles 700.32, 701.27, 708.54, and 620.62, and as indirectly referenced for essential electrical systems in Article 517.

END OF SECTION 262416

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Wall-box motion sensors.
 - 3. Snap switches and wall-box dimmers.
 - 4. Solid-state fan speed controls.
 - 5. Wall-switch and exterior occupancy sensors.
 - 6. Communications outlets.
- B. See Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design Product: As shown on Drawings.
- B. Comparable Products by Cooper, Hubbell, Leviton, Pass & Seymour.

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498. REQUIRED TO BE FEDERAL SPECIFICATION GRADE

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed or non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A.

2.4 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A.
- C. Pilot Light Switches, 20 A.
 - 1. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A.
 - 1. 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 and where otherwise indicated.
- F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors and where otherwise indicated, with factory-supplied key in lieu of switch handle.

2.5 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, toggle switch, or rotary knob; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

1. Wattage as shown on Drawings; dimmers shall require no derating when ganged with other devices.
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.
- 2.6 FAN SPEED CONTROLS
 - A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
 1. Continuously adjustable slider, toggle switch, or rotary knob, 5 A.
 2. Three-speed adjustable slider or rotary knob, 1.5 A.
- 2.7 OCCUPANCY SENSORS
 - A. Wall-Switch Sensors:
 1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of **900 sq. ft.**
 - B. Wall-Switch Sensors:
 1. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of **900 sq. ft.**
 - C. Long-Range Wall-Switch Sensors:
 1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of **1200 sq. ft.**
 - D. Long-Range Wall-Switch Sensors:
 1. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of **1200 sq. ft.**
 - E. Wide-Range Wall-Switch Sensors:
 1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of **1200 sq. ft.**
 - F. Exterior Occupancy Sensors:
 1. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and **110-foot** detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.
- 2.8 COMMUNICATIONS OUTLETS
 - A. Telephone Outlet:
 1. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1 complying with Category 5e. Comply with UL 1863.
 - B. Combination TV and Telephone Outlet:
 1. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.
- 2.9 WALL PLATES
 - A. Single and combination types to match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: **0.035-inch-** thick, satin-finished stainless steel.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
 - B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.
- 2.10 FLOOR SERVICE FITTINGS
 - A. Type: Modular, [**flush-type**] [**flap-type**] [**above-floor**], dual-service units suitable for wiring method used.
 - B. Compartments: Barrier separates power from voice and data communication cabling.
 - C. Service Plate: [**Rectangular**] [**Round**], [**die-cast aluminum**] [**solid brass**] with satin finish.
 - D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

- E. Voice and Data Communication Outlet: [**Blank cover with bushed cable opening**] [**Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable**].
- 2.11 FINISHES
- A. Color: Wiring device catalog numbers in Section Text do not designate 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.
 - 3. TVSS Devices: Blue.
- PART 3 - EXECUTION
- 3.1 INSTALLATION
- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
 - B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
 - C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted provided the outlet box is large enough.
 - D. Device Installation:
 - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than **6 inches** in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 - 8. Tighten unused terminal screws on the device.
 - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
 - E. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles [**up**] [**down**], and on horizontally mounted receptacles to the [**right**] [**left**].
 - 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 top. Group adjacent switches under single, multigang wall plates.
- 3.2 IDENTIFICATION
- A. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Use durable wire markers or tags inside outlet boxes.
- 3.3 FIELD QUALITY CONTROL
- A. Perform tests and inspections and prepare test reports.
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
 - B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

END OF SECTION 262726

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes lightning protection for **[buildings]** **[building elements]** **[building site components]**.

1.2 SUBMITTALS

- A. Product Data: For air terminals and mounting accessories indicated.
- B. Shop Drawings: Detail lightning protection system, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway and data on how concealment requirements will be met.
- C. Qualification data.
- D. Certification, signed by Contractor, that roof adhesive for air terminals is approved by manufacturers of both the terminal assembly and the single-ply membrane roofing material.
- E. Field inspection reports indicating compliance with specified requirements.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who is NRTL listed or who is certified by LPI as a Master Installer/Designer.
- B. Listing and Labeling: As defined in NFPA 780, "Definitions" Article.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Automatic Lightning Protection.
 - 2. ERICO International Corporation.
 - 3. Harger Lightning Protection, Inc.
 - 4. Heary Bros. Lightning Protection Co. Inc.
 - 5. Independent Protection Co.
 - 6. Robbins Lightning Inc.
 - 7. Thompson Lightning Protection, Inc.

2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96.
- B. Roof-Mounting Air Terminals: NFPA Class **[I]** **[II]**, **[aluminum]** **[copper]**, **[solid]** **[tubular]**, unless otherwise indicated.
 - 1. Single-Membrane, Roof-Mounting Air Terminals: Designed for single-membrane roof materials.
- C. Ground Rods, Ground Loop Conductors, and Concrete-Encased Electrodes: Comply with Division 26 Section "Grounding and Bonding for Electrical Systems" and with standards referenced in this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops.
- C. Conceal the following conductors:
 - 1. System conductors.
 - 2. Down conductors.
 - 3. Interior conductors.
 - 4. Conductors within normal view from exterior locations at grade within **200 feet** of building.
 - 5. Notify Designer at least 48 hours in advance of inspection before concealing lightning protection components.
- D. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

- E. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.
 - F. Bond extremities of vertical metal bodies exceeding **60 feet** in length to lightning protection components.
 - G. A counterpoise installation based on requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" may be used as a ground loop required by NFPA 780, provided counterpoise conductor meets or exceeds minimum requirements in NFPA 780.
 - 1. Bond ground terminals to counterpoise conductor.
 - 2. Bond grounded metal bodies on building within **12 feet** of ground to counterpoise conductor.
 - 3. Bond grounded metal bodies on building within **12 feet** of roof to [**counterpoise conductor**] [**interconnecting loop at eave level or above**].
 - H. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at **60-foot** intervals.
- 3.2 CORROSION PROTECTION
- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
 - B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.
- 3.3 FIELD QUALITY CONTROL
- A. UL Inspection: Provide inspections as required to obtain a UL Master Label for system.
 - B. Provide an inspection by an inspector certified by LPI to obtain an LPI certification.
- END OF SECTION 264113

LOW-VOLTAGE ELECTRICAL POWER CIRCUITS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes TVSSs for low-voltage power equipment.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain suppression devices and accessories 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 IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."
- D. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."
- E. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449 (3rd edition), "Transient Voltage Surge Suppressors."

1.4 PROJECT CONDITIONS

- A. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F.
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 4. Altitude: Less than 20,000 feet above sea level.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advanced Protection Technologies, Inc.
 - 2. Atlantic Scientific.
 - 3. Current Technology, Inc.
 - 4. Cutler-Hammer, Inc.; Eaton Corporation.
 - 5. Entelec International.
 - 6. General Electric Company.
 - 7. Innovative Technology, Inc.
 - 8. Intermatic, Inc.
 - 9. LEA International.
 - 10. Leviton Mfg. Company Inc.
 - 11. Liebert Corporation; a division of Emerson.
 - 12. Northern Technologies, Inc.
 - 13. Siemens Energy & Automation, Inc.
 - 14. Square D; Schneider Electric.
 - 15. Surge Suppression Incorporated.
 - 16. Sutton Designs Inc.
 - 17. Transtector Systems, Inc.
 - 18. Tycor; Cutler-Hammer, Inc.
 - 19. United Power Corporation.
 - 20. Zero Surge Inc.

LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

2.2 SERVICE ENTRANCE SUPPRESSORS

- A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:
 - 1. LED indicator lights for power and protection status.
 - 2. Audible alarm, with silencing switch, to indicate when protection has failed.
 - 3. Fuses, rated at 200-kA interrupting capacity.
 - 4. Integral disconnect switch.
 - 5. Redundant suppression circuits.
 - 6. Surge-event operations counter.
- B. Peak Single-Impulse Surge Current Rating: [320] [240] [160] kA per phase.
- C. Connection Means: Permanently wired.
- D. Protection modes and UL 1449 suppressed voltage rating for grounded wye circuits with voltages of [480Y/277] [208Y/120], 3-phase, 4-wire circuits shall be as follows:
 - 1. Line to Neutral: [800 V for 480Y/277] [400 V for 208Y/120].
 - 2. Line to Ground: [800 V for 480Y/277] [400 V for 208Y/120].
 - 3. Neutral to Ground: [800 V for 480Y/277] [400 V for 208Y/120].
- E. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, single-phase, 3-wire circuits shall be as follows:
 - 1. Line to Neutral: 400 V.
 - 2. Line to Ground: 400 V.
 - 3. Neutral to Ground: 400 V.
- F. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
 - 1. Line to Neutral: 400 V, 800 V from high leg.
 - 2. Line to Ground: 400 V.
 - 3. Neutral to Ground: 400 V.
- G. Protection modes and UL 1449 suppressed voltage rating for voltages of 240 or 480, 3-phase, 3-wire, delta circuits shall be as follows:
 - 1. Line to Line: [2000 V for 480 V] [1000 V for 240 V].
 - 2. Line to Ground: [2000 V for 480 V] [1000 V for 240 V].

2.3 PANELBOARD SUPPRESSORS

- A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:
 - 1. LED indicator lights for power and protection status.
 - 2. Audible alarm, with silencing switch, to indicate when protection has failed.
 - 3. Fuses, rated at 200-kA interrupting capacity.
 - 4. Integral disconnect switch.
 - 5. Redundant suppression circuits.
 - 6. Surge-event operations counter.
- B. Peak Single-Impulse Surge Current Rating: [160] [120] [80] kA per phase.
- C. Protection modes and UL 1449 suppressed voltage rating for grounded wye circuits with voltages of [480Y/277] [208Y/120], 3-phase, 4-wire circuits shall be as follows:
 - 1. Line to Neutral: [800 V for 480Y/277] [400 V for 208Y/120].
 - 2. Line to Ground: [800 V for 480Y/277] [400 V for 208Y/120].
 - 3. Neutral to Ground: [800 V for 480Y/277] [400 V for 208Y/120].
- D. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, single-phase, 3-wire circuits shall be as follows:
 - 1. Line to Neutral: 400 V.
 - 2. Line to Ground: 400 V.
 - 3. Neutral to Ground: 400 V.
- E. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:

LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

1. Line to Neutral: 400 V, 800 V from high leg.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.
 - F. Protection modes and UL 1449 suppressed voltage rating for voltages of 240 or 480, 3-phase, 3-wire, delta circuits shall be as follows:
 1. Line to Line: **[2000 V for 480 V] [1000 V for 240 V]**.
 2. Line to Ground: **[1500 V for 480 V] [800 V for 240 V]**.
- 2.4 SUPPRESSORS FOR ELECTRONIC-GRADE PANELBOARDS
- A. Surge Protection Device Description: Sine-wave-tracking type, panel-mounted design with the following features and accessories:
 1. LED indicator lights for power and protection status.
 2. Audible alarm, with silencing switch, to indicate when protection has failed.
 3. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 - B. Peak Single-Impulse Surge Current Rating: **[160] [120] [80]** kA per phase.
 - C. Protection modes and UL 1449 suppressed voltage rating for grounded wye circuits with voltages of **[480Y/277] [208Y/120]**, 3-phase, 4-wire circuits shall be as follows:
 1. Line to Neutral: **[800 V for 480Y/277] [400 V for 208Y/120]**.
 2. Line to Ground: **[800 V for 480Y/277] [400 V for 208Y/120]**.
 3. Neutral to Ground: **[800 V for 480Y/277] [400 V for 208Y/120]**.
 - D. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, single-phase, 3-wire circuits shall be as follows:
 1. Line to Neutral: 400 V.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.
 - E. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
 1. Line to Neutral: 400 V, 800 V from high leg.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.
 - F. Protection modes and UL 1449 suppressed voltage rating for voltages of 240, 480, or 600, 3-phase, 3-wire, delta circuits shall be as follows:
 1. Line to Line: **[2000 V for 480 V] [1000 V for 240 V]**.
 2. Line to Ground: **[1500 V for 480 V] [800 V for 240 V]**.
- 2.5 ENCLOSURES
- A. NEMA 250, with type matching the enclosure of panel or device being protected.
- PART 3 - EXECUTION
- 3.1 INSTALLATION OF SURGE PROTECTION DEVICES
- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground. Install devices on all emergency panels per NEC 700.8.
 - B. Install devices for panelboard and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 1. Provide multipole, **[30] [60] [100]**-A circuit breaker as a dedicated disconnect for suppressor, unless otherwise indicated.
- 3.2 PLACING SYSTEM INTO SERVICE
- A. Do not energize or connect **[service entrance equipment] [panelboards] [control terminals] [data terminals]** to their sources until surge protection devices are installed and connected.
- 3.3 FIELD QUALITY CONTROL
- A. Testing: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports:
 - B. Testing: Perform the following field tests and inspections and prepare test reports:
 1. Complete startup checks according to manufacturer's written instructions.

2. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

END OF SECTION 264313

SECTION 265100 - INTERIOR LIGHTING**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Interior lighting fixtures, lamps, and ballasts.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Lighting fixture supports.
 - 5. Retrofit kits for fluorescent lighting fixtures.
- B. See Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
- C. See Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.2 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- D. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
 - 1. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.
 - 2. Pre-approved manufacturers: Cooper Industries, Lithonia, Philips, and Hubbell.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. 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.
- E. 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.
 - 4. Laminated Silver Metallized Film: 90 percent.
- F. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least **0.125 inch** minimum unless different thickness is indicated.
 - b. UV stabilized.
 2. Glass: Annealed crystal glass, unless otherwise indicated.
- 2.3 EXIT SIGNS
- A. Internally Lighted Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
 1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
- 2.4 EMERGENCY LIGHTING UNITS
- A. Description: Self-contained units complying with UL 924.
 1. Battery: Sealed, maintenance-free, lead-acid type.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. 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.
 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
- 2.5 LAMPS
- A. LED: color temperature [**4000**] K,
- 2.6 LIGHTING FIXTURE SUPPORT COMPONENTS
- A. Comply with Division 26 Section "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 fixture.
 - C. Twin-Stem Hangers: Two, **1/2-inch** steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
 - D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, [**12 gage**].
 - E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, [**12 gage**].
 - F. Rod Hangers: **3/16-inch** minimum diameter, cadmium-plated, threaded steel rod.
 - G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Comply with NFPA 70 for minimum fixture supports.
- C. Suspended Lighting Fixture Support:
 1. Pendants and Rods: Where longer than **48 inches**, brace to limit swinging.
 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
- E. Adjust aimable lighting fixtures to provide required light intensities.
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

- G. For 2x4 fixtures in suspended ceilings, install support wires (ceiling hanger wires) from 2 diagonal corners directly to structure, independent of ceiling grid.

3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. 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.

END OF SECTION 265100

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 lighting for the following outdoor sports venues, specified primarily by illumination performance:
 - 1. Football fields.
 - 2. Soccer fields.

1.3 DEFINITIONS

- A. CV: Coefficient of variation; a statistical measure of the weighted average of all relevant illumination values for the playing area, expressed as the ratio of the standard deviation for all illuminance values to the mean illuminance value.
- B. Delegated-Design Submittals: Documents, including drawings, calculations, and material and product specifications prepared as a responsibility of Contractor to obtain acceptance by Owner and authorities having jurisdiction.
- C. Horizontal Illuminance: Measurement in **foot-candles (lux)**, on a horizontal surface **36 inches (915 mm)** above ground, unless otherwise indicated.
- D. LLD: Lamp lumen depreciation.
- E. LLF: Light loss factor.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.
- G. Target Illuminance: Average maintained illuminance level, calculated by multiplying initial illuminance by LLF.
- H. UG: Uniformity gradient; the rate of change of illuminance on the playing field, expressed as a ratio between the illuminances of adjacent measuring points on a uniform grid.
- I. Vertical Illuminance: Measurement in **foot-candles (lux)**, in **[four]** directions on a vertical surface, at an elevation coinciding with plane height of horizontal measurements.

1.4 PERFORMANCE REQUIREMENTS

- A. Facility Type: **[Sports club]**.

- B. Illumination Criteria: Comply with criteria in IESNA RP-6 for the following:
1. Minimum average maintained illuminance level for each lighted area for each sports venue and for the indicated class of play.
 2. CV and maximum-to-minimum uniformity ratios for each lighted area equal to or less than those listed in IESNA RP-6 for the indicated class of play.
 3. UG levels within each lighted area and between adjacent lighted areas equal to or less than those listed in IESNA RP-6 for the indicated speed of sport.
- C. Illumination Calculations: Computer-analyzed point method complying with IESNA RP-6 to optimize selection, location, and aiming of luminaires.
1. Grid Pattern Dimensions: For playing areas of each sport and areas of concern for spill-light control, correlate and reference calculated parameters to the grid areas and intersection points of the indicated grid pattern.
 2. Spill-Light Control: Minimize spill light for each playing area on adjacent and nearby areas.
 - a. Prevent light trespass on properties near Project as defined by authorities having jurisdiction.
 - b. For areas indicated on Drawings as "spill-light critical," limit the level of illuminance directed into the area from any luminaire or group of luminaires, and measured **36 inches (915 mm)** above grade to the following:
 - 1) Maximum Horizontal Illuminance: **[0.5 fc (5.4 lux)]**.
 - 2) Maximum Vertical Illuminance from the Direction of the Greatest Contribution of Light: **[2.0 fc (21.5 lux)]**.
 - c. Calculate the horizontal and vertical illuminance due to spill light for points spaced **[20 feet (6 m)]** apart in areas indicated on Drawings as "spill-light critical," to ensure that design meets the above limits.
 3. Use a field factor of **[15]** percent according to IESNA RP-6, in establishing initial illuminance.
 4. Luminaire Mounting Height: Comply with recommendations in IESNA RP-6[, **with consideration for requirements to minimize spill light and glare**].
- D. Soccer Fields:
1. IESNA RP-6, Class of Play: **[II]**.
 2. Speed of Sport: **[Fast]**.
 3. Grid Pattern Dimensions: **30 by 30 feet (9 by 9 m)**.
- E. Electric Power Distribution Requirements:
1. Electric Power: **[480]** V, 3 phase.
 - a. Include roughing-in of service indicated for nonsports improvements on the Project site.

- b. Balance load between phases. Install wiring to balance three phases at each support structure.
- c. Include required overcurrent protective devices and individual lighting control for each sports field or venue.
- d. Include indicated feeder capacity and panelboard provisions for future lighted sports field construction.

1.5 SUBMITTALS

A. Product Data: For each type of lighting product; include the following:

- 1. Lamp life, output, and energy-efficiency data. Energy data shall comply with IESNA LM-47.
- 2. Photometric data based on laboratory tests of each luminaire type, complete with lamps, ballasts, and accessories.
 - a. Photometric data shall be certified by a qualified independent testing agency.
 - b. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Delegated-Design Submittals: The following documents, signed and sealed by a qualified professional engineer:

- 1. Drawings and specifications for construction of lighting system.
- 2. Manufacturer's determination of LLF used in design calculations.
- 3. Structural analysis data and calculations used for pole selection.
- 4. Foundation design shall be provided by the installer. Foundation design shall be based on site specific soil investigation and analysis.
 - a. Manufacturer Seismic Qualification Certification: Submit certification that sports lighting components and their mounting and anchorage provisions are designed to remain in place without separation of any parts when subjected to the seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems" Include the following:
 - 1) Basis for Certification: Indicate whether withstand certifications are based on actual test of assembled components or on calculation.
 - 2) Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - b. Manufacturer Wind-Load Strength Certification: Submit certification that selected total support system, including poles, complies with AASHTO LTS-4 for location of Project.
- 5. Design calculations for the following:
 - a. Target illuminance.
 - b. Point calculations of horizontal and vertical illuminance, CV, and UG at minimum grid size and area.

- c. Point calculations of horizontal and vertical illuminance in indicated areas of concern for spill light.
 - d. Calculations of source intensity of luminaires observed at eye level from indicated properties nearby the playing fields.
 - e. Short-circuit current calculations for rating of panelboards.
 - f. Total connected and estimated peak-demand electrical load, in kilowatts, of lighting system.
 - g. Capacity of **[feeder]** required to supply the lighting system.
- 6. Wiring requirements, including required conductors and cables and wiring methods.
- C. Manufacturer Certificates: Signed by manufacturers certifying that support structures, including brackets, arms, appurtenances, bases, anchorages, and foundations, comply with requirements.
- D. Qualification Data: For **[Installer]** **[manufacturer]** **[luminaire photometric data testing laboratory]** **[and]** **[field testing agency]**.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For sports lighting system components to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. a service center capable of providing training, parts, and emergency maintenance repairs.
 - 1. Manufacturer's responsibilities include fabricating sports lighting and providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of delegated-design submittals and comprehensive engineering analysis by a qualified professional engineer.
- C. Luminaire Photometric Data Testing Laboratory: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- D. Luminaire Photometric Data Testing Laboratory: 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.
- E. Field Testing Agency Qualifications: An independent testing agency that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, or an NRTL as defined by OSHA in 29 CFR 1910.7, with the experience and capability to conduct field testing according to IESNA LM-5.

- F. 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.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of luminaires, lamps, and luminaire alignment products and to correct misalignment that occurs subsequent to successful acceptance tests. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, and unauthorized repairs and alterations from special warranty coverage.
 - 1. Luminaire Warranty: Luminaire and luminaire assembly (excluding fuses and lamps) shall be free from defects in materials and workmanship for a period of [five] years from date of date of acceptance.
 - 2. Lamp Warranty:
 - a. Replace lamps and fuses that fail within [12] months from date of owner acceptance.
 - b. Provide replacement lamps that fail within the second [12] months from date of owner acceptance.
 - 3. Alignment Warranty: Accuracy of alignment of luminaires shall remain within specified illuminance uniformity ratios for a period of [five] years from date of successful completion of acceptance tests.
 - a. Realign luminaires that become misaligned during the warranty period.
 - b. Replace alignment products that fail within the warranty period.
 - c. Verify successful realignment of luminaires by retesting as specified in Part 3 "Field Quality Control" Article.

PART 2 - PRODUCTS

2.1 LUMINAIRES, LAMPS, AND BALLASTS

- A. Luminaires: Listed and labeled, by an NRTL acceptable to authorities having jurisdiction, for compliance with UL 1598 for installation in wet locations.
 - 1. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without using tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent their accidental falling during relamping and when secured in operating position. Door shall be removable for cleaning or replacing lens.
 - 2. Exposed Hardware: Stainless-steel latches, fasteners, and hinges.
 - 3. Spill-Light Control Devices: Internal louvers and external baffles furnished by manufacturer and designed for secure attachment to specific luminaire.

2.2 SUPPORT STRUCTURES

- A. Support-Structure Wind-Load Strength: Poles and other support structures, brackets, arms, appurtenances, bases, anchorages, and foundations shall comply with AASHTO LTS-4 and shall be certified by manufacturers to withstand steady winds up to [100 mph (160 km/h)] with a gust factor of 1.3 without permanent deflection or whipping. Shall comply with 2018 NCBC (Chapter 16)
- B. Support-Structure Seismic Strength: Poles or other support structures, brackets, arms, appurtenances, base, anchorage, and foundation shall be designed to prevent separation of components or fracture of poles, luminaire supports, or pole foundations during a seismic event. Shall comply with 2018 NCBC (Chapter 16)
- C. Mountings, Fasteners, and Appurtenances:
 - 1. Corrosion resistant, compatible with support components, and shall not cause galvanic action at contact points.
 - a. Steel Components: Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M.
 - b. Mounting Hardware Fasteners: Hot-dip galvanized, complying with ASTM A 153/A 153M.
- D. Concrete for Pole Foundations: 3000-psi (20.7-MPa), 28-day minimum compressive strength. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

2.3 POWER DISTRIBUTION

- A. Wiring Method for Feeders, Subfeeders, Branch Circuits, and Control Wiring: Underground nonmetallic raceway; No. 10 AWG minimum conductor size for power wiring.
- B. Electrical Enclosures Exposed to Weather: NEMA 250, Type [3R] with hinged doors fitted with padlock hasps.

2.4 SURGE PROTECTION

- A. Surge Protection: Comply with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" and include surge suppressors with the following requirements:
 - 1. Panelboard type.
 - 2. Nonmodular, with LED indicator lights.
 - 3. Peak Single-Impulse Surge Current Rating: 65 kA per phase.

2.5 POLE AND BASE PROTECTION

- A. Pole Pads: Wraparound pad, with 4 inches (100 mm) of extra-firm polyfoam, 360-degree coverage of ground-mounted poles and supports, continuous hook-and-loop fastening, and not less than 72 inches (1820 mm) high.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use web fabric slings (not chain or cable) to raise and set structural members.
- B. Install poles and other structural units level, plumb, and square.
- C. Except for embedded structural members, grout void between pole base and foundation. Use nonshrinking or expanding concrete grout firmly packed in entire void space. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole. Nonshrink grout is specified in Division 05 Section "Metal Fabrications."
- D. Install pole pads at all poles inside playing field boundaries and fences.
- E. Extend cast-in-place bolted base foundations 36 inches (914 mm) above grade, minimum.
- F. Install lamps in each luminaire and fasten luminaire to structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- G. Baffles and Louvers for Spill-Light Correction: Install on luminaires with fasteners provided by manufacturer. Install and adjust to correct out-of-limit spill-light[and glare] measurements.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field quality-control tests, inspections, and analysis according to IESNA RP-6 and IESNA LM-5, where applicable, and prepare reports.
- B. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field quality-control tests, inspections, and analysis according to IESNA RP-6 and IESNA LM-5, where applicable, and prepare reports.
- C. Perform the following field quality-control tests, inspections, and analysis according to IESNA RP-6 and IESNA LM-5, where applicable, and prepare test reports:

1. After installing sports lighting system and after electrical circuits have been energized, perform proof-of-performance field measurements and analysis for compliance with requirements.
 2. Make field measurements at established test points in areas of concern for spill light and glare.
 3. Perform analysis to demonstrate correlation of field measurements with specified illumination quality and quantity values and corresponding computer-generated values that were submitted with engineered design documents, and submit a report of the analysis. For computer-generated values, use manufacturer's lamp lumens that are adjusted to lamp age at time of field testing.
- D. Correction of Illumination Deficiencies for Playing Areas: Make corrections to illumination quality or quantity measured in field quality-control tests that vary from specified illumination criteria by plus or minus 10 percent or more; add or replace luminaires, or change mounting height, revise aiming, or install louvers, shields, or baffles. If luminaires are added or mounting height is changed, revise aiming and recalculate and modify or replace support structures, if indicated. Retest as specified above after repairs, adjustments, or replacements are made. Report results in writing.
- E. Correction of Excessive Illumination in Spill-Light-Critical Areas: If measurements indicate that specified limits for spill light are exceeded, make corrections to illumination quantity measured in field quality-control tests that reduce levels to within specified maximum values. Replace luminaires, or change mounting heights, revise aiming, or install louvers, shields, or baffles. If mounting height is changed, revise aiming and recalculate and modify or replace support structures, if indicated. Retest as specified above after repairs, adjustments, or replacements are made. Report results in writing.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sports lighting. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 265668

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DIVISION 31

EARTHWORK



SECTION 31 05 05

DEMOLITION

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. The work of this section consists of removal and disposal of structures, old pavements, abandoned pipelines, and other obstructions as designated, including salvaging of materials and backfilling of resulting trenches, holes and pits. Also included is all work, which relates to explosives including receiving, handling, transporting, storing, distributing, priming, loading, firing, and disposal.

1.02 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 of the Specification and Addenda apply to this section.

PART 2: NOT USED

PART 3: EXECUTION

3.01 DEMOLITION

A. BITUMINOUS PAVED AREAS

Scarify and completely remove. Resultant material may be utilized in bottom portion of areas to receive fill. No pieces shall be left exposed in the fill slopes. If material is used in any portion of the new construction, layers shall be a maximum of 8" and separated by minimum 6" layers of earth. Water and compaction requirements are specified under other sections. No compaction is required for materials used for obliteration work outside the limits of new construction.

B. REMOVAL OF CONCRETE SURFACES AND STRUCTURES

Concrete designed for removal, break into pieces and use for rip-rap. Volume, minimum 0.5 cubic foot; 75% of pieces shall be between 1.5 and 2.0 cubic feet. Stockpile at designated locations.

C. PIPE REMOVAL

Remove pipe, exercising care to avoid breaking or damaging. Store pipe to be re-laid as directed.

3.02 EXPLOSIVES

A. LEGAL REQUIREMENTS

Comply with all applicable Federal, State, and local laws and regulations pertaining to the use, storage, and handling of explosives. It is the intent of these specifications to comply with such laws and regulations. In the event of inconsistencies between these specifications and the laws and regulations, the laws and regulations take precedence, subject to final determination by the Engineer.

B. PROTECTION

The Contractor shall exercise the utmost care not to endanger life and property. Make proper use of blasting mats and other protective devices adopting whatever additional precautions are deemed necessary to prevent damage to trees, shrubs, other landscape features, buildings, utilities, monuments, and other structures. Make every effort to prevent damage to the natural and the constructed surroundings. Should damage occur, make restoration as required by the Engineer.

C. PERSONNEL

One competent, experienced person shall be specifically designated in charge of explosives. The designated person must present certification to the Engineer that he has successfully completed a course in the handling and use of explosives, given by an accredited institution such as the U.S. Bureau of Mines, DuPont, or other explosive manufacturing company. He shall exercise careful supervision of all work related to the use, storage, and handling of explosives. Permit only a minimum number of competent, experienced men, consistent with efficient operation, to handle explosives. Exclude anyone demonstrating carelessness, incompetence, or inexperience from further handling of explosives.

D. GENERAL REQUIREMENTS

The Contractor shall give special attention to the following specific rules:

1. Locate magazines in accordance with the American Tale of Distances for Storage of Explosives and only at sites approved by the Engineer.
2. Magazines shall be bulletproof, fireproof, burglarproof, weather resistant, constructed with adequate screened ventilation and dry wood floors. Countersink all nails exposed to the interior of magazines.
3. Do not store detonators with other explosives but in separate magazines.
4. Magazines shall not be provided with artificial heat or lights.
5. Securely lock magazines.

6. Mark magazines and roads in area with appropriate caution and danger signs.
7. Clear blast area of unnecessary personnel and equipment before delivery of any explosives to the site.
8. Keep no more than a one-day supply of explosives at or near the work site. Keep explosives in approved portable magazines in locations approved by the Engineer.
9. Use only wooden tamping bars for charging explosives into drill holes.
10. Do not use electricity from light or power circuits for firing shots unless the electrical connection to the circuit is made within an enclosed switch box securely locked with switch in open position.
11. Provide a positive warning system to give adequate warning in every direction immediately prior to firing explosives. Guard all access points to the blast area to halt personnel and vehicles a safe distance from the blast. Maintain intercommunication between guards and person firing the blast assuring the blast area is clear prior to firing.
12. Provide special signs or signals at all access points including a warning to turn off radio transmitters whenever electrical detonators are used.

3.03 DISPOSAL

- A. Dispose of debris from demolition operations in an approved and satisfactory manner.

END OF SECTION

SECTION 31 05 19

ENGINEERING FABRICS

PART 1: GENERAL

1.01 SCOPE OF WORK

The work covered by this Section consists of the installation of an acceptable engineering fabric (filter fabric) appropriate for the application(s) called for on the plans. Placement of the fabric shall be an integral function of the construction of shoulder drains, subsurface drainage systems, temporary silt fences and placement of erosion control stone or rip rap facilities. The Contractor shall furnish all equipment, tools, labor and materials necessary to complete the work in accordance with the plans and specifications.

PART 2: PRODUCTS

2.01 MATERIALS

Engineering fabric shall have material properties strictly conforming to those specified in Section 1056 of the "Standard Specifications for Roads and Structures" dated January 1, 2018, published by the North Carolina Department of Transportation. The Contractor shall provide engineering fabric(s) for various applications which meet or exceed the corresponding criteria for each different fabric utilized per the subject specification.

PART 3: EXECUTION

3.01 INSTALLATION

A. GENERAL REQUIREMENTS

1. Engineering fabric installed under erosion control stone or rip rap shall be placed at locations, to the dimensions as shown on the plans or as directed by the Engineer.
2. Surfaces to receive filter fabric shall be graded to the lines and grades as shown on the plans, unless otherwise directed by the Engineer. The surface shall be free of obstructions, debris and pockets of soft or low density material.
3. At the time of installation, the fabric shall be free of defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage.
4. The filter fabric shall be laid smooth and free from tension, stress, folds, wrinkles, or creases. Horizontal overlaps shall be a minimum of 12 inches with the upper fabric overlapping the lower fabric. Vertical overlaps shall be a minimum of 18 inches with the upstream fabric overlapping the downstream fabric. In the event that the fabric is displaced or damaged during stone placement, the stone shall be

removed and the fabric repositioned or replaced prior to replacement of the stone, all at no additional cost to the Owner.

5. The placement of the filter fabric and stone shall be performed in a continuous manner as directed by the Engineer. The filter fabric shall be protected from damage due to the placement of stone or other materials by limiting the height of drop of the material or by placing a cushioning layer of sand on top of the fabric before dumping the material.
6. No more than 72 hours shall elapse from the time the fabric is unwrapped to the time the fabric is covered with stone or sand.
7. Filter fabric installed in association with shoulder drains or other subsurface drainage systems shall be installed in such a manner that all splice joints are provided with a minimum overlap of 2 feet. The overlap of the closure at the top of the trench shall be at least 6 inches and secured with mechanical ties. Where outlet pipe passes through the fabric, a separate piece of fabric shall be wrapped around the outlet pipe, flared against the side of the filled drain, and secured with anchor pins.
8. Field splices of filter fabric shall be anchored with anchor pins to insure that required overlap is maintained.
9. At the time of installation, the fabric will be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.
10. Aggregate placement operations and the pipe installation shall be done so as to prevent damage to the filter fabric. Damaged sections of filter fabric shall be replaced at no cost to the Owner.
11. The aggregate shall be compacted to a degree acceptable to the Engineer by the use of a vibratory compactor before making the filter fabric closure at the top of the trench.
12. Filter fabric installed in association with temporary silt fences shall be a water permeable filter type for the purpose of removing suspended particles from the water passing through it. Silt fences shall be constructed in accordance with Section 1605 of the "Standard Specifications for Roads and Structures" dated January 1, 2018, published by the North Carolina Department of Transportation in the locations and to the configurations as shown in the plans and as directed by the Engineer. Should the requirements of local, regional or state authorities having jurisdiction over the project exceed the requirements of this section or other sections in this specification regarding temporary silt fences, the more stringent shall govern.

B. PHYSICAL PROPERTIES OF ENGINEERING FABRICS

PHYSICAL PROPERTIES OF ENGINEERING FABRICS					
Physical Property	Test Method (Article 1056-2)	Type 1	Type 2	Type 3 Class A	Class B
Min. Roll Width	---	---	---	36"	36"
Min. Fabric Weight	1	4.0 oz/yd ²	---	---	---
Min. Tensile Strength	2	90 lb.	200 lb.	50 lb.	100 lb.
Elongation	2	80% Max.	15% Min.	30% Max.	25% Max.
Min. Burst Strength	3	150 psi	400 psi	100 psi	180 psi
Min. Puncture Strength	4	45 lb.	80 lb.	30 lb.	60 lb.
Apparent Opening Opening Size - Max/Min (U.S. Std. Sieve)	5	60/100	30/130	20/50	20/50
Min. Ultra-Violet Exposure Strength Retention	6	80 lb.	140 lb.	40 lb.	80 lb.
Fungus Resistance	7	No Growth	No Growth	No Growth	No Growth
Min. Permeability (Thickness x Permittivity)	8	0.2 cm/sec.	---	---	---
Min. Flow Rate	8	---	---	10 gal/min/ft ²	10 gal/min/ft ²
Typical Application	--	Shoulder Drain	Under Riprap	Temporary Silt Fence	

3.02 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 31 10 05

WASTE MATERIAL DISPOSAL

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. The work covered by this section consists of the disposal of waste and debris in accordance with the requirements of these specifications. Waste will be considered to be all excavated, grubbed or removed materials, which are not utilized in the construction of the project.

PART 2: NOT USED

PART 3: EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Waste shall be disposed of in areas that are outside of the project area and provided by the Contractor, unless otherwise required by the plans or special provisions or unless disposal within the project area is permitted by the Engineer.
- B. The Contractor shall maintain the earth surfaces of all waste areas, both during the work and until the completion of all seeding and mulching or other erosion control measures specified, in a manner which will effectively control erosion and siltation.
- C. The following requirements shall also be applicable to all waste or disposal areas other than active public waste or disposal areas:
 - 1. Rock waste shall be shaped to contours which are comparable to and blend in with the adjacent topography where practical, and shall be covered with a minimum 6" thick layer of earth material either from the project waste or from borrow.
 - 2. Earth waste shall be shaped to contours which are comparable to and blend in with the adjacent topography where practicable, but in no case will slopes steeper than 2:1 be permitted.
 - 3. Construction debris, grubbed debris and all broken concrete and masonry shall be covered with a minimum 6" thick layer of earth waste material from the project or borrow. The completed waste area shall be shaped as required above for disposal of earth waste. (Broken concrete must be taken to landfill)
 - 4. Seeding and mulching shall be performed over all earth or earth covered waste areas. The work of seeding and mulching shall be performed in accordance with Section 32 92 19 – Seeding and Mulching.

5. Where the Engineer has granted permission to dispose of waste and debris within the project, the Engineer will have the authority to establish whatever additional requirements may be necessary to insure the satisfactory appearance of the completed project.

Disposal of waste or debris in active public waste or disposal areas will not be permitted without prior approval by the Engineer. Such disposal will not be permitted when, in the opinion of the Engineer, it will result in excessive siltation or pollution.

END OF SECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. Clearing and grubbing shall consist of the removal and satisfactory disposal of all trees, brush, stumps, logs, grass, weeds, roots, decayed vegetable matter, posts, fences, stubs, rubbish and all other objectionable matter resting on or protruding through the original ground surface and occurring within the construction limits or right-of-way of any excavation, borrow area, or embankment.

PART 2: NOT USED

PART 3: EXECUTION

3.01 GENERAL

- A. Clearing and grubbing operations shall be completed sufficiently in advance of grading operations as may be necessary to prevent any of the debris from the clearing and grubbing operations from interfering with the excavation or embankment operations. All work under this section shall be performed in a manner which will cause minimum soil erosion. The Contractor shall perform such erosion control work, temporary or permanent, as may be directed by the Engineer in order to satisfactorily minimize erosion resulting from clearing and grubbing operations.

1. Clearing:

- a. The work of clearing shall be performed within the limits established by the plans, specifications, or the Engineer.
- b. Clearing shall consist of the felling and cutting up, or the trimming of trees, and the satisfactory disposal of the trees and other vegetation together with the down timber, snags, brush and rubbish occurring within the areas to be cleared. Trees and other vegetation, except such individual trees, groups of trees, and vegetation, as may be indicated on the plans to be left standing, and all stumps, roots and brush in the areas to be cleared shall be cut off six inches above the original ground surface.
- c. Individual trees and groups of trees designated to be left standing within cleared areas shall be trimmed of all branches to such heights and in such manner as may be necessary to prevent

interference with construction operations. All limbs and branches required to be trimmed shall be neatly cut close to the whole of the tree or to main branches, and the cuts thus made shall be painted with an approved tree wound paint. Individual trees, groups of trees, and other vegetation, to be left standing shall be thoroughly protected from damage incident to construction operations by the erection of barriers or by such other means as the circumstances require.

- d. The Engineer will designate all areas of growth or individual trees which are to be preserved due to their desirability for landscape or erosion control purposes. When the trees to be preserved are located within the construction limits, they will be shown on the plans or designated by the Engineer.
- e. Clearing operations shall be conducted so as to prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction, and so as to provide for the safety of employees and others. When such damages occur, all damaged areas shall be repaired, removed or otherwise resolved utilizing generally accepted practices at the Contractor's expense.

2. Grubbing:

- a. Grubbing shall consist of the removal and disposal of all stumps, roots and matted roots from all cleared areas, except as herein specified.
- b. In embankment areas, when the depth of embankment exceeds 3'-6" in height sound stumps shall be cut off not more than 6" above the existing ground level and not grubbed. Unsound or decayed stumps shall be removed to a depth of approximately two feet below the natural ground surface.
- c. All depressions excavated below the natural ground surface for or by the removal of stumps and roots shall be refilled with suitable material and compacted to make the surface conform to the surrounding ground surface.

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Norton Intramural Fields

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3. Disposal of Cleared and Grubbed Material:

Saw logs, pulp wood, cord wood or other merchantable timber removed incidental to clearing and grubbing shall become the property of the Contractor. All combustible matter shall be deposited at locations approved by the Engineer. Combustible matter may be burned or may be disposed of as stated above. Debris shall not be burned unless written permission or permit is issued by the Fire Marshall having jurisdiction in the area if applicable. The Contractor shall adhere to all limitations and conditions set forth in the permit. Burning shall be done at such time and such manner as to prevent fire from spreading and to prevent any damage to adjacent cover and shall further be subject to all requirements of State or Federal Governments pertaining to the burning. Disposal by burning shall be kept under constant attendance until all fires have burned out or have been extinguished.

END OF SECTION

SECTION 31 22 00

GRADING

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. This portion of the project includes the excavation, undercut excavating, grading, earthwork and compaction required as shown on the plans and all other associated miscellaneous items of earthwork construction, as shown on the plans. The Contractor shall furnish all materials, labor, equipment and incidental items necessary to complete this portion of the work as detailed on the plans and as called for in these Specifications.
 - 1. All classified excavation shall be in accordance with Section 226 of the "Standard Specifications for Roads and Structures" dated February 2018, published by the North Carolina Department of Transportation, unless otherwise directed herein.
 - 2. Site grading shall conform to the grades indicated by the finish contours on the plans. Where topsoil, pavement, gravel or crushed stone surfacing and other items are shown, rough grade shall be finished to such depth below finish grade as necessary to accommodate these items. All areas where structures are to be built on fill shall be stripped to such depth as necessary to remove turf, roots, organic matter, and other objectionable materials.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Topsoil shall be considered to mean original surface soil, typical of the area, which is capable of supporting native plant growth, and shall be free of large stones, roots, brush, waste, construction debris and other undesirable material or contamination.
- B. All fill used for site grading operations should consist of a clean (free of organics and debris) low plasticity soil (plasticity index less than 30).

PART 3: EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Construction stakeout will be provided by the Contractor. Exact locations and grade points are to be staked or fixed by the Contractor before construction. The Contractor shall not disturb any bench marks, reference stakes or property line monuments. In the event it becomes necessary to remove any bench mark, reference stake or property line monument in the performance of the work, the

Contractor shall reference such points in preparation for replacement. If any such points are disturbed or damaged, they shall be replaced by a North Carolina Registered Land Surveyor at the expense of the Contractor.

- B. Existing utility lines (either overhead or underground), sidewalks, fencing, pavement or other structures shown on the drawings, shown to the Contractor or mentioned in the plans and specifications shall be kept free of damage by the Contractor's operations. It shall be the responsibility of the Contractor to verify the existence and location of all underground utilities within the Project Site. The omission from or the inclusion of utility locations on the plans is not to be considered as the non-existence of or a definite location of existing underground utilities. Any existing construction damaged by the Contractor shall be restored to an equal condition as that existing at the time prior to damage, at the Contractor's expense. If any existing utility is inadvertently damaged during construction, the Contractor shall notify the utility, the Engineer and the Owner of said damaged utility at once so that emergency repairs may be made at the Contractor's expense and to the satisfaction of the party having jurisdiction of the utility.

3.02 CLASSIFIED EXCAVATION

- A. Excavation is classified and includes all excavation to the required elevations. Excavation shall be classified as earth excavation (includes borrow and waste materials as required), trench rock excavation, mass rock excavation, undercut excavation. There shall be no additional payment made for earth excavation. Trench rock excavation, mass rock excavation and undercut excavation shall be paid at the unit prices as provided in the bid form. The Engineer should be notified immediately if rock is encountered. All excavated materials which are not required or suitable for fills shall be considered as waste and shall be disposed of off the Owner's property at the Contractor's expense.
- B. Earth excavation includes excavation of pavements and other obstructions visible on the surface, underground structures, utilities, and other items indicated to be demolished and removed in order to reach subgrade elevation; together with soils and other materials encountered that are not classified as trench rock excavation, mass rock excavation or undercut excavation.
- C. Trench rock excavation shall be considered any naturally occurring material which cannot be removed with a Caterpillar 225 backhoe or equal, equipped with rock teeth, and which requires for its removal drilling and blasting, or wedging or sledging and barring.
1. In addition, classification as trench rock is only applicable when encountered, as described above, during the installation of storm drainage lines, water lines or services, sewer lines or services and associated structures as represented on the design drawings. Where trench rock excavation is necessary, the Contractor shall excavate the same as near the neat lines of the trench as practicable and the Contractor shall take all due

precautions in the pursuance of the work. The Contractor will be held strictly responsible for all injury to life and to public and private property.

2. Trench rock shall be removed from the applicable excavation to the following limits:
 - a. Trenches: The diameter of the pipe plus 8 inches on each side, extending 6 inches below the pipe wall and bell.
 - b. Structures: 12 inches beyond the vertical plane of the structure on all sides and on the bottom only to the depth necessary for proper installation.
3. Trench rock excavation includes removal and off-site disposal of rock material and obstructions encountered in trench excavations that cannot be removed without systematic drillings, blasting, or ripping; and backfilling with the specified compaction of the trench with suitable material.

D. Mass rock excavation shall be considered any naturally occurring material, in the opinion of the Engineer, cannot be removed with a Caterpillar D-9 or equal, equipped with a properly fitted single tooth ripper, or removed by a Caterpillar 225 backhoe or equal, equipped with rock teeth. Mass rock in the bottom of roadway cuts shall be excavated to a depth of one foot below the roadbed and ditches. Mass rock in building pad areas shall be excavated to a depth of one foot below finished grade, or as directed by the Engineer. Where mass rock excavation is necessary, the Contractor shall excavate the same as near the neat limits of excavation as practicable and the Contractor shall take all due precautions in the pursuance of the work. The Contractor will be held strictly responsible for all injury to life and to public and private property.

1. Mass rock excavation includes removal and off-site disposal of rock material and obstructions encountered in excavations that cannot be removed without systematic drillings, blasting, or ripping; and backfilling with the specified compaction of the undercut rock with suitable material.

E. Undercut excavation shall be any natural soil materials, not including topsoil, situated at or below the proposed subgrade elevation that is deemed unsuitable or undesirable in their location or condition as determined by a qualified Geotechnical Engineer, employed by the Owner. The Geotechnical Engineer may require that the Contractor remove this undesirable material and backfill with approved material properly compacted. Moisture content shall not be an acceptable means for declaring a soil unsuitable. It is the responsibility of the contractor to properly condition the soil to an acceptable moisture content prior to use in grading operations.

1. Undercut excavation includes excavation and off-site disposal of undesirable material; any backfilling in the undercut area from an approved borrow source; and proper compaction of the borrow material. Topsoil, regardless of depth, shall not be classified as undercut excavation

material and the replacement thereof shall be covered in the price for earth excavation as described above. Topsoil depth may be specified by the geotechnical report.

- F. Borrow material shall be suitable material from an approved off-site area that is required to; backfill undercut areas; bring the site to the proposed grades in the absence of sufficient material on-site; backfill trenches and other excavations as required. The borrow material shall be checked for suitability for compaction and approved by a qualified Geotechnical Engineer prior to placement on-site at the Contractor's expense. Borrow excavation shall be performed in accordance with Section 230 of the NCDOT Standard Specifications for Roads and Structures except where modified herein. All borrow material required shall be permitted, acquired, and placed at the Contractor's sole expense. Borrow material required to bring the site to proposed grades in the absence of sufficient material on site shall be considered part of earth excavation and, therefore, no additional payment shall be made.
- G. The Contractor shall provide all sheeting, shoring, underpinning and bracing required to hold the sides of any excavation and for the protection of all adjacent structures. The Contractor shall be held responsible for any damage to any part of the work by failure of excavated sides or bottoms.

3.03 BLASTING

- A. Any and all blasting operations shall be conducted in strict accordance with existing ordinances and regulations relative to storage and use of explosives. Blasting shall be done only by experienced and qualified personnel and extreme caution and care shall be exercised to prevent injury to persons or damage to any pipe, mains, wires, drains, buildings, railroad tracks or other property above or below the surface of the ground. The Contractor shall use safety nets or other equivalent measures as approved by the Engineer to reduce the possibility of flying rock as a result of blasting operations. The Contractor shall be held strictly responsible for any injury to persons or damage to public or private property.
- B. The Contractor shall submit blasting plans to the Engineer for review and shall not proceed with blasting operations until approval has been granted. As directed by the Engineer, blasting operations shall be monitored to insure that vibration levels produced by blasting are within tolerable limits.
- C. The Contractor shall obtain at his expense, all Federal, State and Local permits required to perform blasting operations.

3.04 DEWATERING

The Contractor shall control the grading in all areas so that the surface of the ground will be properly sloped, diked or ditched to prevent water from entering into excavated areas. The Contractor shall maintain sufficient personnel and equipment to promptly and continuously remove all water, from any source, entering or accumulating in the excavation or other parts of the work.

All water pumped or drained from these areas

shall be disposed of in a suitable manner without damaging adjacent property or other work under construction.

3.05 EMBANKMENTS, FILLS, & BACKFILLS

- A. Upon completion of the stripping operations, the exposed subgrade in areas to receive fill should be proof rolled with a loaded dump truck or similar pneumatic-tired vehicle with a minimum loaded weight of 20 tons, under the supervision of the geotechnical engineer. The proof rolling procedure should consist of four complete passes of the exposed areas with two of the passes being in a direction perpendicular to the preceding ones. Any areas which deflect, rut or pump excessively during the proofrolling or fail to "tighten up" after successive passes should be undercut to suitable soils and replaced with compacted fill.
- B. Embankments and fills shall be constructed at the locations and to the lines and grades indicated on the drawings. Material shall be placed in horizontal layers not to exceed 8 inches in loose depth and thoroughly compacted prior to placing each following layer. All fill material shall be free from roots or other organic material, trash, and from all stones having any one dimension greater than 6 inches. Stones larger than 4 inches, maximum dimension, shall not be permitted in the upper 6 inches of fill or embankment. Fill areas shall be kept level with graders or other approved devices. Fill shall not be placed on surfaces that are muddy, frozen, or contain frost or ice.
- C. Embankment and fill compaction shall be accomplished by thoroughly compacting each layer with sheep foot rollers, pneumatic rollers, and mechanical tampers in places inaccessible to rollers, or other equipment. When material has too much moisture, grading operations shall be limited to drying soil by spreading and turning for drying by the sun and aeration. When material is dry, moisture shall be added by sprinkling by approved means.
- D. Where natural slopes exceed 4:1, horizontal benches shall be cut to receive fill material. Slopes of less than 4:1 and other areas shall be scarified prior to placing fill material.
- E. All embankments and fills shall be compacted to the following percentages of the maximum dry density as determined by the Standard Proctor Density Test, ASTM D-698, Method C.
- F. The following table shall be used throughout the project unless otherwise directed by the Engineer:

TABLE OF COMPACTION

<u>Type Fill or Embankment</u>	<u>Zone</u>	<u>Minimum Density %</u>
Structures	All Depths	98
Paved Areas	All Depths	98
Yard or Field Areas	All Depths	95

1. Embankment types are defined as follows:

Structure- beneath concrete slabs of buildings, floors, foundations, etc.

Paved Areas- beneath all roads, tracks, runways, pads, streets, truck operations, and automobile parking lots.

- G. Where backfilling is required after the completion of drainage structures, all forms, trash, and construction debris shall be removed from excavation before backfilling begins. Backfill shall be placed in horizontal layers of 6 inches in loose depth. Compaction shall conform to requirements in the above table. Heavy rollers, crawler equipment, trucks or other heavy equipment shall not be used for compacting backfill within 5 feet of structure walls or other facilities which may be damaged by their weight or operation. No backfilling shall begin until concrete and masonry walls are properly cured.
- H. The Contractor shall carry the top of embankments, fills, or backfills to the surrounding grade so that upon compaction and subsequent settlement, the grade will be at proper elevation. Should settlement occur during the guarantee period of the contract, the Contractor shall provide sufficient fill to bring area up to finished grade and shall reseed as required.

3.06 PROOFROLLING

- A. Proofrolling under the observation of the Soils Engineer will be performed using a loaded dump truck or similar pneumatic-tired vehicle with a minimum loaded weight of 20 tons as specified herein and as follows: The proofrolling procedure should consist of four complete passes of the exposed areas with two of the passes being in a direction perpendicular to the preceding ones. Any areas which deflect, rut or pump excessively during the proofrolling or fail to "tighten up" after successive passes should be undercut to suitable soils and replaced with compacted fill.

- B. Immediately following stripping, all areas to receive fill shall be proof rolled as specified herein.
- C. Immediately following the completion of excavation to proposed grades in cut areas, proofrolling shall be performed as specified herein.
- D. Immediately prior to stone base course placement in pavement areas and following final floor slab preparation, all subgrade areas will be proof rolled. Any local areas which deflect, rut or pump under the roller shall be undercut and replaced with compacted fill material as specified herein. Undercut will not be paid for in fill areas where proof roll does not pass.

3.07 AIR POLLUTION

- A. Comply with all pollution control rules, regulations, ordinances, and statutes which apply to any work performed under the Contract, including any air pollution control rules, regulations, ordinances and statutes, or any municipal regulations pertaining to air pollution.
- B. During the progress of the work, maintain the area of activity, including sweeping and sprinkling of streets as necessary, so as to minimize the creation and dispersion of dust. If the Engineer decides that it is necessary to use calcium chloride or more effective dust control, furnish and spread the material, as directed, and without additional compensation.

3.08 SOIL INSPECTION AND TESTS

- A. All excavated and fill material shall be removed, selected, placed and compacted under supervision of a representative of a commercial soils testing laboratory which will be selected by the Owner. A commercial soils testing laboratory shall be any firm properly equipped to perform such compaction tests and who has in their employment a Professional Engineer experienced in testing and soil mechanics. The laboratory representative shall have the authority to approve or disapprove the condition of the subgrade on which fill is to be placed, filled material, placement methods, compaction methods, and shall make compaction density tests as necessary to determine that the specified density is obtained. The Contractor shall notify the laboratory at least three (3) days prior to starting fill operations in order that suitability of material for compaction may be checked and no material shall be used that has not been previously checked and approved by the laboratory. The laboratory shall be notified before any cut is made or fill is placed in order that the laboratory representative may be present during all grading operations. The Contractor shall remove, replace, recompact and retest all fills failing to meet the density requirements at no additional expense to the Owner.
- B. A soils testing laboratory shall be retained by the Owner to supervise fill placement and compaction at no expense to the Contractor. However, extra time and trips caused by excessive delay, failure of the Contractor to properly

coordinate with the laboratory, or failure of the Contractor to properly compact fill material shall be back charged to the Contractor.

- C. Field density tests shall be performed by the Owner's testing agency for each one foot of fill material placed at the following frequency:
- D. A minimum of one field density test shall be made for each 2,000 square feet/vertical foot of fill placement in building areas.
- E. A minimum of one field density test shall be made for each 5,000 square feet/vertical foot of fill placement in all other areas where pavement is to be placed.
- F. Prior to final acceptance, the Soils Engineer and Surveyor shall submit certification specifying that the project compaction criteria and subgrade elevations have been satisfactorily obtained. The Contractor is responsible for the certification statement from the Surveyor. This certification should be in the form of a letter accompanied by a stamped as-built drawing showing spot elevations.

3.09 BORROW AND WASTE MATERIALS

- A. Borrow:

In the event borrow material is required, the borrow material shall be checked for suitability for compaction and approved by the soils testing laboratory. The Contractor shall notify the laboratory at least three (3) days in advance of beginning borrow operations. Borrow excavation shall be performed in accordance with Section 230 of the NCDOT Standard Specifications for Roads and Structures except where modified herein. The Contractor shall be responsible for any erosion control, seeding, and stabilization of any borrow area regardless of whether such area is located on or off the Owners property.

- B. Waste:

Excavated materials not suited for backfill and excavated material in excess of that needed to complete the work shall be hauled off the Owner's property at the Contractor's expense. The Contractor shall be responsible for any erosion control, seeding and stabilization at any waste site at no additional cost to the Owner. See section "31 10 05 - Waste Material Disposal."

3.10 RESIDUAL SOIL AREAS

If proofrolling indicates that on-site virgin soils supporting any roadway, parking, building or other structural areas are not adequate as determined by the Soils Engineer, then these unsuitable areas shall be classified as undercut and be repaired by the Contractor. The necessary repair procedure shall be determined by the Soils Engineer and may include scarifying, drying and recompaction procedures or undercutting and replacement procedures.

3.11 FINAL GRADING

- A. On completion of all grading, all graded areas (except building pads and pavement areas and all cut slopes steeper than 4: 1 slope) shall be provided with 4 inches of topsoil and brought to the finished grades shown on the drawings. Areas disturbed by operations of the Contractor shall be properly returned to their original condition with a topsoil covering of 4 inches.
- B. After the entire graded area has been brought to the finished grades shown on drawings, all areas shall be left smooth and free from erosion, ridges, ditches and evidence of ponding. Final grades shall be free from all roots, debris, rock and soil lumps and left in readiness for seeding.
- C. Prior to acceptance of the entire project, the Contractor shall correct all embankments and graded areas of all damages due to washes, settlement, erosion, equipment ruts or any other cause at his expense.
- D. Prior to final acceptance, the Contractor shall provide certification as specified in paragraph 3.7.6 that all grades are ± 0.1 foot of the finished grades shown on project drawings.
- E. The Contractor shall stabilize all disturbed areas, unless otherwise directed, by seeding and mulching per section 32 32 00 of these specifications or other means of stabilization called for by the contract drawings.

3.11 CLEAN UP

Upon completion or termination of the work, and before final payment is made, the Contractor shall remove from site all equipment, waste materials and rubbish resulting from his operations. In the event of his failure to do so, the same may be done by the Owner at the expense of the Contractor.

END OF SECTION

**SECTION 31 23 00 EXCAVATING, BACKFILL, AND COMPACTING FOR
UTILITIES & STRUCTURES**

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, material, equipment, and supplies, and shall perform all earthwork for installation of utilities including excavation and backfill, pavement removal, sheathing, bracing, shoring, pumping or bailing, dewatering, restoration and cleanup; all as indicated, specified and/or necessary to complete the work.
- B. Any reference to NCDOT standard specifications was obtained from "Standard Specifications for Roads and Surfaces" published by the North Carolina Department of Transportation dated February 10, 2006. Unless otherwise noted, the most current date published applies.
- C. Related Work: Reference the following specifications for related work:
- | | |
|----------|-------------------------|
| 31 32 00 | Site Stabilization |
| 32 01 00 | Restoration of Surfaces |

PART 2: PRODUCTS

2.01 MATERIALS

- A. Fill Material shall be classified as ML-low plasticity silt or better by the Unified Soil Classification System and tabulated below:

	UNIFIED CLASS	DESCRIPTION
CLASS I	GW	¼"- 1 ½" well graded stone including coral, slag, cinders, crushed stone & shell
CLASS II	GP	Coarse gravel, poorly graded
	SW	Coarse sands, well graded
	SP	Coarse sands, poorly graded
CLASS III	GM	Silt-y, sandy gravel
	GC	Clay-y, sandy gravel
	SM	Silt-y sands
	SC	Clay-y sands
CLASS IV	ML	Inorganic silts and fine sands

- B. Backfill material shall exhibit a plasticity index of less than 20, and Standard Proctor maximum density at optimum moisture greater than 90 pounds per cubic foot.
- C. The following materials are unacceptable:

	UNIFIED CLASS	DESCRIPTION
CLASS IV	CL	Inorganic clays- low plasticity
	MH	Inorganic elastic silts
	CH	Inorganic clays- high plasticity
CLASS V	OL	Organic silts
	OH	Organic clays
	PT	Highly organic soil

- D. Washed Stone: Stone material where indicated shall be crushed stone or gravel of strong, durable nature and shall conform to standard size No. 57 per NCDOT Section 1000.
- E. Concrete: Minimum 28-day compressive strength of 3000 psi.

PART 3: EXECUTION

3.01 EXISTING FACILITIES

- A. Existing Utilities Shown on the Drawings: It shall be the Contractor's responsibility to conduct the work in such a manner as to avoid damage to or interference with any utilities services shown on the drawings. If such damage, interference, or interruption of service shall occur as a result of his work, then it shall be the Contractor's responsibility to promptly notify the Engineer of the occurrence and to repair or correct it immediately, at his own expense, and to the satisfaction of the Engineer and the Owner of the Utility.
- B. Existing Utilities Not Shown on the Drawings: It shall be the Contractor's responsibility to exercise all reasonable precaution in the performance of the work to avoid damage to or interference with any utilities services, even though not shown on the drawings. If such damage, interference, or interruption of service shall occur as the result of this work, then the Contractor's responsibility will be the same as stipulated in Paragraph 3.1.A above.

3.02 EXISTING STREAMS

Exercise reasonable precaution to prevent the silting of streams. Provide at Contractor's expense temporary erosion and sediment control measures to prevent the silting of streams and existing drainage facilities. The Contractor shall size structures and conform fully with the North Carolina Sedimentation Pollution Control Act.

3.03 EXCAVATION AND BACKFILL – GENERAL REQUIREMENTS

- A. Pavement, gutters, sidewalks, aprons and curbs which will be disturbed by excavation shall be removed and disposed of as a part of ordinary excavation. That which is to be removed shall be cut or sawn along clean straight lines from that which is to remain. Remove enough such that a minimum of twelve inches of undisturbed earth remain between the excavation and that which is to remain.
- B. Where required, and as approved by the Engineer, sheeting and bracing shall be used to prevent injury to persons, caving of trench walls and to conform with all governing laws and ordinances. Sheeting and bracing shall be left in place until the trench is refilled to a safe limit. The top portion may then be removed, but the lower portion shall remain undisturbed.
- C. It is the responsibility of the Contractor to provide an adequate dewatering system where required. The system shall be capable of removing any water that accumulates in the excavation and maintaining the excavation in a dry condition while construction is in progress. The surface of the ground shall be sloped away from the excavation or piping provided to prevent surface water from entering the excavation. Disposal of water resulting from the dewatering operation shall be done in a manner that does not interfere with normal drainage, and does not cause damage to any portion of the work or adjacent property. All drains, culverts, storm sewers and inlets subject to the dewatering operation shall be kept clean and open for normal surface drainage. The dewatering system shall be maintained until backfilling is completed or as otherwise directed by the Engineer. All damage resulting from the dewatering operation shall be repaired by the Contractor to the satisfaction of the Engineer and at no cost to the Owner.
- D. The Contractor shall erect, maintain, and safeguard temporary bridges, walkways, or crossings where it is necessary to maintain traffic. Where trenches are open in the vicinity of pedestrian or vehicular travel lanes, suitable carriers will be constructed and maintained and the work will be further protected from sunset to sunrise with a sufficient number of lights or flares to fully protect the public from accidents on account of construction. The Contractor shall maintain at a minimum a single lane of traffic during all construction activities at all times. The Contractor shall provide flaggers as necessary to safely direct and accommodate traffic during construction.

- E. If the specified depth for foundations proves insufficient to reach firm ground, the Engineer shall be notified and will furnish instructions for proceeding with the work.
- F. Rock, wherever used as a name for excavation material, shall mean boulders exceeding one-half cubic yard in volume or solid ledge rock, which in the opinion of the Engineer, requires for its removal drilling and blasting, or wedging or slogging and barring. Where rock excavation is necessary, the Contractor shall excavate the same as near the neat lines of the trench as practicable and he shall take all due precautions in the pursuance of the work. He will be held strictly responsible for all injury to life and to public and private property.
 - 1. Rock shall be removed from the excavation to the following limits:
 - a. Trenches: The diameter of the pipe plus 8 inches on each side, extending 6 inches below the pipe wall and bell.
 - b. Structures: 12 inches beyond the vertical plane of the structure on all sides and on the bottom only to the depth necessary for proper installation.
- G. Blasting: Prior to commencing any blasting operations the Contractor shall notify the Engineer and either the Local Fire Department - Fire Prevention Section or the County Fire Administrator (as applicable) and obtain blasting permits as required. The Contractor must furnish proof (certification) of insurance specifically covering any and all obligations assumed pursuant to the use of explosives.

All blasting operations shall be conducted in strict accordance with any and all decrees, rules, regulations, ordinances, laws as may be imposed by any regulatory body and/or agency having jurisdiction over the work relative to handling, transporting, use and storage of explosives. Blasting shall be done only by competent, and experienced men whose activities shall be conducted in a workmanlike manner. Satisfactory information must be provided to the Engineer, that the blaster meets or exceeds the qualifications enumerated in OSHA Regulations Part 1926, Subpart U, Section 1926.901 - Blaster Qualifications.

The Contractor shall protect all structures from the effects of the blast and repair any resulting damage. If the Contractor repeatedly uses excessive blasting charges or blasts in an unsafe or improper manner, the Engineer may direct the Contractor to employ an independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge.

- 1. Overburden: Undisturbed overburden may be deemed adequate in lieu of matting but only after the actual depth of the undisturbed overburden has been determined and adjudged sufficient by the Engineer. Under no

circumstances will loose or fill overburden be adequate without the use of weighted mats.

2. **Permission to Blast:** The Contractor shall not be allowed to blast before 9 a.m. or after 3 p.m. without approval of the Engineer and Owner. Blasting will not occur within any rights-of-way maintained by any agency (D.O.T., R.R., Gas, Owner, etc.) without specific approval of the controlling agency and only in accordance with their respective requirements (as exceeded herein). The Contractor shall be held responsible for any and all injury to persons or damage to public or private property.
3. The Contractor shall not use excavated rock as backfill material. Dispose of rock which is surplus or not suitable for use as rip rap.
4. **Monitoring:** The Contractor shall notify the Engineer prior to any blasting. Additionally, the Contractor shall notify the Engineer before any charge is set. Following review by the Engineer regarding the proximity of permanent structures to the blasting site, the Engineer may direct the Contractor to employ an independent, qualified specialty sub-contractor, approved by the Engineer, to monitor the blasting by use of seismograph, identify the areas where light charges must be used, conduct pre-blast and post-blast inspections of structures, including photographs or videos, and maintain a detailed written log.

3.04 TRENCH EXCAVATION AND BACKFILL

A. TRENCH EXCAVATION

1. **General:** Perform all excavation of every description and of whatever substance encountered so that the pipe can be laid to the alignment and depth shown on the Drawings.
2. Brace and shore all trenches, where required, in accordance with the rules and regulations, promulgated by the Department of Labor, Occupation Safety and Health Administration, "Safety and Health Regulations for Construction".
3. Make all excavations by open cut unless otherwise specified or indicated on the Drawings.
4. **Width of Trenches:** Excavate trenches sufficiently wide to allow proper installation of pipe, fittings and other materials and not more than 18" clear of pipe on either side at any point. Do not widen trenches by scraping or loosening materials from the sides.

5. Trench Excavation in Earth: Earth excavation includes all excavation of whatever substance encountered. In locations where pipe is to be bedded in earth excavated trenches, fine grade the bottoms of such trenches to allow firm bearing for the bottom of the pipe on undisturbed earth. Where any part of the trench has been excavated below the grade of the pipe, fill the part excavated below such grade with pipe bedding material and compact at the Contractor's expense.
6. Trench Excavation in Fill: If pipe is to be laid in embankments or other recently filled material, first place the fill material to the finish grade or to a height of at least one foot above the top of the pipe, whichever is the lesser. Take particular care to ensure maximum consolidation of material under the pipe location. Excavate the pipe trench as though in undisturbed material.
7. Trench Bottom in Poor Soil: Excavate and remove unstable or unsuitable soil to a width and depth, as directed by the Engineer, and refill with a thoroughly compacted gravel bedding.
8. Bell Holes: Provide bell holes at each joint to permit the joint to be made properly and to provide a continuous bearing and support for the pipe.

B. TRENCH BACKFILL

1. General: Unless otherwise specified or indicated on the Drawings, use suitable material for backfill which was removed in the course of making the construction excavations. Do not use frozen material for the backfill and do not place backfill on frozen material. Remove previously frozen material before new backfill is placed. Start backfilling as soon as practicable after the pipes have been laid, or the structures have been built and are structurally adequate to support the loads, including construction loads to which they will be subjected, and proceed until its completion.
2. With the exception mentioned below in this paragraph, do not backfill trenches at pipe joints until after that section of the pipeline has successfully passed any specified tests required. Should the Contractor wish to minimize the maintenance of lights, and barricades, and the obstruction of traffic, he may, at his own risk, backfill the entire trench as soon as practicable after installation of pipe, and the related structures have acquired a suitable degree of strength. He shall, however, be responsible for removing and later replacing such backfill, at his own expense, should he be ordered to do so in order to locate and repair or replace leaking or defective joints or pipe.
3. Material: The nature of the materials will govern both their acceptability for backfill and the methods best suited for their placement and

compaction in the backfill. Both are subject to the approval of the Engineer. Do not place stone or rock fragments larger than 4" in greatest dimension in the backfill. Do not drop large masses of backfill material into the trench in such a manner as to endanger the pipeline. Use a timber grillage to break the fall of material dropped from a height of more than 5 feet. Exclude pieces of bituminous pavement from the backfill unless their use is expressly permitted.

4. **Zone Around Pipe:** Place bedding material to the level shown on the Drawings and work material carefully around the pipe to insure that all voids are filled, particularly in bell holes. For backfill up to a level of 2 feet over the top of the pipe, use only selected materials containing no rock, clods or organic materials. Place the backfill and compact thoroughly under the pipe haunches and up to the mid-line of the pipe in layers not exceeding 6" in depth. Place each layer and tamp carefully and uniformly so as to eliminate the possibility of lateral displacement. Place and compact the remainder of the zone around the pipe and to a height of one foot above the pipe in layers not exceeding 6" and compact to a maximum density of at least 100 % as determined by ASTM D0698.
5. **Tamping:** Deposit and spread backfill materials in uniform, parallel layers not exceeding 12" thick before compaction. Tamp each layer before the next layer is placed to obtain a thoroughly compacted mass. Furnish and use, if necessary, an adequate number of power driven tampers, each weighing at least 20 pounds for this purpose. Take care that the material close to the bank, as well as in all other portions of the trench, is thoroughly compacted. When the trench width and the depth to which backfill has been placed are sufficient to make it feasible, and it can be done effectively and without damage to the pipe, backfill may, on approval, be compacted by the use of suitable rollers, tractors, or similarly powered equipment instead of by tamping. For compaction by tamping (or rolling), the rate at which backfilling material is deposited in the trench shall not exceed that permitted by the facilities for its spreading, leveling and compacting as furnished by the Contractor.
6. Wet the material by sprinkling, if necessary, to insure proper compaction by tamping (or rolling). Perform no compaction by tamping (or rolling) when the material is too wet either from rain or applied water to be compacted properly.
7. **Trench Compaction:** Compact backfill in pipe trenches that is under pavement to the maximum density of soil material compacted at optimum moisture content to 95% and with the last 2' being 98%. Compact backfill in pipe trenches that is not under pavement to the maximum density of soil material compacted at optimum moisture content to 95%.

3.05 STRUCTURE EXCAVATION AND BACKFILL

A. STRUCTURE EXCAVATION

1. Structure Excavation shall be made at the locations shown on the plans and to the exact subgrade required. Bottom of excavations shall be level and in firm, solid material, with soft material or voids treated as specified. Excavated areas shall be kept free of water during the construction period. Where earth will stand, footing trenches may be cut to the exact size of the footings; otherwise, forms shall be used. Where necessary, sides of excavations shall be shored and sheathed, or cofferdams built, as required for protection of the work and personnel.
2. Wherever excavation for a foundation extends below the water table or where specifically indicated on the plans, washed stone shall be placed to a minimum thickness of 12 inches, unless otherwise shown or as directed by the Engineer, prior to placing the foundation. The washed stone shall be compacted to 90% of maximum as determined by the Standard Proctor test (ASTM D698).
3. If the specified depth for foundations proves insufficient to reach firm ground, the Engineer shall be notified for furnishing instructions and proceeding with the work.

B. STRUCTURE BACKFILL

1. Structure Backfill shall be done with material free from large clods, frozen earth, organic material or any foreign matter, and shall evenly and carefully be placed and tamped in horizontal layers. Compaction equipment specifically designed for these purposes must be present and operational at the job site and shall be utilized throughout to obtain uniform compaction. The degree of compaction and the density shall be determined by the Standard Proctor Test (ASTM D698), with compaction requirements as follows:

Percent of Maximum Density
at Optimum Moisture

Location

- | | |
|----|---|
| 98 | Top 24" of fill beneath pavement and structures. |
| 95 | 24" or deeper beneath all roads and driveways, full depth under sidewalks and undercut backfill for structure excavation. |
2. No backfill shall be placed against a structural wall until all connecting structural members are in place. It shall be the Contractor's responsibility

to provide compaction to such a degree that subsidence after placing shall not be detrimental to the stability or appearance of the structure, adjacent ground, or paved areas. The Contractor shall provide adequate protection to all structures during backfilling and shall use every precaution to avoid damaging or defacing them in any way. Contractor shall be responsible for the protection of all structures from damage or flotation prior to backfill being placed.

3. Unless otherwise approved by the Engineer, liquid-retaining structures shall not be backfilled until tested for leakage.

3.06 UNSTABLE SUBGRADE

Should unstable soil, organic soil, or soil types classified as fine-grained soils (silts and clays) by ASTM D-2487 be encountered in the bottom of pipe trenches or structure excavations, such soils shall be removed to a depth and width determined by the Engineer, properly disposed of and shall be backfilled with crushed stone conforming to the Department of Transportation Specifications, Size 57. Placement shall not exceed 12-inches loose and compacted to 90% of the dry density determined by the Standard Proctor test ASTM D698 (Concrete may be substituted in place of #57 stone at the Contractor's option. A 24-hour cure must be given before proceeding with the work).

3.07 COMPACTION

Compaction: Unless otherwise noted, each layer of fill and backfill and the top 12 inches of existing subgrade material in cuts shall be compacted by approved equipment as specified below. Maximum lift thickness shall be 8" of loose material prior to compaction efforts. The degree of compaction and the density shall be determined by the Standard Proctor Test (ASTM D698).

	Percent of Max. Dry Density at <u>Optimum Moisture Content</u>
Top 24 inches of fill under pavement or structures	98%
24" and deeper under roads and structures	95%
Fill and backfill in other areas	95%

Material too dry for proper compaction shall be moistened by suitable watering devices, turned and harrowed to distribute moisture, and then properly compacted. When

material is too wet for proper compaction, operations shall cease until such material has sufficiently dried.

3.07 COMPACTION TESTING

The Owner, or its authorized representatives, reserve the right to perform compaction tests on any or all portion(s) of backfill placed at no cost to the Contractor. However, in the event the compaction of this backfill is not in compliance with the specification, then the Contractor shall take corrective measures at no cost to the Owner to bring the backfill within the limits of the specifications. The Contractor shall then be responsible for reimbursing the Owner all costs associated with the performance of compaction test(s) in those sections of the backfill that failed the initial compaction test(s). Minimum testing shall be:

1. Every 300 lf/lift in paved areas for linear utilities in paved areas.
2. Every 500 lf/lift in non-paved areas.
3. Other areas, such as adjacent to structures, 1 test/40 cubic yards of material.

In the event that the soil compaction is not in compliance with these specifications, then the Contractor shall take corrective action, at no cost to the Owner, to compact the soils within the limits of the specifications. The Engineer shall be notified within 24 hours of any failing compaction tests. Any retesting of failed areas shall be performed only after corrective measures have been made by the Contractor to bring the compacted soils into compliance. All retesting shall be performed with the Engineer present.

END OF SECTION

SECTION 31 23 13

SUBGRADE

PART 1: GENERAL

1.01 SCOPE OF WORK

The work covered by this section consists of the preparation, shaping, and compaction of that portion of the roadbed upon which base or pavement, including base and paving for shoulders, is to be placed.

PART 2: NOT USED

PART 3: EXECUTION

3.01 CONSTRUCTION

- A. The subgrade shall be shaped to the lines, grades, and typical sections shown on the plans. All unsuitable material, boulders, and all vegetative matter shall be removed and replaced with suitable material. Suitable material, when not available from the subgrade work, shall be taken from roadway excavation or borrow pits.
- B. Material excavated in preparing the subgrade shall be stored or stockpiled in such a manner as to not interfere with proper drainage or any of the subsequent operations of placing base or pavement.
- C. The top 24" of subgrade in paved areas shall be compacted at a moisture content required to produce 98% of maximum density. All other areas subgrade will be compacted to 95% of maximum density at the optimum moisture content. The Contractor shall dry or add moisture to the subgrade when required to provide a uniformly compacted and acceptable subgrade.

3.02 QUALITY CONTROL

- A. Refer to Section 31 23 00 "Excavating, Backfilling, and Compacting for Utilities" for testing scenarios.
- B. A tolerance of plus or minus 1/2" from the established grade will be permitted after the subgrade has been graded to a uniform surface.
- C. Ditches and drains shall be provided and maintained when required to satisfactorily drain the subgrade. Where previously approved subgrade is damaged by natural causes, by hauling equipment, or by other traffic, the Contractor shall restore the subgrade to the required lines, grades, and typical sections and to the required density at no cost to the Owner.

3.03 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENT CONTROL

1. DESCRIPTION:

- 1.1 Erosion and sedimentation control shall be provided by the Contractor for all areas of the site denuded or otherwise disturbed during construction. The Contractor shall be responsible for all installation, materials, labor, and maintenance of erosion and sediment control devices, as well as removal of temporary erosion and sediment control devices shown on the plans or required to protect all downstream properties, natural waterways, streams, lakes, ponds, catch basins, drainage ditches, roads, gutters, natural buffer zones, and man-made structures.
- 1.2 Erosion and sediment control procedures and facilities shall conform to the "Erosion and Sediment Control Planning and Design Manual" as published by the North Carolina Sedimentation Control Commission, Sections 1607 and 1610 of the "Standard Specifications for Roads and Structures" dated January 1, 2018, as published by the North Carolina Department of Transportation and to all applicable local codes or ordinances, whichever is more stringent.
- 1.3 Related Work: See the following sections for related work.
 - 1. 31 32 00 Site Stabilization

2. MATERIALS:

- 2.1 Washed stone to be used in temporary sediment basins shall be of strong, durable nature, resistant to weathering and shall be graded to conform to Standard Size Number 57 per Section 1008 of the "Standard Specifications for Road and Structures" dated January 1, 2018, as published by the North Carolina Department of Transportation.
- 2.2 Refer to other sections within these specifications as listed in Item 1.3 above for other material specification required in the installation of erosion and sediment control facilities.

3. **INSTALLATION:**

3.1 **General Requirements:**

- 3.1.1 The Contractor shall follow the erosion control construction sequence schedule as shown on the contract drawings, except that should circumstances dictate that extra precaution be taken to prohibit erosion and sedimentation on the project, the Contractor will, at his own expense, take preventative measures as needed.
- 3.1.2 The Contractor is required to maintain all erosion and sediment control facilities to insure proper performance throughout the construction phase and until such time all disturbed areas are permanently stabilized.
- 3.1.3 Upon completion of construction or successful permanent stabilization of all areas which were disturbed before or during construction operations or as indicated on the construction drawings, whichever occurs last, the Contractor shall remove all temporary erosion and sediment control devices and facilities from the project site. The Contractor shall retain these items for future use or properly dispose of these items offsite.
- 3.1.4 The Contractor shall provide temporary or permanent ground cover as called for on the construction plans.

END OF SECTION

SECTION 31 25 13

TEMPORARY SILT FENCE

1. DESCRIPTION:

- 1.1 The work covered by this Section consists of the furnishing, installing, maintaining, replacing as needed, and removing of temporary silt fence. The Contractor shall furnish all equipment, tools, labor and materials necessary to complete the work in accordance with the plans and specifications. All materials and procedures shall conform to Section 1605 of the "Standard Specifications for Roads and Structures", dated January 1, 2018, published by the North Carolina Department of Transportation, Section 4.3.1 of the "Erosion and Sediment Control Planning and Design Manual", published by the North Carolina Sediment Control Commission and all local codes and ordinances, whichever is more stringent.

2. MATERIALS:

2.1 General Requirements:

- 2.1.1 Temporary silt fence shall be a water permeable filter type fence for the purposes of removing suspended particles from the water passing through it.

2.2 Posts:

- 2.2.1 Either wood posts or steel posts may be used. Wood posts shall be a minimum of 6 feet long, at least 3 inches in diameter, and straight enough to provide a fence without noticeable misalignment. Steel posts shall be at least 5 feet in length, approximately 1-3/8 inches wide measured parallel to the fence, and have a minimum weight of 1.25 lb/ft of length. The post shall be equipped with an anchor plate having a minimum area of 14.0 square inches, and shall have a means of retaining wire and fabric in the desired position without displacement.

2.3 Woven Wire Fence:

- 2.3.1 Wire fence fabric shall be at least 32 inches high, and shall have at least 6 horizontal wires. Vertical wires shall be spaced 12 inches apart. The top and bottom wires shall be at least 10 gage. All other wires shall be at least 12-1/2 gage.

2.4 Silt Fence Filter Fabric:

- 2.4.1 Filter fabric shall meet the requirements of Type 3 Engineering Fabric, Class A or B, per Section 1056 of the "Standard Specifications for Roads and Structures" dated January 1, 1990, published by the North Carolina Department of Transportation. Silt fence which incorporates filter fabric meeting the requirements of Section 1056 but which fails to

perform in an acceptable manner shall be replaced with silt fence which is capable of

acceptable performance. Silt fence should also meet the requirements of the "NCDENR Erosion Control Planning and Design Manual", latest revision.

2.5 Wire Staples:

2.5.1 Wire staples shall be a No. 9 staple and shall be at least 1½ inches long.

3. Installation:

3.1 General Requirements:

3.1.1 The Contractor shall install temporary silt fence as shown on the plans. The silt fence shall be constructed at the locations shown on the plans and at all other locations necessary to prevent sediment transport, as directed by the Engineer.

3.1.2 Class A synthetic filter fabric may be used only in conjunction with woven wire fence fabric backing. Filter fabric shall be attached to the wire fence fabric by wire or other acceptable means.

3.1.3 Class B synthetic filter fabric may be used without the woven wire fence fabric backing, subject to the following conditions:

3.1.4 Post spacing is reduced to a maximum of 6 feet.

3.1.5 The proposed fabric has been approved by the Engineer as being suitable for use without the woven wire fence fabric backing.

3.1.6 Fence posts shall be inclined toward the runoff source at an angle of not more than 20° from vertical.

3.1.7 Posts shall be installed so that no more than 3 feet of the post shall protrude above the ground. Where possible, the filter fabric from a continuous roll cut to the length of the barrier shall be used to avoid joints. When joints are necessary, securely fasten the filter cloth only at a support post with overlap to the next post. At the time of installation, the fabric will be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.

3.2 Maintenance and Removal:

3.2.1 The Contractor shall inspect temporary silt fences at least once a week and after each rainfall and shall make any required repairs and remove and dispose of silt accumulation immediately. Should the fabric of the silt fence collapse, tear, decompose or become ineffective, the Contractor will replace it promptly at his own expense.

The Contractor shall remove sediment deposits as necessary to provide adequate storage volume for the next rain and to reduce pressure on the fence.

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22-24232-01A

- 3.2.2 The Contractor shall remove all temporary silt fence and associated appurtenances once all disturbed areas upland of the fence are properly and satisfactorily stabilized as called for on the plans.

END OF SECTION

SECTION 31 32 00

SITE STABILIZATION

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. This section covers the furnishing of all labor, equipment and materials necessary for the establishment of vegetation of all areas of the site disturbed by construction operations and all earth surfaces of embankments including rough and fine grading, topsoil if required, fertilizer, lime, seeding and mulching. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of the grasses and legumes.

PART 2: PRODUCTS

2.01 MATERIALS

A. FERTILIZER

1. The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the North Carolina Board of Agriculture.
2. Fertilizer shall be 10-10-10 grade. Upon written approval of the Engineer a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.
3. During handling and storing, the fertilizer shall be cared for in such a manner that it will be protected against hardening, caking, or loss of plant food values. Any hardened or caked fertilizer shall be pulverized to its original conditions before being used.

B. LIME

1. The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Lime Law and regulations adopted by the North Carolina Board of Agriculture.
2. During the handling and storing, the lime shall be cared for in such a manner that it will be protected against hardening and caking. Any hardened or caked lime shall be pulverized to its original conditions before being used.
3. Lime shall be agriculture grade ground dolomitic limestone. It shall contain not less than 85% of the calcium and magnesium carbonates and

shall be of such fineness that at least 90% will pass a No. 10 sieve and at least 50% will pass a No. 100 sieve.

C. SEED

1. The quality of seed and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Seed Law and regulations adopted by the North Carolina Board of Agriculture. Seed shall have been approved by the North Carolina Department of Agriculture or any agency approved by the Engineer before being sown, and no seed will be accepted with a date of test more than 9 months prior to the date of sowing. Such testing however, will not relieve the Contractor from responsibility for furnishing and sowing seed that meets these specifications at the time of sowing. When a low percentage of germination causes the quality of the seed to fall below the minimum pure live seed specified, the Contractor may elect, subject to the approval of the Engineer, to increase the rate of seeding sufficiently to obtain the minimum pure live seed contents specified, provided that such an increase in seeding does not cause the quantity of noxious weed seed per square yard to exceed the quantity that would be allowable at the regular rate of seed.
2. During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents or other causes.
3. Seed shall be entirely free from bulblets or seed of Johnson Grass, Nutgrass, Sandbur, Wild Onion, Wild Garlic, and Bermuda Grass. The specifications for restricted noxious weed seed refers to the number per pound, singly or collectively, of Blessed Thistle, Wild Radish, Canada Thistle, Corncockle, Field Bindweed, Quackgrass, Daddies, Dock, Horsenettle, Bracted Plantain, Buckhorn or Wild Mustard; but in no case shall the number of Blessed Thistle or Wild Radish exceed 27 seeds of each per pound. No tolerance on weed seed will be allowed.

D. MULCH

Straw Mulch shall be threshed straw of oats, rye or wheat free from matured seed of obnoxious weeds or other species which would grow and be detrimental to the specified grass.

E. TACKIFIER

Emulsified asphalt or organic tackifier such as Reclamare R2400 shall be sprayed uniformly on mulch as it is ejected from blower or immediately thereafter. Tackifier shall be applied evenly over area creating uniform appearance. Rates of application will vary with conditions. Asphalt shall not be used in freezing weather.

PART 3: EXECUTION

3.01 PREPARATION

A. PROTECTION OF EXISTING TREES AND VEGETATION

1. Protect existing trees and other vegetation indicated to remain in place against cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide wood or metal stakes set on 8 to 10 foot centers and connected at a 4'-0" height by 2" minimum brightly colored flagging tape to protect trees and vegetation to remain. Set perimeter of protection at the drip line of trees to remain unless approved otherwise by the Engineer.
2. Provide protection for roots over 1-1/2" diameter cut during construction operations. Cleanly cut off end of damaged root and coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out and cover with earth as soon as possible.
3. The Contractor shall not remove or damage trees and shrubs which are outside the Clearing Limits established by the Owner or those within the Clearing Limits designated to remain.
4. Repair trees scheduled to remain and damaged by construction operations in a manner acceptable to the Engineer. Repair damaged trees promptly to prevent progressive deterioration caused by damage.
5. Replace trees scheduled to remain and damaged beyond repair by construction operations, as determined by the Engineer with trees of similar size and species. Repair and replacement of trees scheduled to remain and damaged by construction operations or lack of adequate protection during construction operations shall be at the Contractor's expense.

B. GRADING

1. Rough grading shall be done as soon as all excavation required in the area has been backfilled. The necessary earthwork shall be accomplished to bring the existing ground to the desired finish elevations as shown on the Contract Drawings or otherwise directed.

2. Fine grading shall consist of shaping the final contours for drainage and removing all large rock, clumps of earth, roots and waste construction material. It shall also include thorough loosening of the soil to a depth of 6" by plowing, discing, harrowing or other approved methods until the area is acceptable as suitable for subsequent landscaping operations. The work of establishing vegetation shall be performed on a section by section basis immediately upon completion of earthwork or pipeline installation.
3. Upon failure or neglect on the part of the Contractor to coordinate his grading with seeding and mulching operations and diligently pursue the control of erosion and siltation, the Engineer may suspend the Contractor's grading operations until such time as the work is coordinated in a manner acceptable to the Engineer.

C. SEEDBED PREPARATION

1. The Contractor shall cut and satisfactorily dispose of weeds or other unacceptable growth on the areas to be seeded. Uneven and rough areas outside the graded section, such as crop rows, farm contours, ditches and ditch spoil banks, fence line and hedgerow soil accumulations, and other minor irregularities which cannot be obliterated by normal seedbed preparation operations, shall be shaped and smoothed as directed by the Engineer to provide for more effective seeding and for ease of subsequent mowing operations.
2. The soil shall then be scarified or otherwise loosened to a depth of not less than 6" except as otherwise provided below or otherwise directed by the Engineer. Clods shall be broken and the top 2" to 3" of soil shall be worked into an acceptable seedbed by the use of soil pulverizers, drags, or harrows; or by other methods approved by the Engineer.
3. On 2:1 slopes a seedbed preparation will be required that is the same depth as that required on flatter areas, although the degree of smoothness may be reduced from that required on the flatter areas if so permitted by the Engineer.
4. On cut slopes that are steeper than 2:1, both the depth of preparation and the degree of smoothness of the seedbed may be reduced as permitted by the Engineer, but in all cases the slope surface shall be scarified, grooved, trenched, or punctured so as to provide pockets, ridges, or trenches in which the seeding materials can lodge.
5. On cut slopes that are either 2:1 or steeper, the Engineer may permit the preparation of a partial or complete seedbed during the grading of the slope. If at the time of seeding and mulching operations such preparation is still in condition acceptable to the Engineer, additional seedbed preparation may be reduced or eliminated.

6. The preparation of seedbeds shall not be done when the soil is frozen, extremely wet, or when the Engineer determines that it is in an otherwise unfavorable working condition.

3.02 APPLICATION

- A. Seed shall be applied by means of a hydro-seeder or other approved methods. The rates of application of seed, fertilizer and limestone shall be as stated in Table I.
- B. Equipment to be used for the application, covering or compaction of limestone, fertilizer, and seed shall have been approved by the Engineer before being used on the project. Approval may be revoked at any time if equipment is not maintained in satisfactory working condition, or if the equipment operation damages the seed.
- C. Limestone, fertilizer, and seed shall be applied within 24 hours after completion of seedbed preparation unless otherwise permitted by the Engineer, but no limestone or fertilizer shall be distributed and no seed shall be sown when the Engineer determines that weather and soil conditions are unfavorable for such operations.
- D. Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer shall be distributed uniformly over the prepared seedbed at the specified rate of application and then harrowed, raked, or otherwise thoroughly worked or mixed into the seedbed. Seed shall be distributed uniformly over the seedbed at the required rate of application, and immediately harrowed, dragged, raked, or otherwise worked so as to cover the seed with a layer of soil. The depth of covering shall be as directed by the Engineer. If two kinds of seed are to be used which require different depths of covering, they shall be sown separately.
- E. When a combination seed and fertilizer drill is used, fertilizer may be drilled in with the seed after limestone has been applied and worked into the soil. If two kinds of seed are being used which require different depths of covering, the seed requiring the lighter covering may be sown broadcast or with a special attachment to the drill, or drilled lightly following the initial drilling operation.
- F. When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 30 minutes prior to application unless otherwise permitted by the Engineer.
- G. Immediately after seed has been properly covered the seedbed shall be compacted in the manner and degree approved by the Engineer.
- H. When adverse seeding conditions are encountered due to steepness of slope, height of slope, or soil conditions, the Engineer may direct or permit that modifications be made in the above requirements which pertain to incorporating

limestone into the seedbed; covering limestone, seed, and fertilizer; and compaction of the seedbed.

Such modifications may include but not be limited to the following:

1. The incorporation of limestone into the seedbed may be omitted on (a) cut slopes steeper than 2:1; (b) on 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or (c) on areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.
2. The rates of application of limestone, fertilizer, and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.
3. Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces, or on other areas where soil conditions would make compaction undesirable.

I. MULCHING

1. All seeded areas shall be mulched unless otherwise indicated in the special provisions or directed by the Engineer.
2. It shall be spread uniformly at a rate of two tons per acre in a continuous blanket over the areas specified.
3. Before mulch is applied on cut or fill slopes which are 3:1 or flatter, and ditch slopes, the Contractor shall remove and dispose of all exposed stones in excess of 3" in diameter and all roots or other debris which will prevent proper contact of the mulch with the soil. Mulch shall be applied within 24 hours after the completion of seeding unless otherwise permitted by the Engineer. Care shall be exercised to prevent displacement of soil or seed or other damage to the seeded area during the mulching operation.
4. Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers which will provide an acceptable application. An acceptable application will be that which will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion, and conserve soil moisture.
5. Mulch shall be held in place by applying a sufficient amount of asphalt or other approved binding material to assure that the mulch is properly held in place. The rate and method of application of binding material shall meet the approval of the Engineer. Where the binding material is not applied directly with the mulch it shall be applied immediately following the mulch application.
6. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water, or other

causes and shall promptly remove any blockage to drainage facilities which may occur.

3.03 MAINTENANCE

- A. The Contractor shall keep all seeded areas in good condition, reseeding if and when necessary, until an acceptable stand of grass is established over the entire area seeded and shall maintain these areas in an approved condition until final acceptance of the Contract. Any of these additional efforts will be at no additional cost to the Owner.
- B. Grassed areas will be accepted when a 95% cover by permanent grasses is obtained and weeds are not dominant. On slopes, the Contractor shall provide against washouts by an approved method. Any washouts which occur shall be regraded and reseeded until a good sod is established.
- C. Areas of damage or failure due to any cause shall be corrected by being repaired or by being completely redone as may be directed by the Engineer. Areas of damage or failure resulting either from negligence on the part of the Contractor in performing subsequent construction operations or from not taking adequate precautions to control erosion and siltation as required throughout the various sections of the specifications, shall be repaired by the Contractor as directed by the Engineer at no cost to the Owner.

TABLE I - APPLICATION RATES

A. LIME AND FERTILIZER

In the absence of a soil test, the following rates of application of limestone and fertilizer shall be:

- 1. 4,000 pounds limestone per acre
- 2. 1000 pounds 10-10-10 (N-P₂O₅-K₂O) fertilizer per acre and the remaining quantity applied when vegetation is three inches in height or 45 days after seeding, whichever comes first.

B. MULCH

Mulch shall be applied at the following rates per acre:

- 1. 3,000-4,000 pounds straw mulch, or
- 2. 1,500-2,000 pounds wood cellulose fiber.
- 3. 35-40 cubic yards of shredded or hammermilled hardwood bark
- 4. 1,200-1,400 pounds of fiberglass roving

C. TEMPORARY SEED

The kinds of seed and the rates of application shall be as contained in this table. All rates are in pounds per acre. See Notes 1 and 2.

1. Fall and Winter (Normally August 1 to June 1)

80 pounds of Ky-31 tall fescue and 15 pounds of rye grain
2. Summer (Normally May 1 to September 1)

100 pounds of Ky-31 tall fescue

NOTES

1. On cut and fill slopes having 2:1 or steeper slopes, add 40 pounds of sericea lespedeza per acre to the planned seeding (hulled in spring and summer unhulled in fall and winter) plus 15 pounds of sudangrass in summer seeding or 25 pounds of rye cereal per acre in fall and winter seeding, if seeded September to February.
2. These seeding rates are prescribed for all sites with less than 50% ground cover and for sites with more than 50% ground cover where complete seeding is necessary to establish effective erosion control vegetative cover. On sites having 50% to 80% ground cover where complete seeding is not necessary to establish vegetative cover, reduce the seeding rate at least one-half the normal rate.

3.04 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 31 37 00

RIP RAP

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. The work covered by this section consists of the construction of plain rip rap in accordance with the requirements of the plans and these specifications and at the locations designated by the Engineer.

PART 2: PRODUCTS

2.01 DEFINITIONS

A. PLAIN RIP RAP

Plain rip rap shall consist of quarry run stone, or field stone or granite stone, etc., and shall be classified by size into Class 1, or Class 2. The class and thickness to be used will be called for on the plans.

B. CLASS 1 RIP RAP

Stone shall vary in weight from 5 to 200 pounds. At least 30% of the total weight of the rip rap shall be in individual pieces weighing a minimum of 60 pounds each. Not more than 10% of the total weight of the rip rap may be in individual pieces weighing less than 15 pounds each.

C. CLASS 2 RIP RAP

Stone shall vary in weight from 25 to 250 pounds. At least 60% of the total weight shall be in individual pieces weighing a minimum of 100 pounds each and not more than 100 pounds each and not more than 5% of the total weight may be individual pieces weighing less than 50 pounds each.

PART 3: EXECUTION

3.01 PLACEMENT OF RIP RAP

- A. Unless otherwise indicated or directed by the Engineer, the stone shall be placed upon a slope which shall be no steeper than the angle of repose. The stone shall be graded so that the smaller stones are uniformly distributed throughout the mass. The area and thickness shall be as shown on the plans or as designated by the Engineer.
- B. The Contractor may place the stone by mechanical methods, augmented by hand placing where necessary; provided that when the rip rap is completed it forms a properly graded, dense, neat layer of stone.

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22-24232-01A

3.02 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

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22-24232-01A

DIVISION 32

EXTERIOR IMPROVEMENTS



SECTION 32 01 17

ASPHALT PAVEMENT REPAIRS

PART 1: GENERAL

1.01 SCOPE OF WORK

This section covers the repairs of pavement for all asphalt surfaces.

1.02 PERFORMANCE

Construction of the subgrade, base course and paving shall be undertaken immediately after completion of all underground piping and structures, all curbs and gutters, all yard piping, conduits and other facilities passing beneath paved areas, and all structural slabs and foundations required within or adjacent to the paved areas.

1.03 REFERENCES

All work and materials required under this section of the specifications shall conform to the applicable sections of the North Carolina Department of Transportation, Division of Highways, Standard Specifications for Roads and Structures - Latest Edition.

PART 2: NOT USED

PART 3: EXECUTION

3.01 INSTALLATION

A. PREPARATION OF SUBGRADE

The work covered under this section of this specification shall be performed in strict accordance with Section 500 or Section 505 whichever is applicable, of the Standard Specifications for Road and Structures - Latest Edition, of the North Carolina Department of Transportation, Division of Highways.

B. APPLICATION OF AGGREGATE BASE COURSE

The work covered under this section of this specification shall be performed in strict accordance with Section 520 of the Standard Specification for Road Structures - Latest Edition, of the North Carolina Department of Transportation, Division of Highways.

C. ASPHALT PLANT MIX - GENERAL

The work covered under this section of this specification shall be performed in strict accordance with Section 610 and Section 620 of the Standard Specifications for Roads and Structures - Latest Edition, of the North Carolina Department of Transportation, Division of Highways.

D. TACK COAT

1. Materials used as a tack coat shall meet the requirements for the grades indicated below unless otherwise indicated in the contract. Any of the grades of tack coat material noted in this specification may be used:
 - Asphalt Binder, Grade PG 64-22
 - Emulsified Asphalt, Grade RS-1H, CRS-1H, CRS-1, HFMS-1, CRS-2
2. Do not dilute or mix the tack coat with water, solvents, or other materials prior to application.
3. When tack coat is required beneath an open-graded asphalt friction course, the asphalt grade and rate of application to be used will be specified on the job mix formula.
4. Surface Preparation
 - a. The surface to which the tack coat is to be applied shall be cleaned of dust, dirt, clay, and any other deleterious matter prior to placing the tack coat.
 - b. The Contractor shall remove grass, dirt and other materials from the edge of the existing pavement prior to the placement of tack coat.
5. Weather Limitations
 - a. Tack shall be applied only when the surface to be treated is sufficiently dry and the atmospheric temperature in the shade away from artificial heat is 35° F or above.
 - b. Tack coat shall not be applied when the weather is foggy or rainy.
6. Application Rates and Temperatures
 - a. Tack coat shall be uniformly applied at a rate from 0.04 to 0.08 gallons per square yard. The exact rate of application will be established by the Engineer and will be based on the volume of material at the actual application temperature. When tack coat is required beneath an open-graded asphalt friction course, an asphalt binder Grade PG 64-22 material shall be used. The exact rate of application will be specified on the job mix formula and will be within the range of 0.06 to 0.08 gallons per square yard.

- b. The temperature of the material at the time of application shall be within the ranges shown in the table below:

Application Temperatures for Tack Coat

Asphalt Material	Temperature Range
Asphalt Binder, Grade PG 64-22	375 - 425°F
Emulsified Asphalt, Grade RS-1H, CRS-1, CRS-1H	90 - 150°F
Emulsified Asphalt, Grade HFMS-1	90 - 160°F
Emulsified Asphalt, Grade CRS-2	125 - 185°F

7. Application

- a. No more tack coat material shall be applied than can be covered with base, intermediate, or surface course during the following day's paving operations.
- b. Tack coat material shall be uniformly applied to the entire surface utilizing an adjustable spray bar. Areas of tack coat application should be uniformly and completely covered.
- c. Tack coat shall be applied only in the presence of and as directed by the Engineer. No base or surface mixture shall be deposited onto the tacked pavement until the tack coat has sufficiently cured.
- d. Contact surfaces of headers, curbs, gutters, manholes, vertical faces of old pavements, and all exposed transverse and longitudinal edges of each course shall be painted or sprayed with tack coat before new asphalt mixture is placed adjacent to such surfaces.
- e. Bridge floors, curbs and handrails of structures, and all other appurtenances shall be covered to prevent tack coat from being tracked or splattered on the structures or appurtenances.

8. Protection

- a. Protect the tack coat after application until it has cured for a sufficient length of time to prevent it from being picked up by traffic.

- b. Contractor shall take the necessary precautions to minimize tracking and/or accumulation of tack coat material on existing or newly constructed pavements. Corrective measures may be required in areas where an excessive accumulation of tack has occurred.
- E. BASE COURSE (B 25.0X); INTERMEDIATE COURSE (I 19.0X); SURFACE COURSES (S 12.5X, S AND SF 9.5X)

1. Weather and Temperature Limitations

- a. Asphalt mixtures shall not be produced or placed during rainy weather, when the subgrade or base course is frozen, or when the moisture on the surface to be paved would prevent proper bond. Asphalt material shall not be placed when the air temperature, measured in the shade away from artificial heat at the location of the paving operations, is less than the temperatures noted in the table on the following page.
- b. Where the surface course is to be placed on the intermediate course, the surface course shall be placed as soon as possible after the intermediate course has been placed, and in all cases during the same paving season.

Minimum Paving Temperatures

Asphalt Mixture	Minimum Air Temperature (°F)	Minimum Road Surface Temperature (°F)
B 25.0B B 25.0C	35	35
I 19.0B I 19.0C	35	35
S 9.5C, S 9.5D, S 12.5C, S 12.5D	50	50
SF 9.5A S 9.5B	40	50

2. Spreading and Finishing

- a. Coat surface of manhole frames and inlet frames with oil to prevent bonding with asphalt pavement. Do not tack or prime coat these surfaces.

- b. Tack coat shall be applied to the existing pavement, when necessary, in accordance with the provisions of these specifications.
- c. The asphalt mixture shall be spread and struck off to the required grades, cross sections, and thicknesses.
- d. Should unevenness of texture, tearing, segregation, or shoving occur during the paving operation due to unsatisfactory methods or equipment, the Contractor shall immediately take such action as may be necessary to correct such unsatisfactory work. Excessively throwing back material will not be permitted.

3. Compaction

- a. Immediately after the asphalt mixture has been spread, struck off, shaped to the required width, depth, cross-section, and surface and edge irregularities adjusted, it shall be thoroughly and uniformly compacted. Compaction must be obtained in a manner that provides uniform density over the pavement and meets the required degree of compaction for the type of mixture being placed. Compaction rolling shall be complete before material temperature drops below 185°F.
- b. Compaction rolling should be performed at the maximum temperature at which the mix will support the rollers without moving horizontally. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Adjustments to the compaction equipment may be required where uniform density is not being obtained throughout the depth of the layer being tested.
- c. All final wearing surfaces, except open-graded asphalt friction course, shall be compacted using a minimum of 2 steel wheel tandem rollers. Pneumatic-tired rollers with smooth tread tires may be used after the breakdown roller and prior to finish rolling. Vibratory rollers must not be operated in vibratory mode during finish rolling on any mix type or pavement layer.
- d. Rollers used to compact the mixture shall be in good condition and capable of reversing without backlash. The rollers shall be operated with the drive wheels nearest the paver and at uniform speeds slow enough to avoid displacement of the mixture. Steel wheel rollers shall be equipped with wetting devices to prevent the mixture from sticking to the roller wheels. Fuel oil shall not be used to moisten roller wheels.

- e. All asphalt mixtures, except open-graded asphalt friction course and type SF 9.5A, shall be compacted to at least 92 percent of the mixtures maximum specific gravity. An SF 9.5A mixture shall be compacted to at least 90 percent of the mixtures maximum specific gravity.
- f. Rolling for open-graded asphalt friction course shall consist of one coverage with a tandem steel wheel roller weighing a maximum of 10 tons, with additional rolling limited to one coverage with the roller where necessary to improve riding surface.
- g. The use of rolling equipment that results in excessive crushing of the aggregate or excessive displacement of the mixture will not be permitted.
- h. In areas inaccessible to standard rolling equipment, the mixture shall be thoroughly compacted by the use of hand tampers, hand operated mechanical tampers, or other approved equipment.
- i. The tolerance of the final compacted pavement shall be within 1/4" of the typical cross-sections shown on the plans.

4. Joints

- a. Placement of surface course material as the final layer of pavement should not be placed between November 15 and April 1 of the next year unless otherwise approved by the Engineer. In addition, open-graded asphalt friction course shall not be placed between October 31 and April 1, unless otherwise approved.
- b. As an exception to the above, when in any day's operations the placement of a layer of asphalt base course material or intermediate course material 2 inches or greater in thickness has started, it may continue until the temperature drops to 32° F.

F. TRAFFIC MARKINGS

The Contractor shall repair and restripe any traffic markings that were damaged, removed or covered during construction. All work shall be done in accordance with NCDOT requirements and specifications. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

G. EXISTING UTILITIES

All existing manhole and valve covers shall be raised by the Contractor as necessary prior to paving so that the tops of the covers are flush with the final

WCU
Norton Intramural Fields
22-24232-01A

surface. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

3.02 TESTING

All of the above work will be subject to thickness and compaction tests as deemed necessary by the Engineer. Such tests will be at the Expense of the Owner.

3.03 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 03301

MISCELLANEOUS CONCRETE CONSTRUCTION

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. This section covers concrete construction, complete, including reinforcement therefore.

PART 2: PRODUCTS

2.01 MATERIALS

A. REINFORCING

Bar reinforcement shall be intermediate grade new billet steel conforming to the requirements of ASTM A-615. Unless otherwise noted, all reinforcing bars shall be grade 60. Wire fabric reinforcement shall consist of steel wire conforming to the requirements of ASTM A-185, latest revision.

B. CONCRETE

All concrete shall be equivalent to ready mix concrete manufactured and delivered in accordance with the requirements of ASTM C-94, latest revision and having a compressive strength at 28 days of 4000 psi, except as noted herein. The concrete manufacturer shall assume the responsibility of the design of the concrete mix in accordance with Alternate No. 2 of ASTM C-94. Air entrained concrete shall be used for all concrete exposed to the elements.

- a. Cement shall be Type 1 or Type 1A "Portland" cement conforming to ASTM C-150, latest revision or ASTM C-175, latest revision respectively.
- b. Aggregates shall conform to ASTM C-33, latest revision. Coarse aggregate shall be crushed rock or gravel and graded from 3/4" to #4 sieve for walls and slabs and from 2" to #4 sieve for mass or foundation concrete. Fine aggregate shall be natural sand.
- c. Mixing water shall be proportioned so that slump when measured with standard slump cone does not exceed the following:
- i. Slabs in gradeMax. 4", Min. 3"
 - ii. FootingsMax. 5", Min. 3"
 - iii. All othersMax. 6", Min. 3"
- d. Premolded joint filler strips shall be resilient compressive, bituminous and fiber material saturated, with at least 35% and not over 50% by weight of

asphalt. Poured type joint composition for expansion joints shall be elastic compound made up of asphalt and colloidal mineral fillers.

PART 3: EXECUTION

3.01 FORMS

- A. Forms shall be wood, metal, structural hardboard or other suitable material that will produce the required surface finish. Forms placed for successive pours for continuous surfaces shall be fitted to accurate alignment to assure a smooth completed surface free from irregularities, and shall be sufficiently tight to prevent the loss of mortar. No forms shall be left permanently in place without approval of the Engineer. Holes resulting from removal of form ties shall be filled solid within 12 hours after removal of forms with cement mortar.

3.02 PLACEMENT

- A. Concrete shall be placed as nearly as possible in its final position. Runways for wheeled equipment shall not be supported on the reinforcement. Concrete shall be placed and compacted in layers not over 18 inches deep. Vibrators may be used provided they are used under experienced supervision and the mixture is dry enough to prevent segregation. Form vibrators shall not be used. Vibration shall not be used for transporting or moving concrete inside the forms. No more concrete shall be placed than can be consolidated and finished the same day as placed. Free fall of concrete shall be limited so that no segregation of materials occurs.

3.03 JOINTS

- A. Construction of joints not indicated on drawing shall be approved by the Engineer in advance of pour. Joints in foundation walls shall be keyed. Before depositing of concrete is resumed, the hardened surface shall be roughened, cleaned and wetted surfaces shall be slushed with a coating of neat cement grout against which the new concrete shall be placed before the new grout has attained its set.

3.03 FINISHING

- A. After stripping forms, all voids and honeycombs shall be patched by chipping and scarifying the defective area and treating it with an approved bonding tended that all such voids be patched, not merely plastered. Grout mixture shall consist of one part Portland cement and one part sand. Immediately following removal of forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or waterproofed.
- B. Slabs shall be struck off and consolidated by approved machine or hand methods, so that upon completion, the surface shall be true to grade as shown on drawings and free of surface voids. All floors shall have monolithic steel trowel finish

WCU

Norton Intramural Fields

22-24232-01A

unless otherwise indicated on the drawings. Exterior walks shall be compacted, screeded and floated to a true even surface with wood floats and then broomed.

3.04 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSE

PART 1: GENERAL

1.01 SCOPE OF WORK

The work covered by this section consists of the construction of a base composed of an approved aggregate material hauled to the site, placed on the site, compacted, and shaped to conform to the lines, grades, depths, and typical sections shown on the plans or established by the Engineer.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Aggregate base course materials shall consist of crushed stone or uncrushed gravel, or other similar material having hard, strong, durable particles free of adherent coatings.
- C. The Contractor shall furnish aggregate base course material produced in accordance with the requirements indicated herein for Type A, aggregate unless otherwise specified in the special provisions.
- D. All aggregates shall be from approved sources. Sources will not be approved unless the material has satisfactory soundness and satisfactory resistance to abrasion. Satisfactory soundness will be considered to be a weighted average loss of not greater than 15% when subjected to five (5) alternations of the sodium sulfate soundness test in accordance with AASHTO T104. Satisfactory resistance to abrasion will be considered to be a percentage of wear of not greater than 55% when tested in accordance with AASHTO T96.
- E. Aggregates shall be handled in such a manner as to minimize segregation.
- F. Sites for aggregate stockpiles shall be grubbed and cleaned prior to storing aggregates, and the ground surface shall be firm, smooth, and well drained. A cover of at least 3" of aggregate shall be maintained over the ground surface in order to avoid the inclusion of soil or foreign material. Stockpiles shall be built in such a manner as to minimize segregation. When it is necessary to operate trucks or other equipment on a stockpile in the process of building the stockpile, it shall be done in a manner approved by the Engineer.
- G. Stockpiles of different types or sizes of aggregates shall be spaced far enough apart, or else separated by suitable walls or partitions, to prevent the mixing of the aggregates.
- H. Any method of stockpiling aggregates which allows the stockpile to become contaminated with foreign matter or causes excessive degradation of the

aggregate will not be permitted. Excessive degradation will be determined by sieve tests of samples taken from any portion of the stockpile over which equipment has been operated, and failure of such samples to meet all grading requirements for the aggregate will be considered cause for discontinuance of such stockpiling procedure.

I. GRADATION

All standard sizes of aggregates shall meet the gradation requirements when tested in accordance with AASHTO T27.

PART 3: EXECUTION

3.01 CONSTRUCTION OF STONE BASE

- A. The aggregate material shall be spread on the subgrade to a uniform loose depth and without segregation.
- B. Where the required compacted thickness of base is 8" or less the base material may be spread and compacted in one layer. Where the required compacted thickness of base is more than 8", the base material shall be spread and compacted in 2 or more approximately equal layers. The minimum compacted thickness of any one layer shall be approximately 4".
- C. Each layer of material shall have been sampled, tested, compacted, and approved prior to placing succeeding layers of base material or pavement.
- D. No base material shall be placed on frozen subgrade or base. Hauling equipment shall not be operated on subgrade or a previously completed layer of base material soft enough to rut or weave beneath the equipment.
- E. The maximum speed of trucks hauling or traveling over any part of the subgrade or base shall be 5 miles per hour.
- F. The Contractor shall utilize methods of handling, hauling, and placing which will minimize segregation and contamination. If segregation occurs, the Engineer may require that changes be made in the Contractor's methods to minimize segregation, and may also require mixing on the road which may be necessary to correct any segregated material. No additional compensation will be allowed for the work of road mixing as may be required under this provision. Aggregate which is contaminated with foreign materials to the extent the base course will not adequately serve its intended use shall be removed and replaced by the Contractor at no additional cost to the Owner. The above requirements will be applicable regardless of the type of aggregate placed and regardless of prior acceptance.

- G. The Engineer or the owner's representative will have the right to require that any portion of the work done in his presence and if the work is covered up after such instruction, is shall be exposed by the contractor for observation at no additional cost to the owner.

3.02 QUALITY CONTROL

A. TOLERANCES

1. After final shaping and compacting the base, the Engineer will check the surface of the base for conformance to grade and typical section and will determine the base thickness.
2. The thickness of the base shall be within a tolerance of $\pm 1/2''$ of the base thickness required by the plans.

B. MAINTENANCE

Where the base material is placed in a trench section, the Contractor shall provide adequate drainage through the shoulders to protect the subgrade and base until such time as shoulders are completed. The Contractor shall maintain the surface of the base by watering, machining, and rolling or dragging when necessary to prevent damage to the base by weather or traffic.

C. TESTING

1. There will be at least one base density test performed per 5,000 square feet. Compaction will be 100% of the maximum laboratory dry density as determined by ASTM D 1557 or AASHTO T 180. This test procedure will be the Owners responsibility to have done and at the owner's cost.
2. Depth measurements for compacted thickness shall be made by test holes through the base course. Where the base course is deficient, correct such areas by scarifying, adding base material and recompacting as directed by the Engineer. At staggered intervals not to exceed 250 feet for two lane streets and roads.

3.03 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1: GENERAL

1.01 SCOPE OF WORK

The work covered by this section shall consist of the production, delivery, and placement of asphalt plant mix base, intermediate, and surface courses properly laid on a prepared aggregate base course, in accordance with these specifications and in conformity with the lines, grades, thickness, and typical sections shown on the plans.

1.02 SUBMITTALS

- A. Prior to paving operations, the contractor should supply the engineer with the appropriate job mix formulas (JMF) for review and approval.
- B. The quantity of asphalt materials, measured as provided in Section 31 12 16, will be paid for at the contract prices as specified in the bidding documents. In all cases, the Contractor shall furnish copies of certified weight tickets for all asphalt materials placed on the project.

1.03 QUALITY ASSURANCE

- A. The Owner's Representative or Engineer will have the right to require that any portion of the work be performed in his presence and if the work is covered up after such instruction, it shall be exposed by the Contractor for observation at no additional cost to the Owner. However, if the Owner's Representative or Engineer fails to appear within 48 hours, the Contractor may proceed without him.
- B. All work done and materials furnished shall be subject to review by the Owner, Engineer or Project Representative. Improper work shall be reconstructed, and all materials which do not conform to the requirements of the specifications, shall be removed from the work upon notice being received from the Engineer for the rejection of such materials. The Engineer shall have the right to mark rejected materials so as to distinguish them as such.

The Contractor shall give the Owner, Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

- C. When required by the Engineer, the automatic weighing and recording system shall be checked by weighing a truck load of mix with an approved set of platform scales. Other means of checking the automatic weighing and recording system will be designated by the Engineer if such checking becomes necessary.

- D. The Contractor will not be permitted to use an asphalt mixture delivered to the road which is not accompanied by a load ticket signed by the weighman or an automatic printout ticket in accordance with the above requirements.
- E. The original of all tickets, including any voided tickets or tickets for rejected mixture, shall become the property of the Engineer.
- F. Asphalt materials will be accepted at the source of shipment subject to the following conditions:
 - 1. All asphalt transport tankers shall have a sampling valve in accordance with the requirements outlined by the Asphalt Institute and ASTM D140, or a comparable device acceptable to the Engineer.
 - 2. Each transport tanker delivering asphalt materials to the project shall keep a running log showing the date, destination, type and grade of material hauled on each trip. The tanker number shall be printed, stamped, or written in ink on each logbook. The logbook shall be available for examination upon request of the Engineer at any time.
 - 3. The Contractor shall furnish with each shipment two (2) copies of the delivery ticket. One copy shall accompany the shipment and be delivered to the Engineer or his representative at the destination. The delivery ticket shall contain the following information: Delivery ticket number, date shipped, state project or purchase order number, destination, name of consignee, trailer number, storage tank or batch number, quantity loaded (tons or gallons), loading temperature, specific gravity or pounds per gallon at 60°F, and net gallons at 60°F.
 - 4. The Engineer reserves the right to sample and test any shipment regardless of whether or not the above conditions have been met and to reject any material not meeting the requirements of the specifications.

1.04 STORAGE AND DELIVERY

A. ASPHALT MIXTURE STORAGE SYSTEM

- 1. The asphalt mixture storage system shall be capable of conveying the mix from the plant to the storage bin while minimizing production interruptions and ensuring the mixture discharged from the storage bin meets the job mix formula requirements.
- 2. The mixture shall be stored without a loss in temperature, segregation, or oxidation of the mix. Storage time should be limited to the ability of the storage system to maintain the mixture within the specification requirements.

B. TRANSPORTATION OF ASPHALT MIXTURE

1. The mixture shall be transported from the mixing plant to the point of use in vehicles which have tight, clean, smooth metal beds that have been lightly coated with a release agent to prevent the mixture from adhering to the bed. The release agent should be a material that is approved by the North Carolina Department of Transportation (NCDOT) Materials and Test Unit. Each vehicle shall be equipped with a canvas or other suitable material that will cover the bed of the vehicle. All covers shall be constructed and secured as to prevent the entrance of moisture and the rapid loss of temperature. A 3/8" diameter hole shall be provided on each side of the vehicle body near the center of the body and 6" above the bed of the vehicle for the purpose of inserting a thermometer.
2. The temperature of the mixture immediately prior to discharge from the hauling vehicle shall be within a tolerance of plus 15°F to minus 25°F of the specified job mix temperature. The asphalt mixture temperature should not exceed 350°F. Asphaltic concrete shall not be placed once the temperature of the mix falls below 250° F.

PART 2: PRODUCTS

2.01 MATERIALS

A. COMPOSITION OF MIXTURES

1. Asphalt mixtures noted herein refers to mix types for base (B 25.0X), intermediate (I 19.0X), and surface (S 12.5X, S and SF 9.5X) courses.
2. The asphalt plant mix shall be composed of a mixture of course and fine aggregate, asphalt binder, and mineral filler. The aggregate components shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading and physical requirements of the NCDOT specifications for the specified mix type. Materials which will not produce an asphalt mixture within the full allowable tolerances required by these specifications will be rejected.
3. If a recycled mixture is used, reclaimed asphalt pavement (RAP) may constitute up to 50 percent of the total material used.
4. Asphalt mixtures should be designed and produced in accordance with the gradation and design criteria for the specified mix type outlined in Table 610-1 and Table 610-2 of the most current NCDOT Standard Specifications for Roads and Structures.

5. The job mix formula shall be established with the allowable tolerances within the design limits specified for the particular type of asphalt mixture. At a minimum, each job mix formula should include the following information:
 - Asphalt mixture type
 - Asphalt mixture identification number (JMF#)
 - Source and percentage of each aggregate and recycled asphalt pavement (RAP) component to be used.
 - JMF combined gradation including target value for percent passing each standard sieve.
 - Percentage of asphalt binder in RAP.
 - Supplier and percentage of anti-strip additive.
 - Supplier, grade, and percentage of asphalt binder.
 - Target value (percentage) of asphalt binder content by weight of total mix and required design properties at that percentage.
 - Mix temperature.
 - Volumetric properties of compacted mixture.
 - Required Field Density.
6. The job mix formula for each mixture shall be in effect until modified in writing by the Engineer.
7. All mixtures furnished for the work shall conform to the job mix formula within the tolerance ranges specified for the particular mix.
8. Should a change in sources of aggregate, RAP, or asphalt binder materials be made, a new job mix formula will be required before the new mixture is produced.
9. When unsatisfactory results or other conditions make it necessary, the Engineer may establish a new job mix formula.
10. The asphalt binder for the mixtures shall be a performance graded binder meeting the requirements of AASHTO M320. The binder grade used in standard asphalt mixtures in North Carolina is Performance Grade 64-22 (PG 64-22). Depending on traffic conditions and other factors, other grades of asphalt binder may be used.

B. ASPHALT MATERIALS

1. Asphalt Tack Coat
 - a. Materials used as a tack coat shall meet the requirements for the grades indicated below unless otherwise indicated in the contract.

Any of the grades of tack coat material noted in this specification may be used:

- Asphalt Binder, Grade PG 64-22
 - Emulsified Asphalt, Grade RS-1H, CRS-1H, CRS-1, HFMS-1, CRS-2
- b. Do not dilute or mix the tack coat with water, solvents, or other materials prior to application.
- c. When tack coat is required beneath an open-graded asphalt friction course, the asphalt grade and rate of application to be used will be specified on the job mix formula.

PART 3: EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

- A. BASE COURSE (B 25.0X); INTERMEDIATE COURSE (I 19.0X); SURFACE COURSES (S 12.5X, S AND SF 9.5X)
1. Weather and Temperature Limitations:
- a. Asphalt mixtures shall not be produced or placed during rainy weather, when the subgrade or base course is frozen, or when the moisture on the surface to be paved would prevent proper bond. Asphalt material shall not be placed when the air temperature, measured in the shade away from artificial heat at the location of the paving operations, is less than the temperatures noted in the table on the following page.
- b. Where the surface course is to be placed on the intermediate course, the surface course shall be placed as soon as possible after the intermediate course has been placed, and in all cases during the same paving season.

Minimum Paving Temperatures

Asphalt Mixture	Minimum Air Temperature (°F)	Minimum Road Surface Temperature (°F)
B 25.0B B 25.0C	35	35
I 19.0B I 19.0C	35	35
S 9.5C, S 9.5D, S 12.5C, S 12.5D	50	50
SF 9.5A S 9.5B	40	50

2. Spreading and Finishing:

- a. Coat surface of manhole frames and inlet frames with oil to prevent bonding with asphalt pavement. Do not tack or prime coat these surfaces.
- b. Tack coat shall be applied to the existing pavement, when necessary, in accordance with the provisions of these specifications.
- c. The asphalt mixture shall be spread and struck off to the required grades, cross sections, and thicknesses by self contained, power propelled pavers. The pavers shall be equipped with an activated screed plate assembly which is designed to be preheated. The screed unit shall be equipped with a sliding shoe attachment that will form a slope on the edge of the mixture to help prevent edge raveling when the mixture is compacted. The paver shall be equipped with a receiving hopper and an automatically controlled distribution system capable of maintaining a uniform load of material in front of the full length of the screed.
- d. A string line shall be placed by the Contractor for the first lane of each layer of mixture placed to provide alignment control for the paver, except when the first layer is placed adjacent to a curb section.
- e. Pavers shall be operated at forward speeds consistent with plant production, mixture delivery and satisfactory laying of the mixture in order to provide a uniform and continuous laydown operation. Paving and loading operations should be coordinated such that an adequate amount of asphalt mixture is maintained in the paver hopper between trucks. Do not allow the hopper to become empty between loads. Should unevenness of texture, tearing, segregation,

or shoving occur during the paving operation due to unsatisfactory methods or equipment, the Contractor shall immediately take such action as may be necessary to correct such unsatisfactory work. Excessively throwing back material will not be permitted.

- f. Pavers shall be equipped with an electronic screed which will automatically control the longitudinal profile and cross slope of the pavement by the use of either a mobile grade reference(s), or string line(s), joint matching shoes, or other approved methods. When a fixed string line is required, the Engineer will furnish grade stakes for the finished pavement grade and the Contractor shall furnish and erect the necessary guide line for the equipment.
- g. A mobile grade reference system or non-contacting laser or sonar type ski shall be used during placement of the initial lanes and all adjacent lanes of all layers to control the longitudinal profile. A joint matching device may only be used where approved by the Engineer.
- h. An automatic slope control system shall be utilized, unless otherwise approved. The Engineer may waive the requirement for automatic slope controls in areas where the use of such equipment is impractical due to irregular cross section or shape. Mobile grade references may be required when the use of automatic slope controls is waived. Manual screed operation will be permitted based on approval from the Engineer for construction of irregularly shaped and minor areas.
- i. In the case of malfunction of the automatic control equipment, the Contractor may manually operate the paver for the remainder of the workday only provided acceptable results are obtained.
- j. The Engineer will waive the requirement for use of pavers for spreading and finishing where irregularities or obstacles make their use impractical and the Contractor shall spread, rake, and lute the mixture by hand methods.
- k. Roadway paving shall be as continuous as possible. Intersections, auxiliary lanes, and irregular areas shall be paved after the adjacent roadway has been paved.

3. Compaction:

- a. Immediately after the asphalt mixture has been spread, struck off, shaped to the required width, depth, cross-section, and surface and edge irregularities adjusted, it shall be thoroughly and uniformly compacted. Compaction must be obtained in a manner that

provides uniform density over the pavement and meets the required degree of compaction for the type of mixture being placed. Compaction rolling shall be complete before material temperature drops below 185°F.

- b. Compaction rolling should be performed at the maximum temperature at which the mix will support the rollers without moving horizontally. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Adjustments to the compaction equipment may be required where uniform density is not being obtained throughout the depth of the layer being tested.
- c. All final wearing surfaces, except open-graded asphalt friction course, shall be compacted using a minimum of 2 steel wheel tandem rollers. Pneumatic-tired rollers with smooth tread tires may be used after the breakdown roller and prior to finish rolling. Vibratory rollers must not be operated in vibratory mode during finish rolling on any mix type or pavement layer.
- d. Rollers used to compact the mixture shall be in good condition and capable of reversing without backlash. The rollers shall be operated with the drive wheels nearest the paver and at uniform speeds slow enough to avoid displacement of the mixture. Steel wheel rollers shall be equipped with wetting devices to prevent the mixture from sticking to the roller wheels. Fuel oil shall not be used to moisten roller wheels.
- e. All asphalt mixtures, except open-graded asphalt friction course and type SF 9.5A, shall be compacted to at least 92 percent of the mixtures maximum specific gravity. An SF 9.5A mixture shall be compacted to at least 90 percent of the mixtures maximum specific gravity.
- f. Rolling for open-graded asphalt friction course shall consist of one coverage with a tandem steel wheel roller weighing a maximum of 10 tons, with additional rolling limited to one coverage with the roller where necessary to improve riding surface.
- g. The use of rolling equipment that results in excessive crushing of the aggregate or excessive displacement of the mixture will not be permitted.
- h. In areas inaccessible to standard rolling equipment, the mixture shall be thoroughly compacted by the use of hand tampers, hand operated mechanical tampers, or other approved equipment.

- i. The tolerance of the final compacted pavement shall be within 1/4" of the typical cross-sections shown on the plans.
- 4. Joints:
 - a. Transverse Joints-
 - i. Transverse joints shall be constructed when the laying of the mixture is to be suspended long enough to permit the mixture to become cooled. At the end of each day's paving operation, the Contractor shall construct a sloped wedge ahead of the end of the full depth pavement to provide for proper compaction and protection of the full depth pavement. The Contractor shall place a paper parting strip beneath this wedge to facilitate joint construction, unless otherwise waived by the Engineers.
 - ii. Before paving operations are resumed, the Contractor shall remove the sloped wedge and cut back into the previously constructed pavement to the point of full pavement depth. The exposed edge of the previously constructed pavement shall then be lightly coated with tack coat.
 - iii. When laying of the mixture is resumed at the joint, the construction of the joint shall be completed while the mixture is still in a workable condition.
 - b. Longitudinal Joints-
 - i. The exposed edge of all longitudinal joints should be lightly coated with tack coat prior to placing the adjoining pavement.
 - ii. Longitudinal joints shall be formed by allowing the paver to deposit the mixture adjacent to the joint to such depth that maximum compaction can be obtained along the joint. The joint shall be pinched by rolling immediately behind the paver.
 - iii. When multi-lane multi-layer construction is required, the longitudinal joint in each layer shall offset that in the layer immediately below by approximately 6 inches. The joint in the top layer shall be constructed, where possible, between design travel lanes.
 - c. Placement of surface course material as the final layer of pavement should not be placed between November 15 and April 1 of the next

year unless otherwise approved by the Engineer. In addition, open-graded asphalt friction course shall not be placed between October 31 and April 1, unless otherwise approved.

- d. As an exception to the above, when in any day's operations the placement of a layer of asphalt base course material or intermediate course material 2 inches or greater in thickness has started, it may continue until the temperature drops to 32° F.

B. ASPHALT TACK COAT

1. Surface Preparation:

- a. The surface to which the tack coat is to be applied shall be cleaned of dust, dirt, clay, and any other deleterious matter prior to placing the tack coat.
- b. The Contractor shall remove grass, dirt and other materials from the edge of the existing pavement prior to the placement of tack coat.

2. Weather Limitations:

- a. Tack shall be applied only when the surface to be treated is sufficiently dry and the atmospheric temperature in the shade away from artificial heat is 35° F or above.
- b. Tack coat shall not be applied when the weather is foggy or rainy.

3. Application Rates and Temperatures:

- a. Tack coat shall be uniformly applied at a rate from 0.04 to 0.08 gallons per square yard. The exact rate of application will be established by the Engineer and will be based on the volume of material at the actual application temperature. When tack coat is required beneath an open-graded asphalt friction course, an asphalt binder Grade PG 64-22 material shall be used. The exact rate of application will be specified on the job mix formula and will be within the range of 0.06 to 0.08 gallons per square yard.
- b. The temperature of the material at the time of application shall be within the ranges shown in the table below:

Application Temperatures for Tack Coat

Asphalt Material	Temperature Range
Asphalt Binder, Grade PG 64-22	375 - 425°F
Emulsified Asphalt, Grade RS-1H, CRS-1, CRS-1H	90 - 150°F
Emulsified Asphalt, Grade HFMS-1	90 - 160°F
Emulsified Asphalt, Grade CRS-2	125 - 185°F

4. Application:

- a. No more tack coat material shall be applied than can be covered with base, intermediate, or surface course during the following day's paving operations.
- b. Tack coat material shall be uniformly applied to the entire surface utilizing an adjustable spray bar. Areas of tack coat application should be uniformly and completely covered.
- c. Tack coat shall be applied only in the presence of and as directed by the Engineer. No base or surface mixture shall be deposited onto tacked the tacked pavement until the tack coat has sufficiently cured.
- d. Contact surfaces of headers, curbs, gutters, manholes, vertical faces of old pavements, and all exposed transverse and longitudinal edges of each course shall be painted or sprayed with tack coat before new asphalt mixture is placed adjacent to such surfaces.
- e. Bridge floors, curbs and handrails of structures, and all other appurtenances shall be covered to prevent tack coat from being tracked or splattered on the structures or appurtenances.

5. Protection:

- a. Protect the tack coat after application until it has cured for a sufficient length of time to prevent it from being picked up by traffic.

- b. Contractor shall take the necessary precautions to minimize tracking and/or accumulation of tack coat material on existing or newly constructed pavements. Corrective measures may be required in areas where an excessive accumulation of tack has occurred.

3.02 QUALITY CONTROL AND TESTING

A. SAMPLES AND TESTING

1. It will be the responsibility of the Owner to hire and pay for an independent testing agency to perform quality control testing during paving operations.
2. Density testing to verify compaction may be performed by either Nuclear density procedures or Core Sampling procedures, and will be designated by the Engineer.
3. Nuclear density testing shall be performed the same day the mix being tested is placed and compacted. Nuclear density tests must be performed at a frequency of no less than 1 test every 400 linear feet for each mix type and layer, with a minimum of 5 nuclear density readings on a given day's paving.
4. Core samples shall be 6 inches in diameter and obtained no later than the beginning of the next production day, not to exceed 3 calendar days. Core samples shall be tested and test results submitted to the Engineer within one working day from the time the cores are taken. Cores must be obtained at a minimum frequency of 1 core every 1000 linear feet for each mix type and layer, with a minimum of 3 cores obtained on a given day's paving.
5. Cores shall be obtained from the full layer depth of compacted pavement at random locations. Artificial methods may be utilized to cool the pavement layers to allow cutting the core samples as quickly as possible.
6. Where cores have been taken, clean the inside surfaces of the core hole, dry, apply tack coat, place and compact the same type asphalt mixture to conform with the surrounding area.
7. It will be the responsibility of the Contractor to perform sufficient testing at the plant to verify mix production is in accordance with the specified job mix formulas being used.
8. During mix production, samples of the asphalt mixture should be obtained at a minimum frequency of 1 sample every 750 tons produced, with a minimum of 1 sample for each day's production for each asphalt mixture

produced. Each sample should be tested to determine binder content, gradation, and maximum specific gravity. As requested by the Engineer, additional tests may be performed to verify the volumetric properties of the asphalt mixture being produced. The Engineer may also request that the independent testing agency oversee the testing, or perform testing on additional samples.

B. SURFACE REQUIREMENTS

1. The surface of the plant mix base or pavement after compaction shall be smooth and true to the required cross section and grade. Any defective areas shall be corrected with satisfactory material which shall be immediately compacted to conform with the surrounding area. Any area showing an excess of asphalt cement shall be removed and replaced.
2. The surface will be tested by the Engineer at all joints and at other selected locations using a 10'-0" straightedge. The variation of the surface from the testing edge of the straightedge, when applied parallel to the centerline of the surface, shall not exceed 1/8" between any two contact points. Areas found to exceed this tolerance shall be corrected by the Contractor by removal of the defective work and replacement with new material unless other corrective measures are permitted by the Engineer. The work and materials required in the correction of defective work shall be provided by the Contractor at no cost.
3. The Contractor shall repaint and restripe any traffic markings that were damaged, removed or covered during construction. All work shall be done in accordance with NCDOT requirements and specifications. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.
4. All existing manhole, inlet, and valve covers shall be raised by the Contractor as necessary prior to paving so that the tops of the covers are flush with the final surface. Any pavement left on covers shall be removed as necessary by the contractor. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made.

3.03 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 32 16 13

CONCRETE CURB AND GUTTER

PART 1: GENERAL

1.01 SCOPE OF WORK

The work covered by this section consists of the construction of Portland cement concrete curb/curb and gutter, in accordance with the requirements shown on the plans and the provisions of the specifications.

1.02 QUALITY ASSURANCE

Concrete curb/curb and gutter shall meet the requirements of Section 846-3 of the NCDOT Standard Specifications for Roads and Structures (latest edition). The requirements for horizontal and vertical alignment as indicated in the applicable sections of the Specifications shall be strictly adhered to.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Concrete shall be constructed in accordance with Section 03 30 00, except as otherwise provided herein. 4,000-PSI concrete shall be used. Prior to placing forms, the base or subgrade shall have been compacted to the degree required by the applicable section of these specifications. Concrete shall be air entrained with 5 to 7% air. Retarders and accelerators shall be used only as directed by the engineer.
- B. Concrete curb/curb and gutter shall meet the requirements of Section 846-3 of the NCDOT Standard Specifications for Roads and Structures (latest edition). The requirements for horizontal and vertical alignment as indicated in the applicable sections of the Specifications shall be strictly adhered to.

PART 3: EXECUTION

3.01 INSTALLATION

A. FORMS

Forms shall be of such section and design that they will adequately support the concrete and any construction equipment used to construct the work. Straight forms shall be within a tolerance of 1/8" in 10'-0" from a true line horizontally and vertically. Form pins shall be metal and shall be capable of holding the forms rigidly in place during construction operations. The form sections shall be connected by a locking joint, which shall keep the forms free from vertical and horizontal movement. The Engineer shall have approved all forms before

concrete is placed. Forms shall be clean, straight and true. The Engineer has the right to reject forms not properly placed, aligned or cleaned.

- B. When the concrete will be machine placed the surface over which the machine will be operated will have been approved by the Engineer before placing concrete.

C. FINISHING

The concrete shall be given a light broom finish with the brush marks parallel to the curb line or gutter line.

D. CURBING

Curing shall be in accordance with Article 825-9 and Subarticle 700-14(b) of the above referenced NCDOT Specifications. Curing compounds shall be Type 2, white pigmented, in accordance with AASHTO M148 and applied in accordance with Article 420-17(c).

E. JOINTS

1. Joints shall be located as shown on the details except as otherwise provided herein. Where concrete is placed adjacent to Portland cement concrete pavement, the joints shall be located so as to line up with the joints in the concrete pavement.
2. Grooved contraction joints shall be formed by the use of templates or by other approved methods. Where templates do not form such joints, the groove shall be of the depth shown on the details.
3. Grooved butt joints shall be placed between the work and adjacent pavement except where expansion joints are required by the details.
4. All joints shall be hot pour sealed with rubber asphalt joint sealer meeting the requirements of AASHTO M173 except for joints in curb sections. In curb and gutter the joint sealer shall not be poured above the top surface of the gutter. Joints in gutter shall be filled with joint sealer to the top surface of the gutter. Joints shall be sealed before backfilling or other adjacent operations are performed. Joint sealer shall be in accordance with Article 928-2 of the above referenced NCDOT Specifications.

F. BACKFILLING

No earth backfill or pavement shall be placed adjacent to the curb and gutter until at least three curing days have elapsed. Backfill shall be compacted to a degree satisfactory to the Engineer.

G. OPENING TO TRAFFIC

Vehicles may be permitted on the completed work after seven curing days have elapsed. When high early strength concrete is used, vehicles will be permitted on the completed work after three curing days have elapsed.

3.02 QUALITY CONTROL & TESTING

- A. All sampling and testing services shall be performed, at the Owners expense, by a testing agency which operates in accordance to ASTM D 3740 and E 329 latest edition and accepted by the Engineer.
- B. The Contractor shall submit for review a design mix for each class of concrete proposed for use. An approved testing laboratory shall prepare the mix. Compressive strength of at least four (4) specimens of the design mix shall indicate 15% higher than 28-day strengths specified. During the work, the Contractor shall make 3 test cylinders for each 30 cubic yards, or fraction thereof, of concrete placed each day. One cylinder shall be tested at 7 days and the other two at 28 days in accordance with ASTM C 39. Copies of all test reports shall be furnished to the Engineer.
- C. A slump test is to be performed at the same time the cylinders are pulled for each 30cy of concrete placed each day. Slump is to be 4" with a tolerance of +/- 1". Anything out of this range is to be approved by the engineer prior to placement

3.03 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 32 16 23

CONCRETE WALKS

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. The work covered by this section consists of the construction of Portland cement concrete sidewalks in accordance with the requirements shown on the plans and the provisions of these specifications.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Concrete shall be constructed in accordance with Section 03 30 00 and shall be given a sidewalk finish, except as otherwise provided herein. 4000 psi concrete shall be used.

PART 3: EXECUTION

3.01 INSTALLATION

- A. Brooming of the concrete surface shall be done transverse to the direction of traffic. Joint spacing shall not be less than 5'-0". Where existing sidewalks are being widened, transverse joints shall be located so as to line up with existing joints in the adjacent sidewalk. Joints shall not be sealed.
- B. Backfill shall be compacted to a degree comparable to the adjacent undisturbed material.
- C. Vehicles may be permitted on the completed work after seven curing days have elapsed. When high early strength concrete is used, vehicles will be permitted on the completed work after three curing days have elapsed.

3.02 QUALITY CONTROL & TESTING

- A. All sampling and testing services shall be performed, at the Owners expense, by a testing agency which operates in accordance to ASTM D 3740 and E 329 latest edition and accepted by the Engineer. Refer to section 03 11 00 for procedures.

3.03 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. PAINT

The work under this section shall consist of furnishing all labor, equipment, materials and services for the proper placement and installation of all pavement markings in accordance with the requirements shown on the plans and the provisions of these specifications.

B. THERMOPLASTIC PAVING MARKING

This specification covers a reflectorized pavement striping material of the type that is applied to a road surface in a molten state with premixed glass beads by spray or extrusion means, with a supplemental surface application of glass spheres. When applied properly and at the designated thickness and width the stripe shall, upon cooling, be reflectorized and be able to resist deformation by traffic. The applied material shall be impervious to degradation by motor oil, diesel fuel, grease deposits and ice-preventative chemicals.

1.02 DELIVERY, STORAGE, AND HANDLING

Contractor shall deliver paint to site in sealed and labeled containers. Upon Engineer's request, the Contractor shall make containers available for inspection to verify acceptance of product. Paint shall be stored at a minimum ambient temperature of 45°F and a maximum of 90°F, in well ventilated areas, unless required otherwise by manufacturer's instructions.

1.03 RELATED DOCUMENTS

All pavement markings shall be in accordance with the latest edition of the Manual of Uniform Traffic Control Devices (MUTCD) published by the Federal Highway Administration and the North Carolina Supplement to the MUTCD.

PART 2: PRODUCTS

2.01 MATERIALS

A. STANDARDS

The following are minimum requirements and shall govern except all local, state and/or federal highway or transportation department standard specifications shall govern when their requirements are in excess thereof.

B. PAINT

Paint shall be chlorinated rubber-alkyd type meeting the requirements of AASHTO M 248 (FS TT-P-115), Type III factory mixed, quick drying and non-bleeding.

C. THERMOPLASTIC MATERIALS

1. The thermoplastic pavement marking materials used in this contract shall meet the following specifications. This specification covers reflectorized oil and grease impervious thermoplastic road marking materials which are (1) hot extrusion applied with a surface application of glass spheres and (2) heat fused applied. The properly applied markings shall be reflectorized and able to durably resist degradation and deformation by traffic.
2. The thermoplastic materials shall be homogenously composed of pigment, filler, resins, and glass reflectorizing sphere and shall be available in both yellow and white.
3. Composition: The pigment, beads and filler shall be uniformly dispersed in the resin. The materials shall be free from all skins, dirt, and foreign objects and shall comply with requirements according to Table 1. Only new materials shall be acceptable for use on this project.

Table 1

COMPONENT	WHITE	YELLOW
Binder (see note A)	18.0% min	18.0% min
Glass Beads (AAASHTO M247 Type D)	30.0 - 40.0%	30.0 - 40.0%
Titanium Dioxide	10.0% min	----
Yellow Pigments	----	2.0% min
Calcium Carbonate	42.0% max	50.0% max

Note A: The alkyd binder shall consist of a mixture of synthetic resins (at least one of which is solid at room temperature) and a high boiling point plasticizer. At least one third of binder composition shall be solid maleic modified glycerol ester resin and shall be no less than 8% by weight of the entire material formulation. The alkyd binder shall not contain petroleum based hydrocarbon resins.

Note B: The percentage of yellow pigment can be reduced if lead pigments are eliminated from the formulation.

4. Specifications:

- a. Temperature- The molten material temperature shall be between 400 and 440 F unless otherwise recommended by the manufacturer and approved by the Engineer.
- b. Primer- A primer shall be used if thermoplastic is applied to Portland cement concrete. Any primer used shall be compatible with the thermoplastic material.
- c. Thickness- The pavement markings shall yield a solid thickness range of 80 to 95 mils above the roadway surface across the middle two-thirds of the line width when tested as specified in MSMT 729.
- d. Glass Beads- Glass beads shall be uniformly applied to the surface of the molten thermoplastic at the minimum rate of 7 to 9 lb./100ft² as specified in MSMT 729
- e. Color- The color of the dry markings shall match Federal Standard 595 (13538-yellow or 17886-white). The Contractor shall supply the specified color chips for the Engineer's use to visually determine that the thermoplastic material matches the specified color.
- f. Retro reflectance- The millicandela/lux/square meter values taken anytime within the first 30 days shall conform to the following:

Retroreflectance

COLOR	RETROREFLECTIVITY	CORRECTIVE ACTION
White	≥ 250	None
Yellow	≥ 150	
White	< 250	Necessary corrective actions including grinding and, if necessary, re-tracing
Yellow	< 150	

- g. The “Drop-On” glass beads shall conform to AASHTO specifications M-247-81 except as follows:

Glass Bead Gradation

US SIEVE NUMBER	PERCENT PASSING
20	100
30	75-95
50	15-35
80	0-5
100	0

The “Drop-On” glass beads shall be smooth, clear and free from air inclusions. The beads shall have a minimum refractive index of 1.50 and shall be a minimum of 80% true spheres overall and minimum 70% true spheres on each sieve. The beads shall be moisture proof coated and shall meet the requirements of AASHTO M-247-81 Section 4.4.2 to insure optimum embedment of 60-65 percent (60-65%) in various thermoplastic traffic marking systems. The material shall set to bear traffic in not more than 2 minutes when the air temperature is 50 degrees F and not more than 10 minutes when the air temperature is 90 degrees F.

- h. Bond Strength- After heating the thermoplastic material for four hours at 425 degrees F the bond strength to Portland Cement Concrete shall exceed 180 psi (1.24 Mpa Method ASTM D4796-88)
- i. Cracking Resistance- For at least 90 days after application the materials shall show no cracks other than with substrate cracking.
- j. Smear and Softening Resistance- During the life of the materials, the applied markings shall not smear or soften apart from substrate movement.

D. TRAFFIC AND LINE MARKINGS

1. Unless otherwise noted, paint for traffic and line markings shall be white in color.
2. Dimensions and spacing of markings shall be in accordance with MUTCD and as indicated in the pavement markings detail included in the contract drawings.

PART 3: EXECUTION

3.01 SURFACE PREPARATION

Contractor must insure that pavement surface to be painted shall be clean and dry before application. All surface contamination such as oil, grease, dirt, foreign matter, or other deleterious materials will be removed by the Contractor prior to application of paint.

3.02 INSTALLATION

A. PAINT

1. No paint shall be applied when the atmospheric, surface, or material temperature is less than 40°F or when the relative humidity is greater than 85%.
2. No paint shall be applied until the layout and placement has been verified by the Engineer.
3. Paint shall be applied with mechanical equipment to produce uniform straight edges in strict compliance with the manufacturer's instructions. Paint shall be applied in two (2) coats at the manufacturer's recommended rates.

B. THERMOPLASTIC PAVING MARKINGS

1. The molten applied thermoplastic material shall readily screed/extrude at temperatures between 400 degrees F and 440 degrees F from the approved equipment to produce a line which shall be continuous and uniform in shape having sharp dimensions. The application of additional glass beads by drop-on methods shall be at a minimum rate of 8 lbs. per 100 sq ft of marking. Ambient and surface temperatures shall be at least 50 degrees F and rising at the time of application.

2. Method of Application

The Contractor shall furnish and install machine-applied extruded and/or sprayed hot thermoplastic with glass spheres (pre mixed and drop-on) in the proper ratio to immediately produce a highly reflective marking as described elsewhere in these specifications, in accordance with the details in this contract and the following provisions.

3. Primer-Sealer:

It shall be the responsibility of the contractor to recommend to the Engineer and obtain the Engineer's concurrence as to whether primer-sealer is required on a given pavement in order to meet the material

manufacturer's warranty conditions. Generally, on all Portland Cement concrete pavement surfaces and aged asphalt-concrete pavements having less than eighty percent (80%) bituminous concrete, primer-sealer shall be applied to the area where the thermoplastic pavement markings are to be placed. Also, the Owner reserves the right to direct the Contractor to apply primer/sealer for any given markings. The primer/sealer shall be that recommended by the manufacturer of the thermoplastic material, and approved by the Engineer. The material shall form a continuous film which shall dry rapidly and adhere to the pavement. The material shall not discolor nor cause any noticeable change in the appearance of the pavement outside of the finished pavement markings. All solvents shall have evaporated from the primer/sealer prior to the application of the molten thermoplastic materials. A sample of the primer/sealer and the recommended method of application must be submitted to the Engineer, and shall have been approved by the Engineer and the manufacturer of the material before application. The Engineer has the authority to require the Contractor to apply the primer/sealer using a separate vehicle which may require additional traffic control. Payment for application of primer/sealer and any additional traffic control will be incidental to the marking item.

4. Removal of Existing Plastic or Pavement Markings

When called for in the contract or otherwise as directed by the Engineer, removal of existing painted or plastic pavement markings shall be accomplished by the Contractor using equipment and methods specifically approved by the Engineer. Marking removal shall not be by the "painting out" with black paint method nor shall it result in excessive scarring of the pavement. No more than 1/8-inch depth of scarred pavement will be allowed. At least 90 percent of all markings shall be removed.

As directed by the Engineer, the Contractor shall be responsible for sweeping or otherwise adequately cleaning up debris after completion of markings required to be removed by the Engineer because they are improperly located or otherwise incorrect or improper. Unless permitted otherwise by the Engineer, where old markings are removed, the new markings must be applied the same day as the old markings are removed. Whenever grinding, scraping, sandblasting, or other operations are performed, the work shall be conducted in such manner that the finished pavement surface is not damaged or left in a pattern that will mislead or misdirect motorists. When these operations are completed, the pavement markings shall be cleaned to remove residue and debris resulting from the cleaning work.

Where cleaning and/or removal of pavement paint striping or objectionable material is being performed within ten (10) feet of a lane occupied by traffic, the residue removal shall be by method(s) approved by the Engineer.

Any damage to the pavement or pavement joint materials caused by pavement marking removal shall be repaired by the Contractor at no cost to the Owner by methods acceptable to the Engineer.

5. Pre-marking of Lines

When a line is required to be placed in the same location as an existing painted line, and existing painted markings not required to be removed are visible, they shall be retraced (i.e. new markings installed in exactly the same locations, patterns, and dimensions as the old markings). However, if the existing markings are to be removed or are not visible, or if new roadway surface has been placed before markings installation occurs, or if the contract requires a line to be installed where none currently exists, the Contractor will be required to pre-mark as directed by the Engineer and subsequently shall install the required markings in accordance with the requirement of other sections of the specifications. The actual placement of the pavement markings at any such site shall not be performed until the pre-marking has been inspected and approved by the Engineer. Pre-marking is incidental to the pavement marking installation work and there will be no separate payment for pre-marking.

6. Traffic Maintenance

All work shall be performed in accordance with Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) and section 104 of the MSHA Standard Specifications for Construction and Materials. The Contractor shall furnish and place all warning devices, flag persons, and other traffic control devices required to direct, control and protect the traveling public while marking operations are in progress. Maintenance of traffic for this work will be paid under the Maintenance of Traffic item if an item is included in the bid proposal, otherwise it will be considered incidental to the work.

3.02 WARRANTIES

A. THERMOPLASTIC PAVING MARKINGS

The Thermoplastic pavement marking materials and glass beads furnished under this contract shall assume the manufacturer's warranty for these materials and shall be guaranteed by the supplier against failure due to traffic oil degradation.

The contractor shall assume all costs arising from the use of patented materials, equipment, devices or processes used on or incorporated in the work, and agrees to indemnify and hold harmless the Owner and its duly authorized representatives from all suits at law or action of every nature for, or on account of, the use of any patented materials equipment, devices or processes. Further, the material shall meet the requirements of this specification for a period of one year.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1: GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Chain-link fences.

- B. Related Sections:

- 2. Section 03 30 00 "Cast-in-Place Concrete" for concrete post footings.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design chain-link fences and gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCEISEI 7
 - 1. Minimum Post Size: Determine according to ASTM F 1043 for framework up to 12 feet (3.66 m) high, and post spacing not to exceed 10 feet (3 m) for steel.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences.
 - 1. Fence and gate posts, rails, and fittings.
 - 2. Chain-link fabric, reinforcements, and attachments.
- B. Samples for Initial Selection: For components with factory-applied color finishes.

- C. Samples for Verification: Prepared 'on Samples of size indicated below:
 - 1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.
- D. Delegated-Design Submittal: For chain-link fences and gate framework indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Qualification Data: For qualified factory-authorized service representative.
- F. Product Certificates: For each type of chain-link fence, from manufacturer.
- G. Product Test Reports: For framing strength according to ASTM F 1043.
- H. Field quality-control reports.
- I. Operation and Maintenance Data: For the following to include in emergency, operation, and maintenance manuals:
 - 1. Polymer finishes.
 - 2. Gate hardware.
 - 3. Gate operator.
- J. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2: PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:
 - 1. Fabric Height: As indicated on Project Drawing.

2. Steel Wire Fabric: Wire with a diameter of 0.120 inch.
 - a. Mesh Size: 1 3/4" inches.
 - b. Polymer-Coated Fabric: ASTM F 668, Class 1 over zinc coated steel wire.
 - 1) Color: As selected by Architect from manufacturer's full range, complying with ASTM F 934.
 - c. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.
3. Selvage: Knuckled at both selvages.

2.2 FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 or ASTM F 1083 based on the following:
 1. Fence Height: As indicated on Drawing
 2. Light Industrial Strength: Material Group IC-L, round steel pipe, electric-resistance welded pipe
 - a. Line Post: 2.375 inches (60 mm)
 - b. End, Comer and Pull Post: 2.375 inches (60 mm)
 3. Horizontal Framework Members: Intermediate, top, and, bottom rails complying with ASTM F 1043.
 - a. Top Rail: 1.66 inches (42 mm) in diameter
 4. Brace Rails: Comply with ASTM F 1043.
 5. Metallic Coating for Steel Framing:
 - a. Type A, consisting of not less than minimum 2.0-oz.lsq. ft. (0 .61-kq/sq. m) average zinc coating per ASTM A 123/A 123M or 4.0-oz.lsq. ft. (1.22-kq/sq. m) zinc coating per ASTM A 653/A 653M.
 6. Polymer coating over metallic coating.

- a. Color: As selected by Architect from manufacturer's full range, complying with ASTM F 934.

2.3 TENSION WIRE

- A. Metallic-Coated Steel Wire: 0.177-inch- (4.5-mm-) diameter, marcelled tension wire complying with ASTM A 817 and ASTM A 824, with the following metallic coating:
 1. Type II, zinc coated (galvanized) by hot-dip process, with the following minimum coating weight:
 - a. Matching chain-link fabric coating weight.

2.4 FITTINGS

- A. General: Comply with ASTM F626.
- B. Post Caps: Provide for each post.
 1. Provide line post caps with loop to receive tension wire or top rail.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
 1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches (152 mm) long.
 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line-to-line posts.
- E. Tension and Brace Bands: Pressed steel.
- F. Tension Bars: Steel length not less than 2 inches (50 mm) shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- H. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:

- a. Hot-Dip Galvanized Steel: 0.148-inch- (3.76-mm-) diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

I. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. Isq. ft. (366 9 Isq. m) zinc.
 - a. Polymer coating over metallic coating.

2.5 **GROUT AND ANCHORING CEMENT**

- A. Nonshrink, Nonmetallic Grout Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydrauliccontrolled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.
 1. Connectors for Below-Grade Use: Exothermic welded type.
 2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches (16 by 2440 mm).

2.6 **BARBED WIRE**

- A. Metallic Coated Steel Barbed Wire: Comply with ASTM A121, Design Number 12-4-5-14R, double 12-½ gauge (0.099 in.) (2.51 mm) twisted strand wire, with 4 point 14 gauge (0.080 in.) (2.03 mm) round barbs spaced 5 inches (127 mm) on center. Match coating type to that of the chain link fabric. [12-4-5-14R is specifically designed for chain link fence applications] <Insert material coating specification including type and class when applicable>
 1. Coating Type A - Aluminum-Coated (Aluminized): Strand wire coating, 0.30 oz/ft² (90 g/m²) with aluminum alloy barbs.
 2. Coating Type Z - Zinc-coated: Strand wire coating Type Z, Class 3, 0.80 oz/ft² (254 g/m²), barb coating 0.70 oz/ft² (215g/m²)

PART 3: EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
 - 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

- A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.
 - 1. Install fencing on established boundary lines inside property line.

3.4 CHAIN-LINK FENCE INSTALLATION

- A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Concealed Concrete: Top 2 inches below grade to allow covering with surface material.
 - b. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been

inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

- c. Posts Set into Voids in Concrete: Form or core drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
- C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.
 - D. Line Posts: Space line posts uniformly at 96 inches (2440 mm) o.c.
 - E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
 1. Locate horizontal braces at midheight of fabric 72 inches (1830 mm) or higher, on fences with top rail and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
 - F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- (3.05-mm-) diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches (610 mm) o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
 1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches (152 mm) of bottom of fabric and tie to each post with not less than same diameter and type of wire.
 - G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
 - H. Intermediate and Bottom Rails: Install and secure to posts with fittings.

- I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1 inch (25.4 mm) between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner; pull, and gate posts with tension bands spaced no more than 15 inches (380 mm) o.c.
- K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts at 12 inches (300 mm) o.c. and to braces at 24 inches (610 mm) o.c.
- L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain chain-link fences and gates.

3.6 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 32 91 19

TOP SOIL

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. The work of this section consists of furnishing and placing topsoil for turf areas to be seeded, fertilized, and mulched. No topsoil shall be furnished, nor will be paid for, under this section until all job-stockpiles have been exhausted.

1.02 SUBMITTALS

- A. SOIL ANALYSIS CERTIFICATES

Submit six (6) copies of soil analysis certificates covering grain size and additive recommendations from the State University Agricultural Extension Service or other certified testing laboratory.

1.03 DELIVERY

- A. PRODUCT HANDLING

Do not deliver topsoil in frozen or muddy condition.

PART 2: PRODUCTS

2.01 MATERIALS

- A. **TOPSOIL**

Natural, friable, loamy soil, typical of local topsoil which produces heavy vegetative growth; free from subsoil, weeds, sods, stiff clay, stones larger than 1 inch, toxic substances, litter, or other foreign material harmful to plant growth; having a pH between 6.0 and 7.0.

GRADING ANALYSIS

Sieve	Minimum Percent Passing
2 inch	100
No. 4	90
No. 10	80

Topsoil shall contain sand, silt, and clay as required by AASHTO M146.

	Minimum Percent	Maximum Percent
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Sand	20	75
Silt	10	60
Clay	5	30

PART 3: EXECUTION

3.01 PREPARATION

A. JOB CONDITIONS

Do not perform tilling operations when ground is frozen or excessively wet.

3.02 INSTALLATION

A. GENERAL

1. Use equipment and methods to prevent damage to existing structures, utilities, lawns and plantings.
2. Prior to placing topsoil, shape the subgrade to graded lines, and cross sections to provide for 2 inches of compacted topsoil. Clear the subgrade of materials larger than ¼" inch. Excavate to depth of 12 inches all areas that have become saturated with oil, gasoline, or bituminous products; backfill with approved material.
3. After alignment of subgrade, loosen and till to a depth of 6 inches by disking, harrowing, rototilling, or other approved methods.
4. After approval, place and spread topsoil to secure required depth after compaction; rake and remove materials larger than ¼" inch. Compact with approved roller equipment. Finish smoothing even, and true to lines and grades indicated.

3.03 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 32 92 19

SEEDING AND MULCHING

1. DESCRIPTION:

1.1 The work covered by this section consists of furnishing all labor, materials, and equipment to perform all necessary operations to topsoil, fine grade, fertilize, mulch and maintain temporary and permanent seeding of all graded, cleared, or disturbed areas during construction. The work covered by this section shall be in conformance with Section 1660 of the "Standard Specifications for Roads and Structures" dated January 1, 2018, published by the North Carolina Department of Transportation and with Section 6.11 of the "Erosion and Sediment Control Planning and Design Manual" published by the Land Quality Section of the North Carolina Department of Environment and Natural Resources unless otherwise stated herein.

1.2 Related Work: See following sections for related work:

1. 31 11 00 - Clearing and Grubbing.
2. 31 22 00 - Grading
3. 31 25 00 - Erosion and Sediment Control.

2. MATERIALS:

2.1 Topsoil: Topsoil shall be from stockpiles created from stripping and required excavation. Should additional topsoil be required in excess of that obtained from stripping and excavation, the contractor shall obtain material from other sources on the site where authorized by the Owner, or from approved sources off the site. The topsoil shall be natural, friable soil, possessing characteristics of representative soils in the vicinity which produce heavy growths of crops of grass. It shall be obtained from naturally well-drained areas, shall be reasonably free from subsoil, brush, objectionable weeds, and other litter and shall be free from toxic substances, clay lumps, stones, roots and other objects larger than 1/4" inch in diameter, or any other material which might be harmful to plant growth or be a hindrance to grading, planting, and maintenance operations.

2.2 Fertilizer: Fertilizer shall be the product of an approved commercial fertilizer manufacturer and shall be 5-10-5 grade, uniform in composition, free-flowing material suitable for application with approved standard equipment. The fertilizer shall conform to the applicable State fertilizer laws and shall be delivered to the site in bags or other convenient containers each fully labeled and bearing the name, trademark, and warranty of the producer.

2.3 Lime: Lime shall be ground limestone containing not less than 85% of total carbonates and shall be ground to such fineness that at least 50% will pass through a 100-mesh sieve and at least 90% will pass through a 20-mesh sieve. Coarser materials will be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing the 100-mesh sieve, but no additional payment will be made for the increased quantity.

- 2.4 Mulch: Mulch shall be straw from wheat or oats. Materials for securing mulch may be one of the following:
- 2.5 Mulch Netting: Lightweight plastic, cotton, jute, wire or paper nets shall be used.
- 2.6 Peg and Twine: Baling twine and soft wood pegs 1/2" x 1" x 12".
- 2.7 Liquid Mulch Binder: RC-2 cut back asphalt conforming to the requirements of Federal Specifications SS-A671A, and asphalt emulsion shall conform to the requirements of Federal Specification SS-A-674, Type V.
- 2.8 Seed: Seed used shall bear the official "certified seed" label inspected by North Carolina Crop Improvement Association. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be acceptable. The seed used shall be that shown in seeding schedule specified herein or on the plans.
- 2.9 Wire Staples:
- 2.9.1 Wire staples shall be a No. 9 staple and shall be at least 1½ inches long.
3. Installation:
- 3.1 Seedbed Preparation:
- 3.1.1 Clearing: Prior to or during grading and tillage operations, the ground surface shall be well drained, cleared of all brush, roots, stones larger than 2 inches in diameter, or any other material which may hinder proper grading, tillage, or subsequent maintenance operations.
- 3.1.2 Fine Grading: Areas to be seeded shall be graded as shown on the drawings or as directed and all surfaces shall be left in an even and properly compacted condition so as to prevent the formation of depressions where water will stand. Areas to be topsoiled shall be graded to a smooth surface and to a grade that will allow topsoiling to finished grade.
- 3.1.3 Topsoiling: Immediately prior to placing topsoil, the subgrade, where excessively compacted by traffic or other causes, shall be loosened by scarifying to a depth of at least 2 inches to permit bonding of the seeding and mulching to the subgrade.
- 3.1.4 Tillage: After grassed areas required to be seeded have been brought to the grades shown on the plans and as specified, they shall be thoroughly tilled to a depth of 3 inches by approved methods, until the condition of the soil is acceptable to the Engineer. Any objectionable undulations or irregularities in the surface resulting from tillage or other operations shall be removed before planting operations are begun. The work shall be performed only during periods when satisfactory results are likely to be obtained. When conditions are such, by reason of drought, excessive moisture or other factors, that results are not likely to be satisfactory, the Engineer will stop the work and it shall be resumed only when, in his opinion, the desired results are likely to be obtained.

3.2 Limestone, Fertilizer and Seed:

3.2.1 General: Seasonal limitations for seeding operations; the kinds and grades of fertilizers; the kinds of seed; the rates of application of limestone, fertilizer, and seed shall be as shown in the seeding schedule.

3.2.2 Equipment to be used for the application, covering, or compaction of limestone, fertilizer, and seed shall have been approved by the Engineer before being used on the project. Approval may be revoked at any time if equipment is not maintained in satisfactory working condition, or if the equipment operation damages the seed.

3.2.3 Limestone, fertilizer, and seed shall be applied within 24 hours after completion of seedbed preparation unless otherwise permitted by the Engineer, but no limestone or fertilizer shall be distributed and no seed shall be sown when the Engineer determines that weather and soil conditions are unfavorable for such operations.

3.2.4 During the application of fertilizer, adequate precautions shall be taken to prevent damage to structures or any other appurtenances. The Contractor shall either provide adequate covering or change methods of application as required to avoid such damage. When such damage occurs, the Contractor shall repair it, including any cleaning that may be necessary.

3.3 Limestone and Fertilizer: Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer shall be distributed uniformly over the prepared seedbed at a specified rate of application and then harrowed, raked, or otherwise thoroughly worked or mixed into the seedbed.

3.3.1 If liquid fertilizer is used, storage containers for the liquid fertilizer shall be located on the project and shall be equipped for agitation of the liquid prior to its use. The storage containers shall be equipped with approved measuring or metering devices which will enable the Engineer to record at any time the amount of liquid that has been removed from the container. Application equipment for liquid fertilizer, other than a hydraulic seeder, shall be calibrated to insure that the required rate of fertilizer is applied uniformly.

3.4 Seeding: Seed shall be distributed uniformly over the seedbed at the rate indicated in the seeding schedule, and immediately harrowed, dragged, raked, or otherwise worked so as to cover the seed with a layer of soil. The depth of covering shall be as directed by the Engineer. If two kinds of seed are to be used which require different depths of covering, they shall be sown separately.

3.4.1 When a combination seed and fertilizer drill is used, fertilizer may be drilled in with the seed after limestone has been applied and worked into the soil. If two kinds of seed are being used which require different depths of covering, the seed requiring the lighter covering may be sown broadcast or with a special attachment to the drill, or drilled lightly following the initial drilling operation.

3.4.2 When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 30 minutes prior to application unless otherwise permitted by the Engineer.

3.4.3 Immediately after seed has been properly covered, the seedbed shall be compacted in the manner and degree approved by the Engineer.

3.5 Modifications: When adverse seeding conditions are encountered due to steepness of slope, height of slope, or soil conditions, the Engineer may direct or permit that modifications be made in the above requirements which pertain to incorporating limestone into the seedbed; covering limestone, seed, and fertilizer; and compaction of the seedbed.

3.5.1 Such modifications may include but not be limited to the following:

1. The incorporation of limestone into the seedbed may be omitted on (a) cut slopes steeper than 2:1 (b) on 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or (c) on areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.
2. The rates of application of limestone, fertilizer, and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.
3. Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces, or on other areas where soil conditions would make compaction undesirable.

3.6 Mulch:

3.6.1 General: All seeded areas shall be mulched unless otherwise indicated on the plans or directed by the Engineer. Application rate of mulch shall be indicated in seeding schedule.

3.6.2 Mulching: Mulch shall be applied within 36 hours after the completion of seeding unless otherwise permitted by the Engineer. Care shall be exercised to prevent displacement of soil or seed or other damage to the seeded area during the mulching operations.

3.6.3 Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers which will provide an acceptable application. An acceptable application will be that which will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion, and conserve soil moisture.

3.6.4 Mulch Binding: Mulch shall be held in place using devices approved by the Engineer as per manufacturers recommendations. During application, the Contractor shall take adequate precautions to prevent damage to structures or appurtenances.

3.7 Maintenance:

3.7.1 General: The Contractor shall be responsible for the proper care and maintenance of the seeded areas until the work under the entire contract has been completed and accepted by the Engineer. Maintenance shall consist of repair and replacement of eroded areas, watering, refertilizing, reliming, reseeding, and remulching as necessary to provide an even, fixed growth of grass. In addition, the Contractor shall provide protection against traffic and shall erect the necessary barricades and warning signs immediately after planting is completed.

3.7.2 Mowing: The seeded areas shall be mowed with approved mowing equipment as per seeding schedule. If weeds or other undesirable vegetation threaten to smother the planted species, such vegetation shall be removed at no cost to the Owner.

3.8 Inspection and Testing:

3.8.1 Fertilizer and Lime: The Engineer shall be furnished with duplicate copies of invoices for all fertilizer and lime used on the project. Invoices for fertilizer shall show the grade furnished. Invoices for lime shall show total minimum carbonates and minimum percentages of the material furnished that pass 100-mesh and 20-mesh sieve. Upon completion of the project, a final check of the total quantities of fertilizer and lime used will be made against the total area topsoiled and seeded, and if the minimum rates of application have not been met, the Engineer may require the distribution of additional quantities of these materials to make up the minimum application specified at no additional cost to the Owner.

3.8.2 Seed: The Engineer shall be furnished duplicate signed copies of a statement from the Vendor, certifying that each container of seed delivered is fully labeled and in full accordance with the specifications in this section and the seeding schedule.

3.9 Warranty:

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 32 92 23

SODDING

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. This section covers the furnishing of all labor, equipment and materials necessary for the installation of sod as described in the Contract Documents.

1.02 SUBMITTALS

- A. Prior to delivery of sod, the Contractor shall furnish six (6) copies of the following information for the Engineer's approval:
1. Written certification from the grower stating the name and address of the turf grass seed supplier.
 2. The percentage weight of each grass species in the blend.
 3. The percentage by weight of each cultivar type sown into the sod.

1.03 WARRANTY

- A. The Contractor shall at his sole expense, maintain the sod until it is accepted by the Engineer as stated in section 3.04 of this specification. The Contractor shall only be responsible for the replacement of any lawn found dead and/or in poor condition for a period of twelve (12) months from the date of Final Completion with the exception of sod damaged by accidental causes or negligent maintenance practices by the Owner. Contractor shall provide written notice to the Engineer if the condition of the sod is as described above.

PART 2: PRODUCTS

2.01 MATERIALS

- A. SOD

Sod shall be commercially produced on or harvested from mineral based soils, (peat based sod is not acceptable), containing a minimum of 75% non organic soil by mass that has been sown and cultivated in nursery fields as a turf grass crop using certified grass seed blends as shown below:

Fescue/bluegrass mix sod

Any variation of the above seed blends shall be approved by the Engineer prior to the delivery of the sod.

At the time of delivery, the sod shall be free of noxious weeds, debris, stones, disease, turf damaging insects and any grass species, strains, or cultivars other than those specified herein. The sod shall be fine leafed, of uniform texture and of sufficient density that no surface soil is visible. The sod shall be mowed to a height of 2 inches and cut in uniform strips of not less than 1 foot in width and to a uniform thickness of not less than 3/4 inches and not greater than 1 inch as necessary so that the majority of the dense root system is retained and exposed on the bottom side of the sod. The thickness of the sod shall be consistent throughout the entire load delivered to the site.

B. WATER

Water shall be potable from a source approved by the Engineer.

C. FERTILIZER

1. The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the North Carolina Board of Agriculture.
2. Fertilizer shall be 10-10-10 grade. Upon written approval of the Engineer a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.
3. During handling and storing, the fertilizer shall be cared for in such a manner that it will be protected against hardening, caking, or loss of plant food values. Any hardened or caked fertilizer shall be pulverized to its original conditions before being used.

C. HERBICIDES

Herbicides shall be standard commercial products registered for sale and use in North Carolina.

D. INSECTICIDE

Insecticide shall be standard commercial products registered for sale and use in North Carolina.

E. FASTENERS

Fasteners shall be wooden pegs or approved long U shaped staples.

PART 3: EXECUTION

3.01 DELIVERY

The Contractor shall schedule the delivery and installation of sod to coincide with topsoil placement operations. The sod shall be delivered to the site, unloaded, and stored on pallets within 24 hours of being harvested. During transportation, the sod shall be protected to prevent drying and ensure it arrives at the site in a fresh and healthy condition. During wet weather, the sod shall be allowed to dry sufficiently to prevent tearing during handling. During dry weather, the sod shall be protected from drying and shall be watered as necessary to ensure its vitality and to prevent any loss of soil during handling.

3.02 INSTALLATION

- A. Prior to commencing installation of sod, the Contractor shall obtain approval from the Engineer that the finished grade and depth of topsoil are acceptable and installation of sod can start.
- B. The final compacted and rolled topsoil/sod growing medium shall have a minimum depth of 6 inches (ranging from 5 inches of topsoil/1 inch of sod to 5 ¼ inches of topsoil/¾ inches of sod).
- C. Contractor shall install sod during the growing season and within 36 hours of being harvested. The sod shall not be installed in a frozen state or when conditions are unfavorable to the successful installation of the sod.
- D. Prior to placing sod, the Contractor shall lightly scarify and moisten the topsoil. The Contractor shall remove any reinforcement netting that may be used to assist with the harvesting and/or placement of the sod prior to installation.
- E. Contractor shall install sod in uniform rows perpendicular to the face of the slope of the ground with the joints in adjacent rows staggered and packed tightly to adjacent pieces with no overlapping joints. A full row of sod, not less than 18 inches in width, shall be placed along the perimeter of the sodded area, parallel to any planting, walking areas or curbs. All irregular, bare, thin, or dead areas shall be cut out square, using a sharp knife, and replaced with healthy sod.
- F. On slopes greater than 3:1, the Contractor shall install the sod from the bottom of the slope upwards with every second row secured to the topsoil with approved fasteners, driven flush with the grass surface, at intervals of 3 feet on center and 4 inches below the top edge of each sod piece. On slopes greater than 2:1, every row of sod shall be secured as outlined above.
- G. Within two hours following installation, the Contractor shall lightly water the sod. Sod shall then be rolled in two directions at right angles to establish contact with the topsoil and create a uniform surface with adjoining grades, sidewalks, and curbs. Heavy rolling to correct irregularities in the grade shall not be permitted. Edges and areas near existing fixtures that cannot be rolled shall be thoroughly tamped by hand.

- H. After sod has been watered and rolled, the Contractor shall fill all open joints in the sod with a mixture of topsoil and grass seed. The grass seed shall be of the same approved blend used to sow the sod and mixed in a ratio of 60 percent topsoil to 40 percent grass seed. The topsoil and grass seed mixture shall be placed into the openings by means of heavy raking and then rolled.
- I. Following light rolling and joint filling, the Contractor shall water the sod in sufficient quantities to thoroughly saturate both the grass and the underlying topsoil.
- J. All excess soil, debris, or deleterious materials on the pavement or sidewalk surfaces shall be removed and disposed of.
- K. Repairs, rolling, joint filling, watering, and cleanup shall be completed within 48 hours of the initial placement of sod.

3.03 MAINTENANCE

- A. The maintenance period will not commence until the Engineer has certified the installation of the sod, as stated in section 3.02, is complete
- B. The Contractor shall maintain the sod for a minimum continuous period of thirty (30) days or until such time as the Work has been accepted by the engineer in section 3.04. Maintenance of the sod shall include all watering, mowing, weed control, pest control, and cleaning of grass, including replacement of dead, damaged, deficient, slipped, washed out, or vandalized sod.
- C. Contractor shall water the sod in sufficient quantities and at the required frequency to keep the topsoil beneath the sod continuously moist. Contractor shall make all necessary arrangements to obtain a supply of water and shall pay all costs associated with obtaining the water.
- D. Contractor shall provide adequate protection of sod areas from erosion, pedestrian and mechanical damage and shall only remove such protection after the grass area has been accepted by the Engineer.
- E. Contractor shall first mow the sod to 2 inches in height when the grass has initially grown to a height of 3 inches. Clippings shall be removed and disposed of if the grass appears smothered.
- F. Contractor shall apply herbicide when broad leaf weeds begin to develop. Herbicide shall be applied in accordance with the manufacturer's instructions.
- G. Areas sodded after September 15th which do not have an even stand of healthy live growth and/or adequate root development in that year, shall have the maintenance period commence on March 1st of the following year and continue as stated above.

3.03 TERMINATION OF MAINTENANCE PERIOD

The Engineer will terminate the sod maintenance period when all of the following criteria have been met by the Contractor.

1. Sod supplied meets the blend and seed mixture specified.
2. Sod is green, even colored, and free of bare or dead sections, visible joints, undulations, and settlement.
3. Sod does not contain more than 10 broadleaf weeds in a 500 square foot area.
4. Sod roots are well anchored into the underlying moist topsoil and sod is established, healthy, and vigorously growing.
5. No surface soil is visible after the grass has been mowed to a minimum of two (2) times to a height of 2 inches with the most recent mowing occurring within two (2) working dates prior to the date of inspection.
6. Site is clean and sod area is free of any visual obstruction such as leaves.

If the sod does not meet the above criteria, all deficiencies shall be corrected by the Contractor as required by the Engineer and further maintained by the Contractor as stated in section 3.03.

END OF SECTION

WCU
Norton Intramural Fields
22-24232-01A

DIVISION 33

UTILITIES



SECTION 33 11 00

WATER PIPE AND APPURTENANCES

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, equipment, materials and incidentals necessary to install and complete installation of ductile iron water lines in accordance with the plans. All pipe and appurtenance material shall be of the type and class specified herein.
- B. All water pipe excavation, bedding, pipe laying, jointing and coupling of pipe joints and backfilling shall be completed as described herein.
- C. All waterline installation shall conform to this specification and any standards and specifications that have been adopted by the local water authority. It is the contractor's responsibility to verify with the local water authority if any superseding standards and specifications are applicable.
- D. All materials that come in contact with potable water shall meet the requirements of NSF61.

1.02 SUBMITTALS

- A. The Contractor shall provide six (6) copies of shop drawings or submittals for the following:
 - 1. All sizes and types of pipe on the project.
 - 2. Pipe fittings, valves, meters and boxes, vaults, backflow preventers, and necessary appurtenances.

1.03 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall unload pipe so as to avoid deformation or other injury thereto. Pipe shall not be placed within pipe of a large size and shall not be rolled or dragged over gravel or rock during handling. When any joint or section of pipe or other material is damaged during transporting, unloading, handling or storing, the undamaged portions of the pipe or material may be used or if damaged sufficiently, the Engineer will reject the material as being unfit for installation.
- B. If any defective material is discovered after installation, it shall be removed and replaced with sound pipe or shall be repaired by the Contractor in an approved manner and at his own expense.

1.04 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

PART 2: PRODUCTS

2.01 MATERIALS

A. DUCTILE IRON PIPE

1. All materials shall be first quality with smooth interior and exterior surfaces, free from cracks, blisters, honeycombs, and other imperfections, and true to theoretical shapes and forms throughout. All materials shall be subject to the inspection of the Engineer at the plant, trench, or other point of delivery, for the purpose of culling and rejecting material which does not conform to the requirements of these specifications. Such material shall be marked by the Engineer, and the Contractor shall remove it from the project site upon notice being received of its rejection.
2. As specific specifications are cited, the designation shall be construed to refer to the latest revision under the same specification number, or to superseding specifications under a new number, except provisions in revised specifications which are clearly inapplicable.
3. Ductile Iron Pipe shall be manufactured in accordance with AWWA C151. All Ductile Iron Pipe shall be 350 psi Class unless otherwise specified and shall be lined with a cement mortar lining not less than 1/16" thick conforming to AWWA C104. Pipe wall thickness for all Ductile Iron Pipe shall conform to "Thickness Design for Ductile Iron Pipe," AWWA C150. The standard laying condition shall be type 2. The exterior of all Ductile Iron Pipe shall have a protective coating of a coal tar or asphaltic material a minimum of 5 mils thickness conforming to AWWA C110 and C115.
 - a. Flanged Joints:
 - i. Flanged pipe shall have flanges with long hubs, shop fitted on the threaded end of the pipe.
 - ii. Where required, flanges shall be tapped for stud bolts. Flanges shall be accurately faced at right angles to the pipe axis and shall be drilled smooth and true, and covered with coal tar pipe varnish or otherwise protected against corrosion of flange faces. Flange faces shall be cleaned to bare metal with wire brushed before installation of pipe.
 - iii. Ductile Iron Flanged joint pipe shall have a thickness of Class 53 minimum and shall conform to AWWA C110 and AWWA C115. Pipe shall be ordered in lengths needed as no pipe shall be cut, threaded or flanged in the field. All pipe

shall have 125 lb. flanges conforming to AWWA C110 unless otherwise specified.

- iv. In general, flanged joints shall be made up with through bolts of the required size. Stud or tap bolts shall be used only where shown or required. Steel or tap bolts shall be cadmium plated, with good and sound, well-fitting threads, so that the nuts may be turned freely by hand. Cadmium plating shall be by an approved process with a plate thickness of 0.0003" to 0.0005".
- v. Connecting flanges shall be in proper alignment and no external force shall be used to bring them together. Bolts and gaskets shall be furnished by the installer of piping for joints connecting the piping with equipment and piping is furnished by the installer or not.

b. Mechanical Joints:

- i. All mechanical joint pipe shall be manufactured in accordance with AWWA C111. Pipe shall be manufactured in accordance with AWWA C151, and the pipe thickness shall be 350 psi Class as determined by AWWA C150 unless otherwise noted.
- ii. All bolts shall be tightened by means of torque wrenches in such a manner that the follower shall be brought up toward the pipe evenly. If effective sealing is not obtained by tightening the bolts to the specified torques, the joint shall be disassembled and reassembled after thorough cleaning.
- iii. Bolts for mechanical joints shall be high grade steel, low alloy type, with tee or hex head and American Standard threads. Mechanical joint gland shall be gray iron and shall utilize a plain rubber gasket.

c. Slip Joints:

- i. Slip or "push-on" joints shall be manufactured in accordance with AWWA C151. Pipe thickness shall be 350 psi Class as determined by AWWA C150.
- ii. Bells of "slip" joint pipe shall be contoured to receive a bulb shaped circular rubber gasket, and plain ends shall have a slight taper to facilitate installation. The lubricant used in making up the joints shall be furnished by the pipe manufacturer. The jointing shall be done by guiding the plain end into the bell until contact is made with the gasket

and by exerting a sufficient compressive force to drive the joint home until plain end makes full contact with the base of the bell. No joint may exceed a maximum deflection of 4%.

4. Fittings:

- a. All ductile iron pipe fittings for pipe shall be mechanical joint type in accordance with AWWA C110 and AWWA C111 for underground piping. Where flanged pipe is used ductile iron fittings shall be flanged in accordance with AWWA C110 for exposed piping. All flanges shall be Class 125 unless otherwise noted.
- b. All fittings shall be lined with cement mortar not less than 1/16" thick in conformance with AWWA C104 and suitable for a minimum of 250 psi working pressure unless otherwise specified.
- c. All mechanical joints shall be manufactured in accordance with AWWA C111.

B. POLYVINYL CHLORIDE (PVC) PIPE (1-Inch Up To 4-Inch)

1. All pipe 4 inches or larger to be Ductile Iron Pipe.
2. All materials shall be first quality with smooth interior and exterior surfaces, free from cracks, blisters, honeycombs, and other imperfections, and true to theoretical shapes and forms throughout. All materials shall be subject to the inspection of the Engineer at the plant, trench, or other point of delivery, for the purpose of culling and rejecting material which does not conform to the requirements of these specifications. Such material shall be marked by the Engineer, and the Contractor shall remove it from the project site upon notice being received of its rejection.
3. As specific specifications are cited, the designation shall be construed to refer to the latest revision under the same specification number, or to superseding specifications under a new number, except provisions in revised specifications which are clearly inapplicable.
4. Pressure Rated PVC Pipe shall be manufactured in accordance with AWWA C900 and ASTM 2241. All Pressure Rated PVC Pipe shall have a standard dimension ratio (SDR) as indicated in the drawings. The exterior of all PVC Pipe shall bear a stamp which shows SDR and size.
 - a. All pipes shall have slip or "push-on" joints which are manufactured in accordance with AWWA C151. Pipe shall have a bell with integral rubber gasket.

- b. Bells of "slip" joint pipe shall be contoured to receive a bulb shaped circular rubber gasket, and plain ends shall have a slight taper to facilitate installation. The lubricant used in making up the joints shall be furnished by the pipe manufacturer. The jointing shall be done by guiding the plain end into the bell until contact is made with the gasket and by exerting a sufficient compressive force to drive the joint home until the assembly mark on the pipe barrel is flush with the end of the bell. No joint may exceed a maximum deflection of 4%.
- 4. Fittings:
 - a. Fittings for all PVC pipe shall be ductile iron pipe fittings, mechanical joint type in accordance with AWWA C110 and AWWA C111 for underground piping.
 - b. All fittings shall be lined with cement mortar not less than 1/16" thick in conformance with AWWA C104 and suitable for a minimum of 250 psi working pressure unless otherwise specified.
 - c. All mechanical joints shall be manufactured in accordance with AWWA C111. The Contractor shall provide suitable 3" plugs with stainless steel threaded nipples and sleeves for connection of fittings.
- 5. All valves and appurtenances shall comply with NSF61/NSF372.
- 6. All non-ferrous pipe shall be installed with 19-gauge Trace Safe tracer wire or approved equal. Tracer wire will be installed one foot above the top of the pipe and shall be connected to valve boxes and appurtenances per manufacturer requirements.

PART 3: EXECUTION

3.01 INSTALLATION

A. EXCAVATION

1. Trenches will be defined as all excavation for the installation of water pipe, hydrants, valves, water services, water taps, and other unclassified excavation as may be deemed necessary by the Engineer.
2. The excavation shall be done to the lines, grades, typical sections, and details shown on the plans or established by the Engineer. All work covered by this section shall be coordinated with the grading, construction of drainage structures, and other work along the project, and shall be maintained in a satisfactory condition so that adequate drainage is provided at all times. Any roots which protrude into the trench shall be trimmed flush with the sides of the trench. Trenches for pipe lines shall be completed before the pipe is installed unless otherwise permitted by the Engineer.
3. All excavation shall be by open cut unless otherwise authorized by the Engineer. If the bottom of the excavation is found to consist of rock or any materials that cannot be excavated to give a uniform bearing surface, the material shall be removed to a depth at least 6" below established bottom grade and backfilled to grade with #67 washed stone. Any excavations carried below the depths indicated, without specific directions, shall be backfilled in the same manner. The excavation shall be of sufficient width to allow a clearance of not less than 6" between the side of the trench and the outside of the pipe, or in case of pipe with a bell, the outside of the bell of the pipe. This rule will apply at all times, and consequently, proper allowance must be made for additional space required for sheeting the trench where necessary. Maximum trench width, unless as otherwise authorized by the Engineer, as measured at a depth of 2'-0" above the top of the pipe shall be 30" or 10" clearance from each side of the pipe, whichever is greater.
4. Sheeting, Bracing Trenches, and Trench Boxes:

If necessary, the Contractor will be required to keep the sides of the excavation vertical by sheeting and/or bracing or the use of a trench box to prevent movement by slides or settling of the sides of the trench to prevent injury or displacement of the pipe or appurtenances or diminish the working space required at the sides of the pipe. Also, the Contractor may be required, for the purpose of preventing injury to persons or property or adjacent structures in place or to be constructed, to leave sheeting and bracing in place. The Contractor shall provide all means necessary to comply with the latest OSHA requirements.

5. No sheeting or bracing shall extend closer than 2'-0" off the ground surface, or within subgrade, and no timbers shall be left in the trench that may form pockets or cavities that cannot easily be filled during the operation of backfilling and settling or compacting the trench backfill. It is understood that the Owner will be under no obligation to pay for sheeting or bracing left in place by the Contractor. Failure to sheet and brace trenches or other excavation shall be the Contractor's risk, and he will be held responsible for caving, settlement, and all other damage resulting therefrom. If the Engineer is of the opinion, that at any point, sufficient or proper supports have not been provided, he may order additional supports put in at the Contractor's expense, but compliance with such orders shall not release the Contractor from responsibility for the sufficiency of such supports.
6. Excavated materials to be used for backfill will be approved by the Engineer, and if acceptable shall be neatly deposited at the sides of the trenches where space is available. Where stockpiling of excavated material is required, the Contractor shall so maintain his operations as to provide for natural drainage and not present an unsightly appearance.
7. Materials which are excess to the needs of the project will be disposed of by the Contractor.
8. In order to protect existing pavement structures and to make clean-up easier the Contractor shall place a 6" layer of sand on all asphalt or concrete surfaces prior to placing excavated material.
9. Pipe Foundations:
 - a. The preparation of the pipe bedding shall be in accordance with the typical trench cross-sections as shown on the plans for the type of pipe being installed. Unless otherwise noted all pipe shall be installed using a "Type 2" trench foundation as defined in AWWA C151.
 - b. The pipe foundation shall be prepared to be uniformly firm and shall be true to the lines and grades as shown on the plans. Any deviation or field adjustment will require the approval of the Engineer. When an Inspector is present on the site and is so requested by the Contractor, he shall check the position of grades and lines but the Contractor shall be responsible for the finished work conforming to exact and proper line and grade.
 - c. Whenever the nature of the ground will permit, the excavations at the bottom of the trench shall have the shape and dimensions of the outside lower third of the circumference of the pipe, care being taken to secure a firm bearing support uniformly throughout the length of the pipe. A space shall be excavated under and around

each bell to sufficient depth to relieve it of any load and to allow ample space for filling and finishing the joint. The pipe, when thus bedded firmly, shall be on the exact grade.

- d. In case the bed shaped in the bottom of the trench is too low, the pipe shall be completely removed from position, and #67 washed stone of suitable quality shall be placed and thoroughly tamped to prepare a new foundation for the pipe. In no case shall the pipe be brought to grade by blocking up under the barrel or bell of same, but a new and uniform support must be provided for the full length of the pipe.
- e. Where rock or boulders are encountered in the bottom of the trench, the same shall be removed to such depth that no part of the pipe, when laid to grade, will be closer to the rock or boulders than 6". #67 washed stone shall be placed to bring the bottom of the trench to proper subgrade over rock or boulders.
- f. Where the foundation material is found to be of poor supporting value, the Engineer may make minor adjustment in the location of the pipe to provide a more suitable foundation. Where this is not practical, the foundation shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the Engineer, within limits established on the plans, and backfilling with #67 washed stone as approved by the Engineer.
- g. The Contractor shall remove all water which may be encountered or which may accumulate in the trenches by pumping or bailing and no pipes shall be laid until the water has been removed from the trench. Water so removed from the trench must be disposed of in such a manner as not to cause injury to work completed or in progress.
- h. Whenever the bottom of the trench shall be of such nature as to provide unsatisfactory foundation for the pipe, the Engineer will require the pipe to be laid on a washed stone or concrete cradle foundation. Such foundations whether washed stone or a poured concrete cradle, shall be placed by the Contractor and compensation will be allowed the Contractor for the work.

B. INSTALLING PIPE AND APPURTENANCES

1. Laying Pipe:

- a. All piping is to be installed in strict accordance with the manufacturer's recommendations and AWWA C600, AWWA C605, and the contract material specifications. Installation manuals from

various material suppliers will be furnished the Engineer for his review and approval prior to installation of any materials. The Engineer may augment any manufacturer's installation recommendations if, in his opinion, it will best serve the interest of the Owner.

- b. No pipe shall be laid except in the presence of the Engineer or his Inspector, or with special permission from the Engineer.
- c. Proper tools, implements and facilities satisfactory to the Engineer shall be provided and used for the safe and convenient prosecution of pipe laying. All pipe, fittings, valves, and other materials used in the laying of pipe will be lowered into the trench piece by piece by means of suitable equipment in such a manner to prevent damage to the pipe, materials, to the protective coating on the pipe materials, and to provide a safe working condition to all personnel in the trench. Each piece of pipe being lowered into the trench shall be clean and free of defects. It shall be laid on the prepared foundations, as specified elsewhere to produce a straight line on a uniform grade, each pipe being laid so as to form a smooth and straight inside flow line.
- d. Pipe shall be removed at any time if broken, injured or displaced in the process of laying same, or of backfilling the trench.
- e. When cutting short lengths of pipe, a pipe cutter, as approved by the Engineer, will be used and care will be taken to make the cut at right angles to the center line of the pipe or on the exact skew as shown on the plans. In the case of push-on pipe, the cut ends shall be tapered with a portable grinder or coarse file to match the manufactured taper.
- f. All pipe joints shall be constructed in strict accordance with the pipe manufacturer's specifications and materials and any deviation must have prior approval of the Engineer.
- g. The maximum deflection per joint of flexible joint pipe shall be that deflection recommended by the manufacturer. However, at no time will a deflection greater than 4° be allowed.
- h. All water lines shall have a minimum cover of 3'-0" unless otherwise approved by the engineer. All water lines shall have a minimum 18" vertical separation from storm sewer and shall have a minimum of 10'-0" horizontal separation from sanitary sewer or 18" vertical separation with the water line over the sewer line. In the event these separations cannot be met, both water line and sanitary

sewer shall be constructed of ductile iron pipe as directed by the Engineer or as shown on the drawings.

2. Thrust Blocks:

- a. All plugs, caps, tees, bends, and other fittings shall be provided with adequate thrust blocks. Thrust blocks shall be constructed to the minimum dimensions shown on the drawings or as directed by the Engineer, or as per City of Asheville standards. Thrust blocks shall be made of ready mix concrete having a compressive strength of 28 days of 4000 psi and shall bear directly against the undisturbed trench wall. Where possible, the concrete shall be so placed that the fitting joints will be accessible for repair. All bolts and pipe joints shall be protected against contact with thrust block concrete by the installation of a 20 mil polyethylene film placed between the fittings and the concrete. Where any section of a main is provided with concrete thrust blocks, the hydrostatic pressure test shall not be made until three days after installation of the concrete thrust blocks unless otherwise approved by the Engineer. Where trench conditions are, in the opinion of the Engineer, unsuitable for thrust blocks, the Contractor shall provide steel tie rods and socket clamps to adequately anchor the piping. All tie rods and clamps shall be given a bituminous protective coating or shall be galvanized.
- b. Concrete for thrust blocks shall consist of a ready mix of Portland Cement, Fine Coarse aggregate and water to produce concrete with a minimum compressive strength at 28 days of not less than 4000 psi when tested in accordance with ASTM C39 or C42. Sakrete or any similar material will not be permitted under any circumstances.

C. BACKFILLING AND COMPACTION

1. Backfill trenches immediately after approval of the pipeline construction.
2. Use select backfill carefully placed in uniform layers not exceeding 6" in thickness to a depth of 2'-0" over the top of the pipe. Place material and fill the area under the pipe haunches. Place each layer, moisten as necessary; then uniformly compact by use of hand, pneumatic, or mechanical tampers exercising care to prevent lateral displacement. Areas of backfill 2'-0" over top of pipe to top of trench, shall be backfilled with a select material containing no rocks larger than 6" in the greatest dimension and shall be free of material with an exceptionally high void content. The initial backfill shall meet the same requirements except no rocks over 4" in diameter will be allowed.
3. Moisten backfill as necessary above 2'-0" over the top of the pipe and place in 8" layers. Compact each layer with hand, pneumatic or mechanical

compactor. Puddling or flooding of trench for consolidation of backfill or use of wheel rolling by construction equipment will not be permitted.

4. All backfill shall be compacted so as not to damage the pipe and appurtenances and shall be compacted to 95% of the maximum dry density as determined by Standard Proctor Test for the various types of backfill material for the full trench depth in non-paved areas. In paved areas, backfill shall be compacted to 98% of the maximum dry density as determined by Standard Proctor Test for the top 24" below subgrade. Methods of backfilling shall be in strict accordance with the pipe manufacturer's recommendations. All backfill material shall have been approved by the Engineer. Select backfill material shall be used when requested by the Engineer.
5. Roadways and Road Crossings:

Use select backfill placed in uniform layers not exceeding 6" in thickness for full trench depth and width, thoroughly compacted with mechanical tampers under optimum moisture conditions to 95% compaction (98% for the top 2'-0" of sub grade beneath pavements). Replace removed paving and base course with new material of equal or better quality and of the same texture and type as the adjacent roadway.
6. Care shall be taken during backfill and compaction operations to maintain alignment and prevent damage to the joints. The backfill shall be kept free from roots, stones, frozen lumps, chunks of highly plastic clay, or other objectionable material. All pipe backfill areas shall be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill.
7. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a minimum cover as required by the plans. Where any part of the required cover is above the proposed finish grade, the Contractor shall place, maintain, and finally remove such material at no cost to the Owner. Pipe which becomes miss-aligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations, shall be removed and replaced by the Contractor at no cost to the Owner.
8. The Contractor shall maintain all pipes installed in a condition that they will function continuously from the time the pipe is installed until the project is accepted.
9. Cleanup:
 - a. Grade all areas disturbed to a finish ordinarily obtained from a blade grader with no abrupt changes in grade or irregularities that will hold water. Prior to final inspection and acceptance, remove all

rubbish and excess material and leave area in a neat, satisfactory condition.

- b. Cleanup and seeding is part of the pipeline installation. No more than 3,000 L.F. of water line may be laid prior to completion of cleanup of the first section of pipeline laid. To facilitate this the Owner reserves the right to withhold up to 30% of the unit price bid for water line if in the opinion of the Owner and Engineer completed sections have not been properly cleaned.

3.02 QUALITY CONTROL

A. TESTING

1. General: Perform all hydrostatic testing in accordance with AWWA C600, Section 4, unless otherwise specified. When a section of pipe of a length deemed adequate by the Engineer is ready for testing, blow the line free from air and conduct a leakage test. All new water service connections, from taps on the main up to and including meter yokes, meter setters and spool piece for meters in vaults, shall be installed and included in the hydrostatic testing and disinfection processes.
2. Buried Lines: Whenever conditions permit in the opinion of the Engineer, test pipelines before the trench is backfilled. All joints may then be examined during open trench test and all leaks entirely stopped. Should the Contractor wish to minimize the maintenance of lights, and barricades and the obstruction of traffic, he may, at his own risk, backfill the entire trench as soon as practicable after installation of pipe. The Contractor, however, remains responsible for removing and later replacing such backfill, at his own expense, should he be ordered to do so in order to locate and repair or replace leaking or defective joints of pipe.
3. Exposed Lines: Test all exposed lines prior to field painting.
4. Temporary Bulkheads: Furnish, install and remove all temporary bulkheads, flanges, or plugs necessary to permit the required pressure test. Install corporation stops at all high points on the line for blowing lines free from air. Install corporation stops at the test pump location. Install a test pump and means for accurate measurement of water introduced into the line during testing. Keep pump, meters, and gages in use during pressure and leakage tests.

5. Test Pressure and Allowable Leakage: Keep the section to be tested full of water for a period of 24 hours before the pressure and leakage tests are conducted.
6. Hydrostatic Testing: A section of line which is to be hydrostatically tested, shall be slowly filled with water at a rate which will allow complete evacuation of air from the line. Hand pumps shall not be used for the pressure testing of water mains.
 - a. The hydrostatic test shall be witnessed by the Water Engineering Division during the full two-hour duration.
 - b. The line shall be tested to a minimum pressure of 200 psi with a maximum of 250 psi at the lowest elevation for a duration of 2 hours. The pressure gauge used in the hydrostatic test shall be calibrated in increments of 10 psi or less. Pressure shall be maintained at a minimum of 200 psi +/- 5 psi at the highest point throughout the duration of the test by pumping additional water into the test section as often as necessary. At the end of the test period, the leakage shall be measured with an accurate water meter furnished by the City, or other approved means.
 - c. The line to be tested must utilize a backflow prevention assembly. All water for testing must be drawn through this assembly. Prior to connecting to the existing water line the new water line extension shall be pressure tested, disinfected and a clear water sample obtained.
 - d. **The allowable leakage shall be no more than indicated in the table below. Allowable leakage based on the formula:**

$$L=[S*D*(P)^{1/2}]\backslash148,000$$

L = testing allowance (makeup water), in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

ALLOWABLE LEAKAGE PER 1000 FEET OF PIPELINE (GPH)													
Avg. Test Pressure PSI	Pipe Diameter in Inches												
	3	4	6	8	10	12	14	16	18	20	24	30	36
250	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85
225	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65

200	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98
125	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72
100	0.20	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43

e. All visible leaks are to be repaired regardless of the amount of leakage.

7. Defective Materials and Workmanship: Carefully examine all exposed pipe fittings, valves, hydrants, and joints during the test. Locate and repair leaks and replace defective materials if the water loss during the test periods exceeds the allowable leakage. Make the necessary repairs, replace defective material and repeat the hydrostatic test until the leakage does not exceed the allowable leakage as defined herein.

B. STERILIZATION

1. Disinfection to be in compliance with AWWA C651.
2. All new water service connections, from taps on the main up to and including meter yokes, meter setters and spool piece for meters in vaults, shall be installed and included in the hydrostatic testing and disinfection processes.
3. All additions or replacements to the water system shall be chlorinated before being placed in service. Such disinfection shall take place under the continuous supervision of the Engineer or Engineer's Inspector. The maximum total length of water main which may be disinfected at the same time is 3000 linear feet.
4. Disinfection, flushing and sampling of a completed line shall be carried out in the following manner:
 - a. Taps with extended copper tubing will be made at the control valve at the upstream end of the line and at all extremities of the line including valves. These additional taps will not be necessary where a suitable permanent tap is already available as approved by the City.
 - b. Prior to introducing the chlorine solution into the pipe, all blow-offs shall be checked to confirm that all air has been expelled from the pipe and the pipe is filled with water. During the introduction of chlorinated solution into the pipe, the operation of blow-offs shall be carefully controlled to make sure the

solution enters all main lines, branch lines, and service lines thoroughly and that no air is introduced.

- c. All gauge pressure and residual chlorine field test equipment shall be properly calibrated. All equipment used in the disinfection process shall be cleaned and suitable for potable water application.
- d. A solution of water containing high test sodium hypochlorite (70% available chlorine) shall be introduced into the line by regulated pumping at the control-valve tap. The solution shall be of such a concentration that the line shall have a uniform concentration of 50 ppm total chlorine immediately after disinfection. The chart below shows the required quantity of 70% HTH compound to be contained in solution in each 1000 feet section of line to produce the desired concentration of 50 ppm.

PIPE SIZE, INCHES	POUNDS HIGH TEST HYPOCHLORITE (70%) PER 100 FEET OF LINE
6	0.88
8	1.56
10	2.42
12	3.50
14	4.76
16	6.22
20	9.76
24	14.00

- e. Once the new main is uniformly chlorinated at the required concentration as confirmed by the Water Engineering Division Inspector, entrances and blow-offs shall be properly secured and the solution shall be retained in the system for a minimum of 24 hours, during which time all intermediate valves and hydrants shall be operated several times to insure disinfection of the inside faces of these appurtenances. At the end of the 24-hour period, the Inspector shall check entrance points and blow-offs to insure that the pipe is still full of solution without trapped air and the solution at each point checked has retained a chlorine residual of not less than 10 mg/l.
- f. Following the 24-hour period, with the approval of the Inspector, the chlorine solution shall be thoroughly flushed from the new main. Flushing shall not be completed until the residual chlorine measured by the Inspector at the end points of the new main has

a measured chlorine residual within +/- 0.5 mg/l of the water supplied for flushing from the active water main.

- g. Disposal of the chlorinated solution during flushing shall comply with all federal, state, and local regulations. Where a sanitary sewer is located nearby, with the approval of the sewer authority, the chlorinated solution may be discharged to the sanitary sewer with a positive air gap to prevent backsiphonage. Disposal directly to surface waters without removal of chlorine is strictly prohibited.
 - h. After flushing is completed as described in f) above, the new water mains shall be isolated without introducing air by closing all entrance and blow-off points and allowing the new water mains to sit for another 24-hour period. At the end of this 24-hour period, an authorized employee of an accredited testing firm shall collect samples from randomly selected end points of the new water mains and perform bacteriological analysis of the samples in a state-approved certified laboratory. Results of the testing shall be documented and certified by the signature of the laboratory technician and Water Production Supervisor or Superintendent. Test results shall be provided to the contractor and Water Engineering Division. The disinfection process is not completed until the results of all testing are certified as negative for bacteriological contamination.
 - i. If the bacteriological tests fail to produce satisfactory results, the new main shall be reflushed by repeating steps f) through h) above. If bacteriological tests fail the second time, the entire disinfection process shall be repeated.
5. For mains required to be immediately returned to service after disinfecting, take a bacteriologic sample after connection or repair to provide a record by which the effectiveness of the procedure used can be determined.

END OF SECTION

SECTION 33 12 00

WATER VALVES AND APPURTENANCES

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. This specification covers the requirements for furnishing and installing valves and other appurtenances for the various water system improvements shown on the Drawings.
- B. Furnish all labor, equipment, materials and incidentals necessary to install and complete water valve and appurtenance installation in accordance with the plans and specifications. All valves and appurtenance material shall be of the type and class specified herein.
- C. All water valve and appurtenance excavation, bedding, pipe laying, jointing and coupling of pipe joints and backfilling shall be completed as described herein.
- D. All valves and appurtenances shall conform to current NCDENR Standards and Specifications.

1.02 SUBMITTALS

The Contractor shall provide six (6) copies of shop drawings or submittals for the following:

- 1. All valves, valve boxes, hydrants, air relief valves, tapping sleeves, meters, manholes, or any other items required for completion of the project.

1.03 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall unload valves and appurtenances so as to avoid deformation or other injury thereto. The Contractor shall store valves and appurtenances above storm drainage levels. All valves shall be drained and so stored as to protect them from freezing.
- B. If any defective material is discovered after installation, it shall be removed and replaced with sound pipe or shall be repaired by the Contractor in an approved manner and at his own expense.

1.04 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

2.01 MATERIALS

A. BALL VALVES

Ball valves shall be installed on existing/new 2" water main and service lines and all conform to AWWA C800 and AWWA C507 (6-in. through 60-in). Valves shall be made of heavy brass components with a PTFE coated ball on a "blow-out" proof stem with double O-ring seals, and shall be rated for 300 psig working pressure. Operating nut shall be "curb key" design for quarter turn open or close and shall open left. Ball valves shall be as required on the Approved Manufacturers Products List.

B. GATE VALVES

All gate valves shall be designed for a minimum working pressure of 200 psi unless otherwise specified. Valves shall have a clear waterway equal to the full nominal diameter of the pipe. Valves shall be opened by turning counterclockwise. Each valve shall have the initials or name of the maker, pressure rating and year of manufacture cast on the body. Prior to shipment from the factory, each valve shall be tested by hydraulic pressure equal to twice the specified working pressure. Valves shall be operated by hand wheel for above ground installations or 2" square operating nut for below ground installations. Valves shall have an arrow cast in the metal indicating the direction of opening.

Valves to be installed underground (Buried) shall be of the non-rising stem type and shall have mechanical joint connections.

Valves installed above ground or in structures shall have rising stems with outside stem and yoke and 18" diameter minimum hand wheel and shall have flanged ends with 125# flanges unless others noted.

1. Gate Valves Smaller than 2"

- a. Gates valves smaller than 2" shall be all brass, single disc type, double seat tapered wedge type built to manufacturer's standards with material and construction conforming to AWWA C-500.
- b. Each valve shall have a 2" operating nut. Valves shall have screwed ends conforming to NPT standards.

2. Resilient Seated Wedge Valve

- a. Gate valves 2" through 24" diameter size shall be of the ductile iron body, resilient seated wedge type meeting the requirements set

forth in AWWA C-509 and AWWA C-500. All valves shall be from one manufacturer and parts interchangeable.

- b. Gate valves shall have body, bonnet and gate manufactured of ductile iron conforming to ASTM A-536. The shell thickness of all components shall conform to the thicknesses in Table 2, Section 4.4 of AWWA C-509 and C-500. The valve body and bonnet shall be coated on both the interior and exterior surfaces with a fusion bonded epoxy paint conforming to AWWA C-550.
- c. The gate shall be fully covered with a rubber cover over all exterior and interior ferrous surfaces. The rubber shall be securely bonded to the gate body, including the part which houses the stem nut. The gate and rubber coat shall conform to ASTM D429.
- d. Valve stems shall be cast bronze. The stuffing box shall use "O"-ring seal type with two rings located above the thrust collar. The rings shall be replaceable with the valve fully open and under pressure.
- e. Valves larger than 12" diameter shall be designed for horizontal installation with beveled gear boxes with reduction gears to reduce the number of turns required to operate valve.

3. Double Disc Type Gate Valves

- a. Gate valves larger than 24" diameter size shall be of the ductile iron body, double disc parallel seat type meeting the requirements set forth in AWWA C-500. All valves shall be from one manufacturer and parts interchangeable.
- b. Gate valves shall have body, bonnet and gate manufactured of ductile iron conforming to ASTM A-536. The shell thickness of all components shall conform to the thicknesses in C-500. The valve body and bonnet shall be coated on both the interior and exterior surfaces.
- c. The gates shall be high strength cast iron, sturdily proportioned without pockets on the backs. All cam surfaces shall open to the bottom. Gate rings shall be rolled into a dovetail groove under pressure to make a single insertable finish.
- d. Valves shall use bottom wedging type design with a two-part floating wedge contact. The wedge and hook shall be separate castings and not a single piece.

- e. Valve stems shall be cast bronze. The stuffing box shall use "O"-ring seal type with two rings located above the thrust collar. The rings shall be replaceable with the valve fully open and under pressure.
- f. Valves shall be designed for horizontal installation with beveled gear boxes with reduction gears to reduce the number of turns required to operate valve. Valves shall have bronze rollers, tracks, and scrapers.
- g. All valves shall be supplied with a bypass as a part of the valve. Bypass shall be a minimum of 3" diameter with a 3" resilient seated wedge valve.

C. VALVE BOXES

All valve boxes shall be cast iron and shall conform to ASTM A48. Valve boxes shall be of the adjustable screw type with a base to fit the valve yoke with a removable cover with the word "water" cast thereon.

D. FIRE HYDRANTS

1. GENERAL:

- a. All fire hydrants shall meet or exceed the requirements of AWWA C-502, be listed by Underwriters Laboratories, Inc. and have Factory Mutual Research approval. All hydrants shall be rated 250 PSI working pressure minimum and be tested to 500 PSI minimum. The rated working pressure shall be cast on the hydrant barrel. Hydrants shall be of the compression type, constructed such that the main valve closes with water pressure to assure no loss of water in the event of damage to the upper portion of the hydrant. The diameter of the main valve seat shall be four and one-half inches (4 1/2") minimum. The hydrant shall open counter clockwise against the pressure and close clockwise with the pressure.
- b. The bonnet assembly shall have a lubrication reservoir which is sealed from the waterway and all external contaminants by the use of "O" ring seals. A port to add lubricant to the reservoir, without removal of the bonnet, is required.
- c. Fire hydrant shall be manufactured with 1 1/2-inch Pentagon operating nut and thrust nut made of low zinc bronze complying with ASTM B-61, B-62 or B-96, with thrust bearings located both above and below the thrust collar and with operating nut protected

by a cast iron weather shield. In lieu of the bronze operating nut, an integral ductile iron operating nut and weather shield will be acceptable.

- d. Hydrants shall be a 3-way type with two (2) outlet nozzles, two and one-half inches (2 1/2") NST and (1) Steamer nozzle four and one-half inches (4 1/2") NST. All nozzles shall be made of low zinc brass complying with ASTM B-61, B-62 or B-96. All nozzles shall be mechanically locked into the barrel and have "O" ring pressure seals. Caps shall be provided with chains and chain hooks.
- e. The hydrant shall have a traffic "breakaway" coupling which is designed to fracture when the hydrant is impacted by a vehicle. The breakaway coupling shall be made of cast iron or steel and shall allow for 360-degree rotation of the upper barrel to position the nozzles without removing the breakaway coupling or shutting down. All pins, clips, and or retainer rings associated with the "breakaway" coupling shall be stainless steel.
- f. The main valve seat shall have bronze to bronze seating arrangement of low zinc bronze complying with ASTM B-61, B-62 or B-96. A bronze seat ring shall be threaded into bronze sub-seat located in the hydrant elbow. All "O" rings sealing the main valve seat ring shall bear against a non-corrodible low zinc bronze surface.
- g. The main valve assembly shall include double drain valves to operate automatically each time operated without the aid of springs, pins or toggles. The valve upper plate and valve lower plate shall be made of ductile iron or low zinc bronze complying with ASTM B-61, B-62 or B-96. The entire valve and stem assembly must be capable of removal and reassembly by the use of a small lightweight wrench without disassembly of the upper barrel.
- h. The shoe casting, lower barrel casting, and flanges below ground shall be manufactured in accordance with ASTM A- 126, Class B, Grey Iron or Ductile Iron. All ferrous metal surfaces in the hydrant shoe are to be fully coated with a minimum four (4) mills epoxy not to exclude the lower valve plate assembly.
- i. The hydrant will have three and one-half foot (3 1/2') of bury, unless otherwise noted. The hydrant will have a six inch (6") inlet connection of the (mechanical joint) type, unless otherwise noted. Painting and coating of the hydrant shall be as prescribed in

AWWA C-502, latest revision. The color above the ground line flange shall be YELLOW.

- j. Fire hydrants shall be as required in the Approved Manufacturers Products List.

E. AIR RELIEF VALVE

1. The air release valve shall fully conform to AWWA C512 (latest revision) and suitable for use with clean water. It shall be float operated and automatically release accumulated air from the pipeline or system while in operation and under pressure.
2. Valves with 1" (25mm) or larger connection size shall be compound lever type with adjustable seat, smaller size valves shall be simple lever type.
3. The valve's venting orifice diameter shall be selected for 300 PSI (2,069 KPa) maximum working pressure.
4. The valve body and cover shall be rated for 300 PSI (2,069 KPa) and made from cast iron conforming to ASTM A126 Class B.
5. The float ball, orifice and internal linkage mechanism shall be made from Type 316 stainless steel. Non-metallic components are not acceptable.
6. The seat shall be replaceable and made from Buna-N rubber or other suitable elastomer compounds.
7. The exterior of the valve shall be shop coated with enamel primer.

F. MANHOLE SECTIONS AND APPURTENANCES

1. Precast concrete manhole bases, risers and cones shall conform to ASTM C478, latest revision, for precast reinforced concrete manhole sections. Tapered sections and transition sections, where required, shall be of eccentric cone design, having the same wall thickness and reinforcement as the cylindrical ring sections. Flat slab tops shall be required for very shallow manholes and where shown or specified. Cast iron manhole covers and assemblies shall be cast into slab tops for access into manholes.
2. Minimum compressive strength of concrete shall be 4000 psi and the maximum permissible absorption shall be 6.5%. Risers shall be reinforced with a single cage of steel placed within the center third of the wall. The tongue or the groove of the joint shall contain one line of circumferential reinforcement equal in area to that in the barrel of the manhole riser. The

minimum cross-sectional area of steel per linear foot shall be 0.12 square inches for larger sizes. Precast manhole sections shall fit together readily and shall have a self-contained "O"-ring rubber gasket conforming to ASTM C443.

3. The quality of materials, the process of manufacture, and the finished manhole sections shall be subject to inspection and approval by the Engineer and his inspector. The manhole sections shall be perpendicular to their longitudinal axis, within the limits listed in ASTM C478.
4. Castings for manhole frames and covers shall be tough, even grained soft gray iron, free from burnt on sand and other injurious defects and conform to the requirements of ASTM A48, latest revision, Class 30, with "WATER" cast into the cover.
5. Brick for manholes and other structures shall conform to applicable requirements of ASTM C62, latest revision, Grade SW.

G. TAPPING SLEEVE AND VALVE

1. Tapping sleeves shall consist of two piece split ductile iron, jointed by bolts manufactured of high strength cast iron and incorporating a longitudinal compound rubber gasket. The sleeves shall include split end gasket and two piece mechanical joint glands suitable for the class of pipe around which sleeves are to be placed. Glands will be joined by steel bolts and fastened to the bell openings of the sleeves to form totally enclosed rubber water tight seals around the periphery of the pipe and along the longitudinal joints.
2. The sleeves shall have flanged outlets which will accommodate the tapping valves. Valves will be identical to resilient wedge gate valves elsewhere specified with inlet and outlet ends adaptable to the tapping machine and to provide mechanical joint connections to discharge pipes.

H. HYDRAULIC CHECK VALVE

1. GENERAL: Check valves shall be swing-check type conforming to AWWA C508. Valves conforming to AWWA C508 shall have iron body and cover and fully bronze mounted stainless steel hinge pins. Valves shall have clear port opening. Valves shall be spring loaded and shall have flanged ends.
2. CASTING MARKINGS: Cast integral with either the bonnet or the body, the manufacturer's identification, the size of valve, the year of manufacture, and the maximum working pressure.

3. PAINTING: Coat all ferrous parts of the valves, except finished or bearing surfaces, with 2 coats of coal-tar varnish pipe dip or other approved material. After the valves are assembled and tested apply a third coat to the exterior.
4. TESTING: Test each valve at the manufacturer's plant for performance in water tightness and resistance to distortion under internal pressure. Subject each valve to hydrostatic tests under pressure at the working pressure cast on the valve and at 350 PSI.

I. All valves and appurtenances shall comply with NSF61/NSF372.

PART 3: EXECUTION

3.01 INSTALLATION

A. EXCAVATION

1. The work covered by this section consists of the excavation and satisfactory disposal of all materials excavated in the construction of trenches.
2. Trenches will be defined as all excavation for the installation of storm sewers, sanitary sewers, water pipe, manholes, catch basins, hydrants, watergates, sewer services, water taps, drainage structures, drainage ditches and other unclassified excavation as may be deemed necessary by the Engineer.
3. The excavation shall be done to the lines, grades, typical sections, and details shown on the plans or established by the Engineer. All work covered by this section shall be coordinated with the grading, construction of drainage structures, and other work along the project, and shall be maintained in a satisfactory condition so that adequate drainage is provided at all times. Any roots which protrude into the trench shall be trimmed flush with the sides of the trench. Trenches for pipe lines shall be completed before the pipe is installed unless otherwise permitted by the Engineer.
4. All excavation shall be by open cut unless otherwise authorized by the Engineer. If the bottom of the excavation is found to consist of rock or any materials that cannot be excavated to give a uniform bearing surface, the material shall be removed to a depth at least 6" below established bottom grade and backfilled to grade with suitable bedding material thoroughly compacted in place. Any excavations carried below the depths indicated, without specific directions, shall be backfilled in the same manner. The excavation shall be of sufficient width to allow a clearance

of not less than 6" between the side of the trench and the outside of the pipe, or in case of pipe with a bell, the outside of the bell of the pipe. This rule will apply at all times, and consequently, proper allowance must be made for additional space required for sheeting the trench where necessary. Maximum trench width, unless otherwise authorized by the Engineer, as measured at a depth of 2'-0" above the top of the pipe shall be 18" clearance on each side of the pipe.

5. Sheeting, Bracing Trenches, and Trench Boxes:

If necessary, the Contractor will be required to keep the sides of the excavation vertical by sheeting and/or bracing or the use of a trench box to prevent movement by slides or settling of the sides of the trench, in such manner as the Engineer may direct to prevent injury or displacement of the pipe or appurtenances or diminish the working space required at the sides of the pipe. Also, the Contractor may be required as directed by the Engineer for the purpose of preventing injury to persons or property or adjacent structures in place or to be constructed, to leave sheeting and bracing in place.

6. No sheeting or bracing shall extend closer than 2'-0" off the ground surface, or within subgrade, and no timbers shall be left in the trench that may form pockets or cavities that cannot easily be filled during the operation of backfilling and settling or compacting the trench backfill. It is understood that the Owner will be under no obligation to pay for sheeting or bracing left in place by the Contractor. Failure to sheet and brace trenches or other excavation shall be the Contractor's risk, and he will be held responsible for caving, settlement, and all other damage resulting therefrom. If the Engineer is of the opinion, that at any point, sufficient or proper supports have not been provided, he may order additional supports put in at the Contractor's expense, but compliance with such orders shall not release the Contractor from responsibility for the sufficiency of such supports.

7. Excavated materials to be used for backfill will be approved by the Engineer, and if acceptable shall be neatly deposited at the sides of the trenches where space is available. Where stockpiling of excavated material is required, the Contractor shall so maintain his operations as to provide for natural drainage and not present an unsightly appearance.

B. INSTALLING VALVES AND APPURTENANCES

1. Thrust Blocks:

- a. All plugs, caps, tees, bends, reducers and other fittings shall be provided with adequate thrust blocks. Thrust blocks shall be constructed to the minimum dimensions shown on the drawings or as directed by the Engineer. Thrust blocks shall be made of concrete having a compressive strength of 28 days of 4000 psi and shall bear directly against the undisturbed trench wall. Where possible, the backing shall be so placed that the fitting joints will be accessible for repair. All bolts and pipe joints shall be protected against contact with thrust block concrete by the installation of a polyethylene film placed between the fittings and the poured concrete. Where any section of a main is provided with concrete thrust blocks, the hydrostatic pressure test shall not be made until three days after installation of the concrete thrust blocks unless otherwise approved by the Engineer. Where trench conditions are, in the opinion of the Engineer, unsuitable for thrust blocks, the Contractor shall provide steel tie rods and socket clamps to adequately anchor the piping. All tie rods and clamps shall be given a bituminous protective coating or shall be galvanized.
- b. Concrete for thrust blocks shall consist of a mix of Portland Cement, Fine Coarse aggregate and water to produce concrete with a minimum compressive strength at 28 days of not less than 4000 psi when tested in accordance with ASTM C39 or C42. Sakrete or any similar material will not be permitted under any circumstances.

2. Valves:

Before setting each valve, the Contractor shall make sure the interior is clean and test opening and closing. Valves shall be set with stems plumb, unless horizontal installation is called for on the plans, and at the exact locations shown. Trench backfill shall be tamped thoroughly for a distance of 3'-0" on each side of valves boxes.

3. Valve Boxes:

A valve box shall be installed over each underground valve. All boxes shall be set plumb with their top flush with finished grade.

4. Fire Hydrant:

Fire hydrants shall be located as shown. Each hydrant shall be connected to the main with a 6" branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with the pumper nozzle facing the roadway and with the center of the lowest outlet not less than 18" above the finished grade. Hydrants shall be thoroughly blocked with concrete or shall be rodded to the 6" branch tee. Unless otherwise specified, the backfill around hydrants shall be thoroughly compacted to the final grade immediately after installation in order to put the hydrant into service as soon as practicable. Not less than seven (7) cubic feet of clean crushed stone shall be placed around the base of the hydrant to insure drainage of the hydrant barrel. A cap block shall be set under the fire hydrant foot for a solid bottom.

5. Air Relief Valves:

Each air relief valve shall be installed at the exact location shown in a plastic meter box with cast iron lid.

6. Jumper:

A backflow prevention and testing device or a "jumper" is required at all potable water tie-in while water main extension is under construction per CDC detail.

C. BACKFILLING AND COMPACTION

1. Backfill trenches immediately after approval of the pipeline construction.

2. Roadways and Road Crossings:

Use select backfill placed in uniform layers not exceeding 6" in thickness for full trench depth and width, thoroughly compacted with mechanical tampers under optimum moisture conditions to 95% compaction (98% for the top 24" of subgrade beneath pavements). Replace removed paving and base course with new material of equal or better quality and of the same texture and color as the adjacent roadway.

3. All backfill shall be compacted so as not to damage the pipe and appurtenances and shall be compacted to 95% of the Standard Proctor Test (98% for the top 24" of subgrade beneath pavements) for the various types of backfill material. Methods of backfilling shall be in strict accordance with the pipe manufacturer's recommendations. All backfill material shall have been approved by the Engineer. Select backfill material shall be used when requested by the Engineer.

4. Care shall be taken during backfill and compaction operations to maintain alignment and prevent damage to the joints. The backfill shall be kept free from stones, frozen lumps, chunks of highly plastic clay, or other objectionable material. All pipe backfill areas shall be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill.
5. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a minimum cover as required by the plans. Where any part of the required cover is above the proposed finish grade, the Contractor shall place, maintain, and finally remove such material at no cost to the Owner. Pipe which becomes mis-aligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations, shall be removed and replaced by the Contractor at no cost to the Owner.
6. The Contractor shall maintain all pipes installed in a condition that they will function continuously from the time the pipe is installed until the project is accepted.
7. Cleanup:

Grade all areas disturbed to a finish ordinarily obtained from a blade grader with no abrupt changes in grade or irregularities that will hold water. Prior to final inspection and acceptance, remove all rubbish and excess material and leave area in a neat, satisfactory condition.

3.02 QUALITY CONTROL

A. TESTING

Testing of valves and appurtenances shall be incidental to the testing of the water lines, and shall be performed as part of that testing.

END OF SECTION

SECTION 33 12 13

DOMESTIC WATER SERVICE CONNECTION

PART 1: GENERAL

1.01 SCOPE OF WORK

The work covered under this section shall consist of furnishing all materials, labor, equipment and services for the complete installation of a domestic water service connection from the water main line to the property to be served.

PART 2: PRODUCTS

2.01 MATERIALS

- A. The service line shall be constructed of Type "K" flexible copper tubing.
- B. Corporation stops shall be constructed of brass.
- C. Meter box shall be of round style and made of Polyvinyl Chloride Plastic with a minimum wall thickness of .375". Meter box shall be sized to accept a 5/8" water meter and shall have a minimum inside diameter of 18" with a 30" depth. Meter box shall have a non-locking cast iron lid.
- D. The inlet and outlet pipes that pass through the box wall shall be brass and shall be locked in place with brass hex nuts on straight external pipe threads. The inlet and outlet of these nipples shall have external tapered pipe threads and shall be protected by Polyethylene Cap Plugs. An In-Line quarter turn shut off valve with internal tapered pipe thread inlet and water meter coupling outlet shall be used upstream of the water meter. The valves shall be soft seating with a padlock wing. The valves internal components shall be removable from the top of the valve body. An In-Line Dual Check Valve with independent acting checks shall be used downstream of the water meter. The check valve shall have a meter coupling inlet and shall be contained inside the box. The internal parts of the check valve shall be removable without disconnecting the check valve the outlet piping. All brass materials used in contact with the water shall have a minimum copper content of 80% and a maximum zinc content of 10%.
- E. All domestic water services and connections shall conform to current local municipality standards and specifications.

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22-24232-01A

PART 3: EXECUTION

3.01 INSTALLATION

- A. The standard service connection shall connect to the main at a brass corporation stop tapped to the main line.
- B. The water service line shall be constructed of Type "K" flexible copper tubing placed at a depth providing a minimum cover of 3'-0".
- C. The meter box unit shall be a complete unit with all pipe nipples, valves, yoke, and bottom installed and connected prior to delivery.
- D. Meters shall be provided and installed by the local municipality. Meters shall be furnished as specified on the drawings.

3.02 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

END OF SECTION

SECTION 33 31 00

SANITARY SEWER PIPE AND APPURTENANCES

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, equipment, materials and incidentals necessary to install and complete the sanitary sewer installation in accordance with the plans. All pipe and appurtenance material shall be of the type and class specified herein.
- B. All sewer pipe exaction, bedding, pipe laying, jointing and coupling of pipe joints and backfilling shall be completed as described herein

1.02 SUBMITTALS

- A. The Contractor shall provide six (6) copies of shop drawings or submittals for the following:
 - 1. All sizes and types of pipe on the project.
 - 2. Pipe fittings and couplings.
 - 3. All valves, valve boxes, manholes, manhole frames and covers, air relief valves or any other required for completion of the project.

1.03 DELIVERY, STORAGE AND HANDLING

The Contractor shall unload pipe and appurtenances so as to avoid deformation or other injury thereto. Pipe shall not be placed within pipe of a larger size and shall not be rolled or dragged over gravel or rock during handling. The Contractor shall store the pipe and appurtenances on sills above storm drainage level and deliver for laying after the trench is excavated. When any material is damaged during transporting, unloading, handling or storing, the undamaged portions may be used as needed, or, if damaged sufficiently, the Engineer will reject the material as being unfit for installation.

1.04 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

PART 2: PRODUCTS

2.01 GENERAL

- (a) All sanitary sewers fifteen inches in size and smaller shall be constructed of either Ductile Iron or PVC sewer pipe, at the option of the Contractor unless otherwise specified in the Special Conditions or shown on the plans. Sanitary sewers shall be constructed of ductile iron sewer pipe when shown on the plans. Tunnel liners and casing pipes shall be installed at railroad, street, or highway crossings when shown on the plans.
- (b) All PVC, and ductile iron sewer pipe and fittings shall be suitably marked at their places of manufacture to show their class, strength, or thickness, as applicable.

2.02 PVC Pipe

Poly-Vinyl Chloride (PVC) sewer pipe and fittings shall conform to the requirements of ASTM Specification D 3034. Wall thickness shall be SDR 35. Joints shall be integral bell and spigot type with compression type rubber gaskets. Joints shall conform to ASTM specifications D-3212. Couplings for PVC pipe to PVC pipe shall be PVC "Closure" or "Stop" couplings and shall meet ASTM D 3034. Couplings for PVC pipe to Ductile iron pipe shall be as manufactured by Fernco, Indiana Seal, Grainger or equal.

2.03 Ductile Iron Pipe

- (a) Ductile iron pipe shall conform to the requirements of ANSI Specification A21.51. The pipe class, bedding, and loading shall comply with Municipality details. When loading conditions are beyond those shown, the Engineer will submit design computations to the AHJ. The pipe class shall be as shown on the plans. Bedding shall be as shown on the trench details. Joints shall be "push-on" which conform to the requirements of ANSI Specification A21.11. Ductile iron fittings shall conform to the requirements of ANSI Specification A21.10, Class 350 in sizes 24 inches and smaller and Class 250 in sizes larger than 24 inches. Joints for fittings shall be mechanical joints conforming to the requirements of ANSI Specification A21.11. All ductile iron pipe and fittings shall have a cement mortar lining of standard thickness conforming to the requirements of ANSI Specification A21.4. Couplings for Ductile Iron pipe to Ductile Iron pipe shall be Cast iron or Ductile Iron M.J. sleeves.

2.04 Wyes and Services

- (a) Wyes shall be of the same material and strength as the sewers on which they are installed. Saddle type fittings are not acceptable on new construction but may be used for (4") taps on existing sanitary sewer mains of 12 inch or less diameter.

For taps on Ductile Iron Pipe (16") and larger a style "CB" Romac tapping saddle as manufactured by Romac Industries Inc. or approved equal, may be used in lieu of a wye fitting. House, Multi Family, and Commercial services shall be constructed of four (4) inch diameter pipe. Services shall be schedule 40 PVC, or if required class

350 Ductile Iron Pipe. For taps on existing Municipality PVC or VCP sewer mains, a (4") flexible saddle as manufactured by Fernco, Indiana Seal, Grainger, or equal, is acceptable.

- (b) Wye branches shall be placed in sanitary sewer lines at all points shown on the plans or specified herein. If such branches are not to be used immediately they shall be closed with clay, concrete, or plastic plugs with joints as specified for the sewer pipe.
- (c) Wyes shall be placed in sanitary sewers so as to properly serve each existing house and each vacant lot facing or butting on the street or alley in which the sewer is being laid, and at such other locations as may be designated by the Engineer.
- (d) The Contractor, shall measure the distance to the tap or tee from the downstream manhole to obtain the information required for the "As-Built" records. As-built data shall be marked on the plans and turned over to the Owner at the end of the project. As-built information shall be kept up on a day to day basis and be available for review by Engineer at any time.
- (e) The location of all wyes, cleanouts, and house sewers installed in the work shall be identified on the plans and in the field.

2.05 Pipe Laying

- (a) Before sewer pipe is placed in position in the trench the bottom and sides of the trench shall be carefully prepared and the necessary bracing and sheeting installed. Each pipe shall be accurately placed to the exact line and grade called for on the plans. The Engineer will be notified prior to any installation. Engineer reserves the right to reject any pipe that is installed with out notification.
- (b) Each piece of pipe and special fitting shall be carefully inspected before it is placed and no defective pipe shall be laid in the trench. Pipe laying shall proceed upgrade, starting at the lower end of the grade and with the bells upgrade. Pipe shall be straight when placed in the trench. Curved pipe shall not be laid. Trench bottoms found to be at incorrect grade after pipe laying operations have begun shall be corrected and brought to exact line and grade. Any fill required to bring the trench bottom to grade, shall be pipe foundation material or pipe embedment material as specified herein, as applicable.
- (c) Bell holes shall be of sufficient size to allow ample room for properly making the pipe joints. The bottom of the trench between bell holes shall be carefully graded so that the pipe barrel will rest on a solid foundation for its entire length.
- (d) Each joint shall be laid so that it will form a close concentric joint with adjoining pipe and so as to avoid sudden offsets or inequalities in the flow lines. The inside of all bells and the outside of all spigots shall be wiped to remove all dirt, water, or

other foreign matter. Joint lubricants shall be compatible with the pipe and gasket materials and shall be as recommended by the pipe manufacturer.

- (e) All jointing of pipe and fittings shall be in accordance with the pipe manufacturers recommendations.
- (f) Any leaks or defects discovered at any time after completion of the work shall be repaired immediately. All pipe in place shall be carefully protected from damage until the backfilling operations have been completed. Any pipe which has been disturbed shall be taken up, the joint cleaned and remade and the pipe re-laid at Contractor's expense.
- (g) Water shall not be allowed to run or stand in the trench while pipe laying is in progress or before the joints are completed or before the trench has been backfilled. The Contractor shall not open up at any time more trench than his available pumping facilities are able to dewater.
- (h) As the work progresses the interior of all pipe in place shall be thoroughly cleaned. After each line of pipe has been laid it shall be carefully inspected and all dirt, trash, rags, and other foreign matter removed from the interior. When pipe laying is not in progress (for any period exceeding 4 hours), the contractor shall place a watertight plug in the last section of pipe which has been laid. The Contractor shall install temporary watertight plugs in the proposed sewer line at any manhole that is incomplete, at the open end of the pipeline prior to leaving the job site daily and elsewhere as dictated by good engineering and construction practices. All installed pipe shall be backfilled or otherwise securely tied down to prevent flotation in the event water enters or rises in the trench. The plugs as installed shall prevent infiltration or the introduction of any foreign material into either the existing or proposed systems. Upon completion of all construction, the Contractor will be responsible for the complete removal of all watertight plugs.
- (i) Backfilling of trenches shall be started immediately after the pipe is in place and the joints completed.

3.00 Deflection Tests

- (a) After backfilling trenches all sewer pipes shall be lamped and visually inspected for pipe alignment by Engineer or Engineer representative. Each run of pipe must present a full circle when viewed from one of the connected manholes. Any run of pipe which does not present a full circle will be removed and reinstalled.
- (b) After backfilling trenches all PVC sewer pipe shall be tested for initial diametric deflections by the use of a Go-No-Go type mandrel which is acceptable to the Engineer. The initial diametric deflection shall not exceed five percent (5%) of the base inside diameter as defined in ASTM D-3034. Deflection test will be performed after trench is no longer subject to construction traffic loading and a minimum of

thirty (30) days after completion trench backfill. The Engineer will be notified prior to test. Engineer reserves the right to reject any pipe that is tested with out present of Engineer or representative.

Nominal Pipe Size	Pipe I.D. (SDR 35)	Required Mandrel O.D.
8"	7.665"	7.28"
10"	9.563"	9.08"
12"	11.361"	10.79"
15"	13.898"	13.20"

- (c) The mandrel shall be pulled through each section of pipe from manhole to manhole. The mandrel must slide freely through the pipe with only a nominal hand force applied. No mechanical device shall be used in pulling the mandrel. Any pipe which refuses the mandrel shall be removed and replaced. Such sections shall be re-tested for deflection after completion of backfill.
- (d) Mandrel testing may be performed by the AHJ at any time prior to the expiration of the one-year warranty. Any pipe which refuses the mandrel shall be replaced by the contractor as described above.

3.07 **Leakage and Infiltration**

- (a) All pipe and manhole joints shall be as near watertight as it is practicable to construct them with the material and methods specified herein. Any leaks into the sewer shall be repaired or corrected as authorized by the Engineer regardless of infiltration test results. **The AHJ/Owner/ Engineer reserves the rights to TV any section of the sewer system to locate point sources of infiltration, either in the pipe or inside manholes at Contractors expense.** When directed by the Engineer, any desired section shall be isolated and tested separately.
- (b) No sooner than 10 days following completion of backfill, the Contractor along with the Engineer, will be required to determine the level of the ground water table. If the ground water table is above the top of the pipe, the sewer line shall be tested for infiltration. If ground water table is less than 2 feet above the top of the pipe, the sewer line shall be low pressure air tested. Each test shall be as performed as follows:

1. **Infiltration**

The infiltration into each section of the sewer shall be measured in wet weather by the temporary installation of suitable metal or wooden weirs as authorized by the Engineer. These weirs shall be furnished, installed and removed by the Contractor. Infiltration tests limits shall be applied to single reaches of pipe, up to one mile in

length, of the same diameter. For pipes 8" through 15" in diameter, infiltration into the sewer system (including manholes) shall not exceed 50 gallons per mile of sewer per inch of inside diameter of the sewer per 24 hours, and in no case shall it exceed 3,000 gallons per mile per 24 hours. For all pipe sizes larger than 15" in diameter, infiltration into the sewer system (including manholes) shall not exceed 100 gallons per mile of sewer per inch of inside diameter of the sewer per 24 hours, and in no case shall it exceed 3,000 gallons per mile per 24 hours.

2. Air Testing of Gravity Sewers

The Contractor shall conduct low pressure air tests on all completed sections of gravity sewer. Air tests for PVC, DIP, and VCP lines will be performed in accordance with ASTM C828. Air tests for Concrete pipe 24 inches in diameter and smaller shall be performed in accordance with ASTM C924. Air test results will be used to evaluate materials and construction methods on the sewer line sections, and successful air tests shall be mandatory for the acceptance of the sewers 24 inches in diameter and smaller. Contractor shall perform test in presence of Engineer or representative.

- a) Air test will not be required on pipe with diameters exceeding 24 inches. Acceptance of pipes exceeding 24" will be based on infiltration tests and/or visual inspection of the joints.
- b) The Contractor shall furnish an air compressor of the necessary capacity along with all necessary plugs, valves, pressure gages, air hoses, connections, and other equipment necessary to conduct the air tests. Plugs in sewers 18 inches in size and larger shall be connected by steel cable for thrust reaction.
- c) Compressor capacity shall be sufficient to pressurize the sewer main to 4 PSIG within a time equal to or less than the required test time. The following equation may be used to insure compliance with this requirement:

$$C = \frac{0.17 \times D^2 \times L}{T} + Q$$

Where: C = Required Compressor Capacity (cfm)

T = Required Test Time (min) L = Length of Test Section (feet)

D = Pipe Internal Diameter (feet) Q = Allowable Air Loss Rate (cfm)

- d) The following allowable air loss rates will be used for all pipe tests:

<u>Pipe Size</u>	<u>Q (cfm)</u>	<u>Pipe Size</u>	<u>Q (cfm)</u>
4"	2.0	15"	4.0
6"	2.0	18"	5.0
8"	2.0	21"	5.5
10"	2.5	24"	6.0
12"	3.0		

- e) The sewer section shall be plugged at both ends and air pressure shall be

applied until the pressure inside the pipe reaches 4 PSIG. When a stable condition has been reached, the pressure shall be bled back to 3.5 PSIG. At 3.5 PSIG, the time and pressure shall be observed and recorded. If groundwater is present at the sewer, the height of groundwater above the top of the pipe shall be added to the above air pressure readings (height of water in feet X 0.433 = air pressure in PSIG). A minimum of 5 readings will be required for each test.

- f) If the time for the air pressure to decrease from 3.5 PSIG to 2.5 PSIG is equal to or greater than that shown in the following table, the pipe shall be presumed to be free from defect. When these times are not attained, pipe breakage, joint leakage, or leaking plugs are indicated and the cause must be determined and corrected. After repairs have been made, the sewer sections shall be retested. This process shall be repeated until all sewer sections pass the air test.

		<u>Minimum Test Times for Pipe</u>								
Pipe-Size →		4"	6"	8"	10"	12"	15"	18"	21"	24"
↑	25	0:04	0:10	0:17	0:22	0:26	0:31	0:36	0:44	0:53
	50	0:09	0:20	0:35	0:44	0:53	1:02	1:12	1:29	1:47
	75	0:13	0:30	0:53	1:06	1:20	1:34	1:48	2:14	2:40
	100	0:17	0:40	1:11	1:29	1:47	2:05	2:24	2:58	3:33
L E N G T H	125	0:22	0:50	1:29	1:51	2:13	2:36	3:00	3:43	4:27
	150	0:26	1:00	1:47	2:13	2:40	3:07	3:36	4:27	5:20
	175	0:31	1:10	2:04	2:35	3:07	3:39	4:12	5:12	6:14
	200	0:35	1:20	2:22	2:58	3:33	4:10	4:48	5:57	7:07
O F	225	0:40	1:30	2:40	3:20	4:00	4:41	5:24	6:41	8:00
	250	0:44	1:40	2:58	3:42	4:27	5:13	6:00	7:26	8:54
	275	0:49	1:50	3:16	4:05	4:53	5:44	6:36	8:10	9:47
	300	0:53	2:00	3:33	4:27	5:20	6:15	7:12	8:55	10:41
P I P E	325	0:58	2:10	3:51	4:49	5:47	6:47	7:48	9:40	11:34
	350	1:02	2:20	4:09	4:11	6:14	7:18	8:25	10:24	12:28
	375	1:06	2:30	4:27	5:34	6:40	7:49	9:01	11:09	13:21
	400	1:11	2:40	4:45	5:56	7:07	8:21	9:37	11:54	14:14
T E S T E D	425	1:15	2:50	5:02	6:18	7:34	8:52	10:13	12:38	15:08
	450	1:20	3:00	5:20	6:40	8:00	9:23	10:49	13:23	16:01
	475	1:24	3:10	5:38	7:03	8:27	9:54	11:25	14:07	16:55
	500	1:29	3:20	5:56	7:25	8:54	10:26	12:01	14:52	17:48
↓	525	1:33	3:30	6:14	7:47	9:21	10:57	12:37	15:37	18:42
	550	1:38	3:40	6:31	8:09	9:47	11:28	13:13	16:21	19:35
	575	1:42	3:50	6:49	8:32	10:14	11:60	13:49	17:06	20:28
	600	1:47	4:00	7:07	8:54	10:41	12:31	14:25	17:51	21:22

- g) For testing a sewer system with one or more installed service lateral pipes, an effective pipe length shall be added to the total sewer main pipe length. The equation used to calculate Effective Pipe Length is as follows:

$$L_e = \frac{d^2 \times l}{D^2}$$

Where: L_e = Effective Pipe Length (added to Total Test Length)
 d = Diameter of Service Lateral Pipe (inches)
 l = Length of Sewer Lateral (feet)
 D = Diameter of Sewer Main Pipe being tested (inches)

4.08 Manholes

(a) General

- (1) Manholes shall be constructed to the sizes, shapes and dimensions and at the locations shown on the plans. Unless otherwise shown on the plans, manholes shall be as follows:

8" to 18" pipe	4' diameter	5" thick walls
21" to 36" pipe	5' diameter	5" thick walls
39" to 54" pipe	6' diameter	6" thick walls
54" and larger	8' diameter	8" thick walls

- (2) The height or depth of each manhole will vary with the location, but it shall be such as will place the top at the finished grade of the pavement or ground surface or to the elevations shown on the plans and the invert at the elevation shown on the plans. The number of joints shall be minimized. No riser sections for manholes up to six feet (6') tall and no more than 1 riser for each additional 4 feet in height. One additional section will be allowed for transition manholes.

(b) Drop Manholes

Drop Manholes shall be similar in construction to the standard manhole except that a drop connection of pipe and fittings of the proper size and material shall be constructed outside the manhole and supported by Class B concrete as indicated on the plans.

(c) Manhole Construction

- (1) Manholes shall be composed of precast reinforced components with tongue and groove joints. Manholes shall conform to the requirements of ASTM Specification C478, except as modified herein.

- (2) Concrete: Concrete shall conform to ASTM C478 and as follows:

Compressive strength: 5,000 psi minimum at 28 days.

Air Content: 5 - 7 %

Alkalinity: Adequate to provide a Life Factor, Az = Calcium Carbonate
Equivalent times Cover over Reinforcement, no less than 0.35
for bases, risers and cones.

Cementitious Materials: Minimum of 564 pounds per cubic yard

Coarse Aggregates: ASTM C33. Sound, Crushed, Angular Granitic Stone only. Smooth or
rounded stone shall not be used. Free from organic impurities.

Chemical Admixtures: ASTM C494. Calcium Chloride or admixtures
(if used) containing calcium chloride shall not be used.

Air Entraining Admixtures (if used): ASTM C260.

Absorption shall not exceed six (6) percent.

- (3) Reinforcing: Reinforcing steel shall be ASTM A615 grade 60 deformed bar, ASTM A82 wire
or ASTM A185 welded wire fabric.
- (4) Lifting Loops: Lift loops shall be ASTM A416 steel strand. Lifting loops made from
deformed bars shall not be allowed.
- (5) Wall Thickness: The minimum wall thickness of the manhole riser sections shall be as
shown in the table above. Cone sections shall have a minimum wall thickness of eight (8)
inches at their top. The minimum thickness of the bottom shall be six (6) inches for manholes
four (4) feet in diameter and eight (8) inches for all sizes greater than four (4) feet in diameter.
Suitable openings for inlet and outlet sewer pipe shall be cast or cored into the base sections
and into riser sections for drop connections. These openings shall be circular, accurately
made, and located as required for each manhole.

(d) Manhole Components

- (1) Precast Manufacturing: Precast components shall be manufactured in conformance with
ASTM C478. Wall and inside slab finishes resulting from casting against forms standard for
the industry shall be acceptable. Exterior slab surfaces shall have a float finish. Small surface
holes, normal color variations, normal form joint marks, and minor depressions, chips and
spalls will be tolerated. Dimensional tolerances shall be those set forth in the appropriate
references and specified below.
- (2) Certification: Precast manufacturer shall manufacture all precast components with one or
more of the following testing methods.

be used only for Shallow Manholes.

- (6) Precast Transition Cone Sections: Transition Cone Sections shall provide an eccentric transition from 60 inch and larger manholes to 48-inch diameter risers, cones and flat slab top sections. The minimum slope angle for the cone wall shall be 45 degrees. A minimum of (6') height is required between the bench
- (7) Precast Transition Top Sections: Transition Top Section shall provide an eccentric transition from 60 inch and larger manholes to 48" diameter risers, cones, and flat slab top sections. Transition Top sections shall be furnished with vents as shown on the manhole details. The maximum amount of fill over the transition top section shall be 20 feet. Transition tops shall not be used in areas subject to vehicle traffic.
- (8) Precast Flat Slab Top Sections: Standard Flat Slab Top Sections shall have an access opening with an inside diameter at the top of no less than 24" and no more than 26" and shall be designed for HS-20 traffic loadings as defined in ASTM C890. Items to be cast into Special Flat Slab Tops shall be sized to fit within the manhole ID and the top and bottom surfaces.
- (9) Precast Grade Rings and Brick: Precast Grade Rings or Brick shall be used to adjust ring and covers to finished grade. No more than 12 vertical inches of grade rings or brick will be allowed per manhole. Grade Rings shall conform to ASTM C478 and shall be no less than 4" in height. All brick used shall be solid shall be made from Concrete, Clay, or Shale and shall be of standard building size.
- (10) Steps: Provide steps in Bases, Risers, Cones, Transition Cones, and Transition Top sections aligned vertically on 12" or 16" centers. Secure steps to the wall with a compression fit in tapered holes. Steps shall not be vibrated or driven into freshly cast concrete. Steps shall not be grouted in place. The steps shall be a Copolymer Polypropylene Plastic reinforced with a 1/2" diameter grade 60 bar and have serrated tread and tall end lugs. Step pullout strength shall be a minimum of 2000 lbs when tested according to ASTM C497. The minimum width shall be 12 inches. Rubber or plastic covered steel steps shall be as manufactured by Delta Pipe Products Co., M. A. Industries, Inc., American Step Company Inc., or equal. All manhole steps shall comply with the requirements of OSHA.
- (11) Lifting Devices: Lifting devices complying with OSHA Standard 1926.704 for handling the Precast Components shall be provided by the Precast Manufacturer.
- (12) Coatings: Where shown on the plans, the interior/exterior of the manhole walls shall be coated with 21 mils of Coal Tar Epoxy, Koppers 300M,

Sherman Williams or equal. The coating shall be spray applied according to the manufacturer's recommendations by an applicator with a minimum of 5 years experience. The joints between precast sections shall not be coated. Use butyl rubber rope as specified above to seal the interior horizontal joint surface.

- (13) Joint Sealing Materials: Joints shall be sealed by **TWO** Seals. Each seal shall be as described in one of the following paragraphs:

- (a) Internal Butyl Rubber Rope(s) - Internal Butyl Seal(s) shall consist of a plastic or paper-backed butyl rubber rope no less than 14 feet long and no less than 1" in diameter. When manholes are larger than 4' diameter or have a larger than normal space between the joints the length and or diameter of the rope shall be increased as required to achieve a seal. Butyl Rubber Material: Butyl rubber shall conform to Federal Specification SS-S210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1% volatile matter and suitable for application temperatures between 10 and 100 degrees F. Butyl Rubber shall be applied to clean, dry surfaces only. Use of two (2) independent wraps of Butyl Rubber qualifies for the requirement of two seals.
- (b) Internal O-Ring Gasket - Internal O-Ring Gasket shall conform to ASTM C443, and be installed according to the Precast Manufacturer's recommendation.
- (c) Internal Rubber Gasket - Internal Rubber Gasket shall conform to ASTM C361, and be installed according to the Precast Manufacturer's recommendation. Internal Rubber Gasket shall be F114 Manhole Gasket as manufactured by Forsheda Pipe Seal Corp., Ridder flex, McMaster-Carr or preapproved equal.

- (e) Manhole Sleeves and Entrance Joints

- (1) Flexible manhole sleeves or flexible manhole entrance joints shall be installed on all pipe entering and leaving precast manholes. Manhole openings shall be accurately core drilled or cast in place. Sleeve and Joint material shall be of high quality synthetic rubber which complies with the requirements of ASTM Specification C 923. Sleeve hardware (clamps, bands, straps, draw bolts, nuts, etc.) shall be stainless steel and make a watertight union. Sleeves shall be Kor-N-Seal I, Kor-N-Seal II, or Contour Seal, as manufactured by National Pollution Control Systems, Inc., flexible connectors model 72, 73, 74, 107, 117, 126, 127, 128, 1610, or 1612 as manufactured by EPCO, or shall be as manufactured by Lock Joint a subsidiary of Gifford-Hill-American, Inc. or comparable sleeves as manufactured by the Press Seal Gasket Corporation; or equal. Flexible manhole entrance joints shall be cast into the wall of the manhole base to form a tight waterstop. Joints shall be watertight under a 30-foot head of water. Flexible manhole entrance joints shall be A-LOK Joints as

manufactured by the A-LOK Products Corp., Press Wedge II as manufactured by the Press Seal Gasket Corp., or equal. Flexible manhole sleeves and flexible manhole entrance joints shall be installed in accordance with instructions of their manufacturer. Installation on steep grades may require pipe openings cast or cored with a vertical angle. Alternative entrance joint connections must be approved by Municipality prior to construction.

(f) Placing Manhole Sections

The Contractor shall excavate to the required depth and remove materials that are unstable or unsuitable for a good foundation. Prepare a level, compacted foundation extending 6-inches beyond the manhole base.

The base shall be set plumb and level, aligning manhole invert with pipe invert.

Thoroughly clean bells and spigots to remove dirt and other foreign materials that may prevent sealing. Unroll the Butyl Sealant rope directly against base of spigot. Leave protective wrapper attached until sealant is entirely unrolled against spigot. Do not stretch. Overlap from side to side - not top to bottom. For rubber gaskets follow manufacturer's recommendations for installation.

Risers and cones shall be set so that steps align, taking particular care to clean, prepare and seal joints.

(g) Manhole Final Finishing

After placement of manhole frame and vacuum testing, perform the final finishing to the manhole interior by filling all chips or fractures greater than 1/2" in length, width or depth (1/8" deep in inverts) with non-shrink grout. Grout the interior joints between the precast concrete sections with non-shrink grout. When manhole cone top opening is less than manhole frame base inside flange diameter, cone top shall be chamfered or grouted to prevent injury on sharp edges. Shaper edges or rough finishes shall be removed providing a smooth surface throughout the manhole. Clean the interior of the manhole, removing all dirt, spills, or other foreign matter.

(h) Connection to Existing Manholes

- (1) Any connection with 16-inch and smaller pipe at an existing precast or cast-in place manhole will require the Contractor to core the necessary opening through the manhole wall and install a flexible manhole to pipe connector. Connector shall be as specified elsewhere. Connections to existing brick manholes do not required coring and an opening may be carefully hammered or sawed. Connections to existing manholes with 18-inch and larger pipe may be cored or sawed as approved by the Engineer. When noted on the plans or directed in writing by the AHJ, a connection to an existing manhole may be made without

using flexible pipe connectors.

Whenever a connection is made without a flexible pipe connector, it shall utilize non-shrink grout and a brick and mortar collar. The existing manhole bench and invert shall be repaired as specified under manhole materials and installation.

(i) Manhole Inverts

- (1) Manhole inverts shall be constructed of brick and cement grout or precast concrete and shall have a "U" shaped cross section of the same diameter as the invert of the sewers which they connect. "U" shaped inverts shall be constructed to a minimum depth of 6" for 8" sewers (unless full depth is required in Special Conditions) and to full pipe diameter depth of the outlet sewer main for larger mains. The manhole invert shall be carefully formed to the required size and grade by gradual and even changes in sections. Changes in direction of flow through the sewer, whether horizontal or vertical, shall be made with true tangent curve(s) with as large a radius as the size of the manhole will permit. Manhole benches shall slope a minimum of 2" to the lip of the "U" shaped invert. Provide a 1/2" radius at the intersection of 2 or more channels. The minimum concrete thickness in the invert of the channel shall be 2-inches, not including the manhole base thickness.
- (2) When the fall between the inlet and the outlet holes is not available from precast company, the contractor shall construct the invert using 4000 PSI concrete or non shrink grout. Non shrink grout (minimum 2" thickness on invert channel and on bench) may be plastered over layered brick and mortar in lieu of solid non shrink grout invert.
- (3) Inverts shall meet the following additional requirements:

Pipe Openings: Pipe openings shall provide clearance for pipe projecting a minimum of 2" inside the manhole. The crown of small I.D. pipe shall be no lower than the crown of the outlet pipe.

Trough: The fall across the manhole invert shall be as noted on the plans.

Bench: Float finish benches to provide a uniform slope from the high point at the manhole wall to the low point at invert trough. Provide a radius (1/8" to 1" range is acceptable) at the edge of the bench and trough.

Gradual smooth sided depressions and high spots shall be allowed so long as diameter of invert channel ranges from 1/4" less than or 1/2" more than the nominal pipe diameter are maintained. Voids, chips, or fractures over 1/8 inch in diameter or depth shall be filled with a non-shrink grout and finished to a texture reasonably consistent with the bench surface.

(j) Manhole Frame and Cover Construction

- (1) Manhole frames and covers shall be made of cast iron conforming to the minimum requirements of ASTM Specification A48, Class 35B. All castings shall be made accurately to the required dimensions and shall be sound, smooth, clean and free from blisters and other defects. Defective castings which have been plugged or otherwise treated shall be rejected. The contact surfaces between the cover and its corresponding supporting ring in the frame shall be machined so that the cover will rest on the ring for the full perimeter of the contact surfaces.
- (2) All frames and covers shall comply with AASHTO HS20 loading requirements. When a frame is designated as not for use in pavement applications ("N") a reduced height traffic bearing frame may be used in lieu of the standard frame for the purpose of adjusting grade. All manhole frames shall be equipped to accept a cam-lock cover. However, only those frame & covers designated on the plans as watertight ("W") or lock down ("L") shall have covers equipped with cam-locks. When cam-locks are required, covers shall be furnished with two stainless steel, pentagon headed cam-locks. Frames and covers designated as watertight ("W"), shall have a cover equipped with a one-piece gasket permanently attached in a groove in the manhole cover. An o-ring gasket may be placed in a dove tailed groove in the bottom of the cover if cam-lock feature provides sufficient pressure to prevent cover movement and subsequent wear of gasket. Otherwise gasket shall be double edged and placed in a groove in the side of the manhole cover.
- (3) All covers shall have two 5/8-inch diameter lifting bars set into the cover to allow for lifting by a chain hoist. There shall be no holes or perforations in covers. For models other than those listed as preapproved, the manufacturer's shop drawings shall be sent to the Engineer for review and acceptance by AHJ prior to manufacturing and shipping of castings to the job site.
- (4) Pre-approved Heavy Duty Standard Frames include:

USF 577 Ring (with tooling for Bi-Loc Cover) as manufactured by U.S. Foundry & Mfg. Corp.

MH-RCR-3000 series (with tooling for Cam-locks) as manufactured by Dewey Brothers, Inc.

1045Z1-1040AGS (with cam-lock ramp) as manufactured by East Jordan Iron Works, Inc.
- (5) Pre-approved Reduced Height Frames include model:

MH-RCR-3000SR series (with tooling for Cam-locks) as manufactured by

Dewey Brothers, Inc.

1046Z1 (with cam-lock ramp) as manufactured by East Jordan Iron Works, Inc.

B-1602 Series (with cam-lock ramp) as manufactured by Barry Pattern & Foundry

(6) **Manhole Frame Placement**

After the manhole has been set in its final position, set the manhole frames to the required elevation using no more than 12-inches of precast concrete grade rings, or bricks (maximum three layers) sealing all joints between cone, adjusting rings, and manhole frame. When grade rings are used apply a 2" X 1/4" strip of butyl between the rings, the frame, and the cone. When bricks are used, grout with Cement mortar. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted so as to conform to the exact slope, crown and grade of the existing pavement adjacent thereto. Manhole Frames which are placed above final grade will have frames attached to manhole cone section by means of a minimum of three symmetrically placed 1/2-inch diameter stainless steel anchors and stainless steel washers or shall have frames recast into the manhole cone or slab by a District approved process.

(k) **Manhole Submittal Data**

- (1) Drawings and descriptive data on manholes, (including wall thicknesses, vertical dimensions, and deflection angles), concrete used in manufacture of manholes and precast inverts, rubber gaskets, joint sealant, flexible manhole sleeves and joints, frames and covers, inverts, and manhole steps shall be submitted to the Engineer for review prior to their manufacture.

(l) **Manhole Delivery, Storage, and Handling**

- (1) The Contractor shall coordinate delivery with the manufacturer, handle and store the Manhole Components in accordance with the ASTM C891 and the manufacturer's recommendations using methods that will prevent damage to the components and their joint surfaces.

(m) **Grouts**

- (1) All grouts used on manhole interiors shall be "non-shrink" grouts, and Grout used on manhole exteriors shall be either "non-shrink" or standard cement mortar grouts, as specified in Item II, Concrete, of the specifications.

2.09 Vacuum Testing of Manholes

- (a) The requirement for vacuum testing will be per engineer's decision on a case by case basis; if testing required it will follow the guidelines below: Contractor shall perform test in presence of Engineer or representative.
- (b) Vacuum testing of manholes shall be required on no less than ten percent of the manholes installed. In addition, no less than five (5) manholes will be tested. The AHJ will select which manholes shall be tested after construction. Vacuum Testing each manhole prior to backfilling is recommended as most repairs must be made on the manhole exterior. Vacuum testing is not required on manholes with pipe connections in excess of 30" diameter.
- (c) Vacuum test the assembled manhole after completing pipe connections and sealing. The vacuum test shall be as follows:
 - (1) Plug pipes with suitably sized and rated pneumatic or mechanical pipeline plugs. Place plugs a minimum of 6" beyond the manhole wall and brace to prevent displacement of the plugs or pipes during testing.
 - (2) Position the vacuum tester head assembly to seal against the interior surface of the top of the cone section and inflate according to the manufacturer's recommendations.
 - (3) Draw a vacuum of 10" of mercury, close the valve on the vacuum line and shut off the vacuum pump.
 - (4) Measure the time for the vacuum to drop to 9" of mercury. The manhole shall pass when the time to drop to 9" of mercury meets or exceeds the following:

Manhole I.D. (inches)	48	60	72	84	96	120	
Time (seconds)		60	75	90	105	120	150
 - (5) If the manhole fails the test, remove the head assembly and coat the manhole interior with a soap and water solution and repeat the vacuum test for approximately 30 seconds. Leaking areas will have soapy bubbles. Make the necessary repairs and repeat the test until the manhole passes.

5.00 Existing Utilities and Separation Requirements

- (a) The Contractor will be required to excavate to determine the precise location of utilities, or other underground obstructions, which are shown on the Construction Plans. Such location and excavation shall be at least 500 feet ahead of construction or as noted in the Special Conditions Section of this document.
- (b) All utility owners will be notified prior to excavation as required by the 1985 Underground Damage Prevention Act. Contractor to coordinate with local

ONCCALL utility location before any excavation or drilling. The Contractor will be fully responsible for damage to any utilities if the owners have not been properly notified as required by the Underground Damage Prevention Act. All damage to such structures and pipelines and all damage to property or persons resulting from damage to such structures and pipelines shall be borne by the Contractor and shall be completely repaired within a reasonable time. No claim shall be made against the AHJ for damage or delay of the work on account of the proximity of, or the leakage from, such structures and pipelines. Where high pressure gas lines are to be crossed, they shall be uncovered by hand excavation methods before other excavation near them is started.

- (c) Utility owners may, at their option, have representatives present to supervise excavation in the vicinity of their utilities. The cost of such supervision, if any, shall be borne by the Contractor.
- (d) Conflicts with underground utilities may necessitate changes in alignment and/or grade of this construction. All such changes will be approved by the Engineer before construction proceeds.
- (e) When underground obstructions not shown on the Construction Plans are encountered, the Contractor shall promptly report the conflict to the Engineer and shall not proceed with construction until the conflict is resolved.
- (f) When a sewer main or lateral crosses an existing water main or other utility, the Contractor shall make the installation in accordance with the minimum specifications of AHJ and in accordance with the following minimum requirements. When a sewer main or lateral crosses or parallels an existing utility, the following clearance requirements are to be met or ferrous sewer pipe with water tight joints shall be used for a distance of ten feet outside said point of crossing or until horizontal separation requirements are achieved.

(1) Min. Vertical Separation for Sewer Crossings:

Storm Sewers -	12" Vertical
Under Water -	18" Vertical
Over Water -	18" Vertical * Sewer over water requires that both pipes shall be ferrous pipe with a 20 foot jointless span centered at crossing. *
Cable -	24" Vertical
Power -	24" Vertical
Gas -	24" Vertical

(2) Horizontal Separations:

Storm Sewers -	5'
Water Mains -	10'
Water Supply -	100' (AS-I Waters, Class I or Class II impounded)

Water Supply -	50' (WS-I, WS-II, WS-III, B, SA, or SB Waters – Natural High Water)
Designated Trout Streams -	25'
Other Stream, Lake or Impoundment -	10'
Building Foundation -	5'
Basement -	10'
Ground Water Lowering and Surface Drainage Ditch	10'
Swimming Pool -	10'
Private Wells -	25'
Public Wells -	50'

2.11 Deep Services and Maximum Service Grade

- (a) When the depth of cut is over 8 feet and the grade of a sanitary sewer is lower than necessary to drain abutting property, and at such other locations as may be designated by the Engineer, the contractor will construct service lines at grades of up to 100 percent (45 degrees) and shall use 22 1/2 or 45-degree bends, (at each end of steep service line), to bring the service to within 8 feet of the surface.
- (b) Unless required service depth is noted on construction drawings, the contractor shall contact the Engineer and request confirmation of grade prior to constructing any sewer service line at a depth greater than 8 feet or at a grade in excess of 2 percent slope.

2.12 Tie-ins to Existing Public or Private Collection Systems

- (a) Tie-ins to existing public or private collection systems will be allowed when proper precautions are taken to protect the existing Municipality public collection system. Tie-ins to existing inactivated sewer lines not installed under the same contract will not be allowed without written approval from all parties involved (Municipality, contractors, contract holders, etc.).
- (b) If the proposed sewer does not begin at an existing manhole, a new manhole will be "cut in" at the required location and the existing pipe(s) repaired as specified. For Extensions of the system, the new "cut in" manhole or the connection to the existing manhole will not be constructed until all other sewer construction has been completed and tested in compliance with the specifications. For connection to a private collection system, fittings and cleanouts may be substituted for "cut in" manholes if approved by the owner of the private collection system and Department of Environment Health and Natural Resources.
- (c) Pipelines or manholes which contain silt, sedimentation, or other foreign material shall not be connected to any portion of the existing public collection system or any

private collection system already connected to the AHJ system. The Contractor shall at his own expense flush, or otherwise cause the line (and manholes) to be cleaned out without any discharge into the existing system.

2.13 Flow Interruptions and Bypass Pumping

- (a) When the flow of an existing sewer must be interrupted and/or bypassed, the Contractor shall, before beginning any construction, submit a work schedule which will minimize the interruption and/or bypassing of wastewater flow during construction. This schedule must be approved by the District, the Engineer, and (if appropriate) the owners of the private collection system and may require night, holiday, and/or weekend work.
- (b) If pumping is required, an identical standby pump shall be on site in the event of failure of the primary pump. If, at any time during construction, effluent from the existing sewer is not fully contained by the bypass system, gravity service will be restored by a temporary tie to the new construction and work will be suspended until the problem is resolved to the satisfaction of the Engineer. The Contractor shall be responsible for any fines levied as a result of effluent reaching surface waters. The contractor will be required to verify his method of handling sewer flows during construction by pumping at peak flows for 1 hour as approved by the Engineer.

2.14 Repairs on New Construction

- (a) All leaks shall be repaired by identifying and exposing the defective section of pipe and completing repairs. Chemical grouting or internal or external wiping of joints with cement grout are specifically not approved as methods for repairing leaks on new pipelines, regardless of the pipe material approved Methods of Repair as follows:
- (b) VCP: Defective pipe sections, including leaking joints, shall be removed and replaced with sound new pipe. The pipe shall be re-connected with approved couplings.
- (c) PVC or DUCTILE IRON: Defective or damaged pipe shall be removed and replaced with sound new pipe. The pipe shall be re-connected with approved couplings. Joint leaks may be repaired with bell clamps specifically approved by the Engineer.
- (d) RCP: Defective or damaged pipe shall be removed and replaced with sound new pipe. The pipe shall be re-connected with concrete collars or approved couplings. Joint leaks may be repaired with bell clamps specifically approved by the Engineer. Concrete collars or repair couplings shall be limited to one every 100 feet not to exceed three pipe repairs between manholes. Deficiencies in excess of these limitations shall be corrected by relaying the section of pipe.
- (e) Manholes: Defective or damaged manhole components shall be removed and

replaced with sound new components unless repairs are approved by the AHJ.

- (1) Leaks through the manhole joints or walls or around pipe collars, may be repaired with non-shrink grout applied (internally if approved by the AHJ), otherwise externally.
- (2) Leaks around boots or gaskets used to join pipe to manholes shall be repaired as recommended by the manufacturer. In the absence of specific recommendations, such leaks shall be repaired by internal grouting with non-shrink grout or external concrete collars as directed by the Engineer.
- (3) Lift Holes leaving less than 2" of wall thickness shall be plugged from the outside using non-shrink grout. Penetrating lift Holes shall be plugged from the inside and outside using non-shrink grout.

2.15 Abandonment of Existing Sewers and Manholes

- (a) Manholes which are to be abandoned will first have both influent and effluent lines plugged inside the manhole with watertight masonry. The manhole will then be filled with incompressible material (crushed stone or as approved), to a point three feet (3'-0") below the finish grade. The remainder of the manhole shall be broken down and removed. Then the excavation shall be backfilled to finish grade as specified under trench backfill.
- (b) Abandoned mains at active manholes shall be completely disconnected from the manhole by cutting the pipe outside the manhole and then plugging the abandoned main and the manhole wall with watertight masonry. The invert shall then be rebuilt to conform with the standard details.
- (c) Exposed sections of abandoned mains shall be removed to a point not less than 5 feet from the adjacent banks or surface waters. The remaining ends of the pipe shall be plugged with watertight masonry. Concrete piers or collars in the creek channel shall be removed completely. Concrete piers or collars not located in the creek channel shall be removed to a point three feet (3'-0") below the finish grade. Steel piers shall be cut off three feet (3'-0") below finish grade.
- (d) The minimum length of watertight masonry plugs will be the diameter of the abandoned pipe plus one foot.

2.16 Structural Demolition

- (a) Prior to starting construction operations, the Contractor shall demolish and remove therefrom such buildings and other structures as are specifically designated on the plans for removal. Removal and disposal of such materials shall be done in accordance with federal, state, and local ordinances at permitted sites. All permits required shall be obtained by the Contractor.

2.17 Handling and Storage of Materials

- (a) The Contractor shall be responsible for the safe storage of materials furnished by or to him, and accepted by him and intended for the work, until they have been incorporated in the completed project. The interior of all pipe, manholes and other accessories shall be kept free from dirt and foreign materials at all times.
- (b) The Contractor is responsible for the delivery and site distribution of all materials.
- (c) Ductile iron pipe and cast iron accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Pipe shall not be loaded, unloaded, or transported by placing lifting forks inside the barrel or the pipe. Concrete pipe, clay pipe, PVC pipe, all pipe accessories, precast concrete manholes, and manhole frame and covers will be unloaded with hoists and/or as recommended by the respective manufacturers. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.
- (d) In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Pedestrian or vehicular traffic shall not be unduly inconvenienced in placing of material along the streets or right-of-way, as applicable.
- (e) The Contractor will string in advance no more than the amount of pipe and material that can be installed within four (4) weeks or less as approved by the Engineer. All the materials shall be placed in such a manner as not to hinder access, endanger or impede traffic, or create a public nuisance. Materials strung through residential areas (or any area with maintained lawns) shall be placed in such a manner as not to restrict normal maintenance of established lawns, and must either be installed within two (2) weeks or removed to an approved storage yard, as required by the Engineer.
- (f) The Contractor will be responsible for locating and providing storage areas for construction materials and equipment. Unless prior written consent from the owner of the proposed storage area is received by the Engineer, the Contractor will be required to store all equipment and materials within the limits of the right-of-way and temporary construction easement provided. The materials and equipment storage shall comply with all local and state ordinances throughout the construction period.
- (g) The Contractor shall be responsible for the safeguarding of materials and equipment against fire, theft, and vandalism and shall not hold the AHJ responsible in any way for the occurrence of same.
- (h) At the direction of the Engineer, the Contractor shall remove materials which have been damaged beyond repair from the site to prevent accidental placement.

2.18 Care of Coatings and Linings

- (a) Precast manholes, pipe and fittings, including rings and covers, steps, straps, etc., shall be so handled that the coating or lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a manner satisfactory to the Engineer.

2.19 Work Progress and Clean Up

- (a) The project site shall be cleaned up in accordance with the requirements of the General Conditions, as the work progresses. Site clean up shall not lag pipe laying more than 1,000 feet, and site clearing and grubbing shall be limited to 3,000 feet ahead of pipe laying, unless specified or directed otherwise by the Owner or Engineer.

2.20 Owner Notice and Preparation of Site

- (a) The Owner will secure rights-of-way or easements where required through private lands. The Contractor shall be responsible for any damage to buildings, walls, fences, utility poles, bridges, utilities, railroad, or other improvements encountered whether public or private. All such improvements shall be carefully protected from damage, and, in case of damage or removal, shall be completely repaired or restored to its original or better condition. All damage to such improvements and all damage to property or persons resulting from damage to such improvements shall be the responsibility of the Contractor. Special care shall be taken in trenching near buildings, roads and railroads, to avoid or minimize all delays, damage, or injury thereto.
- (b) Prior to any operation, the contractor shall give advance notice to all owners and/or tenants within the project.

2.21 Use of Easements and Rights-of-Way

- (a) Prior to disturbing any area, the contractor shall stake the limits of any easement and/or right-of-way. The contractor shall confine all his operations and personnel within limits of all rights-of-way and easements as shown on the plans. There shall be no disturbance whatsoever outside the easement or rights-of-way nor shall the workmen be allowed to travel at will through the surrounding private property. The contractor is responsible to note any areas where limits have been reduced from typical limits. Prior to using any areas outside the rights-of-way and easements provided, the Contractor shall provide written approval of the current property owner and submit to the Engineer for his approval. **The Contractor shall abide by all Special Conditions Detail Sheets provided in the special conditions section of the specifications.**

2.25 Protection of Designated Trees and Shrubs

- (a) Trees, cultivated shrubs, and similar growth which: occupy areas outside the limits of public rights-of-way or easements OR are designated in the Special Conditions Detail Sheets to remain undisturbed, shall be carefully preserved and protected by the Contractor throughout all stages of the construction work. Adherence to the above shall be the responsibility of the contractor.
- (b) The Contractor shall protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
- (c) The Contractor shall provide protection for roots over 1-1/2" diameter cut during construction operations. Coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out and cover with earth as soon as possible.
- (d) The Contractor shall repair trees scheduled to remain and damaged by construction operations in a manner acceptable to the Engineer. Repair damaged trees promptly to prevent progressive deterioration caused by damage.
- (e) The Contractor shall replace trees scheduled to remain and damaged beyond repair by construction operations, as determined by the Engineer with trees of similar size and species. Repair and replacement of trees scheduled to remain and damaged by construction operations or lack of adequate protection during construction operations shall be at the Contractor's expense.

2.26 Clearing Easements and Rights-of-Way

- (a) Unless otherwise specified in the Special Conditions Detail Sheets, the entire permanent easement shall be cleared.
- (b) Temporary construction easements will be selectively cleared with designated landscape items carefully preserved and protected as stipulated in Special Conditions Detail Sheets.
- (c) Public rights-of-way shall be cleared as shown on the plans and as stipulated in Special Conditions Detail Sheets. The Engineer will provide copies of all required tree permits.
- (d) No clearing or grubbing may be performed on easements procured by Municipality or in rights-of-way except under supervision of the Project Inspector. Areas to be cleared which are occupied by trees, brush or other vegetable growth shall be cleared of such growth and suitably grubbed. All large roots or stumps shall be removed to a depth of at least two feet below original ground surface. Any pits or

cavities thereby created which extend beyond the area to be excavated shall be filled with the materials and in the manner specified for trench backfill in these specifications. All stumps, limbs and trash shall be removed and disposed of at a location approved for disposal of such materials by the agency having jurisdiction.

- (e) Useable timber and/or firewood may be left on the area adjoining the permanent right-of-way at the request of or with the consent of the property owner. The Contractor must obtain such requests in writing from the property owner. The request must release the AHJ from any claims for improper disposal of timber.
- (f) When the Special Conditions Detail Sheets specifies stacking timber or firewood adjacent to the permanent right-of-way, a written release is not required. The Contractor shall verify cut lengths of timber/firewood for such placement and location with the property owner.
- (g) Fences removed during construction shall be replaced of the same material and to the same condition existing prior to the construction, unless provided otherwise in the Special Conditions Detail Sheets.

2.27 Hubs set by the Contractor

- (a) As a minimum, centerline hubs and offset stakes will be set by the Contractor at each manhole. Cut sheets will show the vertical distance from the offset stakes to the inlet and outlet pipe inverts at each manhole.
- (b) Laser beams may be used to set line and grade when the contractor provides adequate and accurate equipment for the Engineer to check line and grade at each cut stake (lock levels shall not be considered adequate). If lasers are used, grades shall be checked at each manhole. Fans may be used in conjunction with laser beams only if approved by the Engineer. The contractor shall keep close check of his laser for variations in line and grade. No variations in line or grade shall be corrected between manholes without relaying that portion of the line which has deviated from line or grade unless otherwise approved by the AHJ.

2.31 Steel Straps and Anchors

- (a) All pipe and/or pier straps shall conform to the requirements of ASTM A36 with a minimum yield strength of 36,000 P.S.I.
- (b) Finished straps, anchors, and hardware (washers, nuts, etc.) shall be galvanized in accordance with ASTM A153. The entire strap and all exposed surfaces of anchors and/or bolts (and nuts) shall be furnished with two (2) evenly applied coats of rust inhibiting enamel paint, either Koppers Glamortex No. 501 Enamel (Black), Southern Coatings Rustaloy No. 0537 Enamel (Black), or equal. Anchor bolts (non-head) shall conform to ASTM A36 with tension text to be made (as required) on the bolt body or on the bar stock used for making the anchor bolts. Unless otherwise specified all other fasteners shall conform to ASTM A307 for carbon steel externally

and internally threaded standard fasteners Grade A or B.

PART 3: EXECUTION

3.01 Shoring and Shielding

- (a) The Contractor shall comply with OSHA trenching and excavation regulations as revised in "Subpart P" of Part 1926 in the Federal Register. Shoring and/or shielding shall be used as specified in "Subpart P" to prevent caving of trench banks and to provide a safe excavation.
- (b) **The Contractor will be responsible for excavation safety and shall designate his "competent person" (as defined in Subpart P) for the determination of proper shielding/shoring systems.**

3.02 Site Grading or General Excavation

- (a) Sites for pumping stations and access roads shall be graded by mechanical equipment within the areas and to the elevations shown on the plans. Grading operations shall be conducted so that material shall not be removed or loosened beyond the required limits. The finished surfaces shall be left in reasonably smooth and uniform planes such as are normally obtainable from the use of hand tools; but if the Contractor is not able to obtain the required degree of evenness by means of mechanical equipment, he will be required to use hand labor methods. Slopes and ditches shall be neatly trimmed and finished to conform to the slope lines shown on the plans or as staked by the Engineer.
- (b) Topsoil from the surface of the ground to be excavated or occupied by fills, within the general area specified to be planted with grass, shall be "stripped" or removed before site grading or other excavation work is started. Topsoil so removed shall be stockpiled at a suitable location on the site of the work so that it can be reused later for planting grass as specified in these specifications. This "stripping" operation shall remove all leaves, loam, and loose topsoil which are unsuitable for foundations. The depth to which topsoil is removed shall be determined by the Engineer, but will be generally between the limits of two and six inches.

3.03 Structural Excavation

- (a) Excavation for structures shall be sufficiently large for the proper placing of forms and concrete and for dewatering purposes, but shall not be excessively large in horizontal area. Banks may be sloped at a safe angle provided that such excavation does not endanger or damage existing or proposed structures, pipelines, etc. The bottom of the excavation shall be true to the required shape

and elevations shown on the plans. No earth backfilling will be permitted under structures unless specifically shown on the plans. Should the Contractor excavate below the elevations shown or specified, he shall fill the void made with thoroughly compacted Class I pipe embedment materials or with Class B concrete at his own expense.

- (b) When muck, quicksand, soft clay, swampy or other material unsuitable for foundations are encountered which extend beyond the limits of the excavation, such materials shall be removed and replaced with thoroughly compacted crushed stone acceptable to the Engineer or with Class B concrete.
- (c) In all cases where materials are deposited along open excavation, they shall be placed so that in the event of rain, no damage will result to the work or adjacent property.

3.04 Trench Excavation

- (a) Trench excavation or excavation for pipelines shall consist of excavation necessary for the construction of sewers, conduits and other pipelines and all appurtenant facilities thereof, including manholes, inlets, outlets, pipe embedment materials, and pipe protection as called for on the plans. It shall include site preparation, backfilling and tamping of pipe trenches and around structures and the disposal of waste materials, all of which shall conform to the applicable provisions of these specifications.
- (b) Trench excavation shall be made in open cut and true to the lines and grades shown on the plans or established by the Engineer, unless tunneling or boring is shown or specified. When practical the banks of the trenches shall be cut in vertical, parallel planes equidistant from the pipe center line. The horizontal distance between such planes, or the overall width of trench, shall vary with the size of the pipe to be installed. The overall width of trench shall be of the dimensions shown on the plans. When sheeting is used, the distance between vertical planes shall be measured from the inside faces of the sheeting. When vertical banks for trench excavation are not practical to construct or create dangerous conditions to workmen, the banks may be sloped provided that such excavation does not damage adjacent structures. When trench banks are sloped, such banks shall be cut to vertical planes as specified above for that part of the ditch below the level of 12 inches above the top of the pipeline. The bottom of the trench shall be level in cross section and shall be cut true to the required grade of the pipe except where concrete cradles or pipe embedment materials are shown on the plans, specified or authorized by the Engineer, in which case the excavation shall extend to the bottom of the cradle or pipe embedment materials.
- (c) Bell holes for bell and spigot pipe shall be excavated at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper installation of joints in the pipe.

- (d) Excavation for manholes and other pipeline structures shall be as specified for structural excavation.
- (e) When muck, quicksand, soft clay, swampy or other material unsuitable for foundations or subgrade are encountered which extend beyond the limits of the excavation, such material shall be removed and replaced with pipe foundation material as specified elsewhere in these specifications.
- (f) All work shall be performed so as to cause the least possible inconvenience to the public. Temporary bridges or crosswalks shall be constructed where necessary to maintain vehicular or pedestrian traffic. Crosswalks and bridges shall have handrails or other features necessary for safe use by the public.
- (g) In all cases where materials are deposited along open trenches, they shall be placed so that in the event of rain, no damage will result to the work or adjacent property.

3.05 Dewatering Excavated Areas

- (a) The Contractor shall provide and maintain ample equipment with which to remove all water from every source which enters excavations for structures and pipelines. Dewatering operations shall ensure dry excavations and the preservation of the elevations of the bottoms of the excavations shown on the plans.
- (b) Surface drainage shall not be allowed to enter excavated areas.
- (c) Where the areas to be excavated are located under water surfaces or near the banks of flowing streams or other bodies of water, the Contractor may adopt and carry out any method of dewatering he may deem feasible for the performance of the excavation work and for protection of the work thereafter; provided that the method and equipment to be used results in completed work which complies with the specifications and is acceptable to the Engineer. In such cases, the excavation area shall be effectively protected from water damage during the excavation period and until all contemplated construction work therein has been completed.
- (d) Prior to beginning excavation for structures which are to be constructed at or below the groundwater table, groundwater levels shall be lowered and maintained at workable levels. For structures other than manholes this level must be at least three (3) feet below the bottom of such structures until construction and backfilling operations have been completed.
- (e) The Contractor shall be responsible for damage to structures caused by hydrostatic displacement during construction operations.
- (f) The Special Conditions may contain additional requirements for dewatering

excavated areas.

3.06 Borrow Excavation

- (a) Wherever the backfill or embankment requires a volume of material that is in excess of the volume of suitable material available from the authorized excavations, such excess volume shall be obtained from other sources. Where borrow pits on the construction site are specifically designated on the plans, borrow excavation shall be obtained there from; otherwise, the Contractor shall provide suitable borrow material from areas accessible to the work. Before a borrow pit is opened the quality and suitability of the material to be obtained there from shall be approved by the Engineer.
- (b) Borrow pits shall be properly cleared and grubbed and all objectionable matter shall be removed from the borrow pit material prior to its placement in the backfills.
- (c) Borrow shall be excavated so that the remaining surfaces and slopes will be reasonably smooth and even and will provide adequate drainage over the entire area. Drainage ditches shall be constructed where necessary to provide outlets of water to the nearest natural channel so that the formation of pools in the borrow pit area will be avoided. Sides of borrow pit cuts shall be left at two to one slope unless otherwise authorized by the Engineer.
- (d) The contractor shall furnish to the District written approval for the use of the Borrow Pit site. Upon completion of work the Borrow Pit shall be restored to a condition acceptable to the landowner.

3.07 Rock Excavation

- (a) The removal of sound, solid rock of whatever nature which occurs in its original position in ledges, bedded deposits or stratified and unstratified masses within the excavation limits shown on the plans, and which is of such hardness or texture that it cannot be loosened, or broken down and removed without resort to drilling and blasting methods, shall be classified as rock excavation.
- (b) The removal of hardpan, chert, clay, soft or disintegrated shale, and of other rock materials and boulders less than one cubic yard in volume, shall not be classified as rock excavation although the Contractor may elect to excavate same by drilling and blasting methods. The excavation and removal of all such materials shall be classified as common excavation.
- (c) The removal of existing pavements, sidewalks, driveways, manholes and similar structures called for on the plans shall be performed under these specifications and shall not be classified as rock excavation.

3.08 Rock in Pipe Trenches

- (a) Rock encountered in trench excavation for sewers and other pipelines shall be removed for the overall width of trench which shall be as shown on the plans. It shall be removed to a minimum depth of six (6) inches below the bottom of the pipe. Where pipelines are constructed on concrete cradles, rock shall be excavated to the bottom of the cradle as shown on the plans.
- (b) After the Engineer has examined the completed excavation, and has taken the necessary measurements for volume determination, the space below the ultimate pipe grade shall be filled with pipe embedment materials as required, compacted to proper grade and made ready for pipe laying.

3.09 Drilling and Blasting

- (a) Prior to commencing any blasting operations the Contractor shall: notify the Engineer, notify the official from the list below (if applicable) and obtain blasting permits as required. The Contractor must furnish certification of insurance specifically covering any and all obligations assumed pursuant to the use of explosives.

BLASTING PERMITS:

City of Asheville -	FIRE MARSHAL (259-5636)
Biltmore Forest -	PUBLIC WORKS DIRECTOR (274-3919)
Black Mtn. & Montreat -	FIRE DEPT. (669-8074)
Weaverville -	FIRE MARSHAL (645-3500)

- (b) Drilling and blasting methods used in rock excavation shall be optional with the Contractor but shall be conducted with due regard to the safety of persons and property in the vicinity of the work and in strict conformity with all laws, ordinances or regulations governing blasting and the use of explosives. Rock excavation near existing structures of all types shall be conducted with the utmost care, and every precaution shall be taken to prevent damage to such structures. Any damage or injury of whatever nature to persons or property caused directly or indirectly by blasting operations shall be promptly repaired, replaced or compensated for by the Contractor at his own expense and to the entire satisfaction of the persons injured or the owners of the property damaged.
- (c) Where future units or pipe trenches are adjacent to structures requiring rock excavation, the rock shall be drilled and blasted (not excavated) for a distance of approximately 10 feet from the present construction, as shown on the plans or as authorized by the Engineer.
- (d) The Contractor shall not be allowed to blast within any rights-of-way maintained by any Public agency without specific approval of the controlling agency and only

in accordance with their respective requirements.

3.10 Pre-Blast Survey, Vibration Monitoring, and Post-Blast Survey

- (a) Prior to conducting any blasting operations, the Contractor shall conduct a preblast survey of all structures within 300 feet of the proposed sewer line, along the entire route of the proposed sewer.
- (b) The pre-blast survey shall consist of 35 mm color photographs of all observable exterior and interior surfaces. The photographs shall be bound in a notebook, with a photo index describing the location of each photograph to facilitate easy comparison of a given structures condition. Existing defects in structures shall be photographed and appropriately documented. The Contractor shall furnish a copy of the survey results, including photographs, to the Owner, prior to beginning blasting operations.
- (c) All blasting operations conducted within 300 feet of existing structures shall be monitored. In areas where several structures are located adjacent to blasting a sufficient number of seismic units shall be deployed to allow for comprehensive documentation of blasting operations. The resultant seismic data shall be provided to the blasters to allow for blast design changes based on the location of the next blast and the resultant vibration levels for the previous shot. A copy of all resultant seismic data shall be provided to the Owner.
- (d) In the event of a damage claim arising from blasting, the Contractor shall conduct a post-blast survey of all structures that are a part of the claim. The Contractor shall furnish a copy of the post-blast survey results, including photographs to the Owner.
- (e) The pre-blast survey, vibration and over pressure monitoring, and post-blast survey, if necessary, shall be conducted by a professional seismic consultant.
- (f) All photographs and/or negatives shall be kept on file by the Seismic Consultant and shall be available to the District upon request.
- (g) Separate payment will not be made for the pre-blast survey, vibration and over pressure monitoring, nor the post-blast survey, nor any other work related to the blasting or excavation of rock, but this work shall be considered incidental to, and included in, the unit bid prices for sewer pipe, as listed in the bid schedule.

3.11 Backfilling Trenches

- (a) The backfilling of pipeline trenches shall be started immediately after the pipe work has been installed. The initial backfill material (above pipe embedment materials), shall be placed to a height of two (2) feet above the top of the pipe.

- (b) Where the trench extends along or across streets, roadways, usable alleys, or sidewalks the trench shall be completely backfilled (above pipe embedment materials) with either compacted earth or class I pipe embedment material. Unless otherwise specified in the Special Conditions or shown on the plans, such trenches shall be backfilled with compacted earth. Backfill materials shall be as specified herein. Earth shall be deposited in 6 inch layers (before compaction) and thoroughly compacted with power tools to 95% standard proctor in unpaved areas. In paved areas, the top 24" below subgrade shall be compacted to 98% standard proctor.
- (c) Where excavation has been made within the limits of easements across private property, the top one (1) foot of backfill material shall consist of fine loose earth free from large clods, vegetable matter, debris, stones, and/or other objectionable materials. Backfill material shall be carefully placed and compacted to 85% standard proctor.
- (d) Any deficiency in the quantity of materials for backfilling the trenches, or for filling depressions caused by settlement, shall be supplied by the Contractor.
- (e) The Engineer may provide the services of a field technician of a recognized commercial testing laboratory during the compaction of the trench backfill to make density determinations. The field technician shall report the test results to the Contractor and Engineer on the project site as soon as these results are known. The results of all density tests shall be reported in writing and shall include the date of test, test location, depth below finished grade, wet density, moisture content, dry density, percent compaction of test sample, and maximum dry density used for comparison. Should any test fail, the cost of any subsequent test will be at the expense of the contractor.
- (f) Where pipe trenches are cut across or along pavement the Contractor shall construct a temporary surface over the cut which will not disintegrate under traffic and which shall be maintained in good condition under traffic until the permanent pavement has been constructed.
- (g) Backfilling around structures shall be done in the manner specified above for pipe trenches by power tamping for the full depth of cut from the bottom of the finished grade.
- (h) All backfilling shall be done in such manner as will not disturb or injure the pipe or structure over or against which it is being placed. Any pipe or structure injured, damaged or moved from its proper line or grade during backfilling operations shall be opened up and repaired and then re-backfilled as herein specified.
- (i) The Contractor shall replace all surface materials and shall restore paving, curbing, sidewalks, gutters, shrubbery, fences, sod, and other surfaces disturbed,

to a condition equal to that before the work began, furnishing all labor and materials incidental thereto as provided elsewhere in these specifications.

3.12 Disposal of Materials

- (a) All materials removed by excavation which are suitable for the purpose shall be used whenever practicable for fills, embankments, backfilling pipe trenches, and for such other purposes as may be shown on the plans or authorized by the Engineer. All materials not used for such purposes shall be considered as waste materials and disposed of by the Contractor.
- (b) Waste materials may be deposited in spoil banks on the site of the work if space is available. Such "on site" spoil bank locations shall be authorized by the Engineer. Waste materials shall not be left in unsightly piles but shall be spread in uniform layers and neatly leveled and shaped. Spoil banks shall be provided with adequate openings to permit surface drainage of adjacent lands. Where "on site" disposal is not practical, the Contractor shall be responsible for "off site" disposal. See Special Conditions – Disposal of Unusable Materials.
- (c) On completion of any part of the work proper disposal shall be made of all surplus or unused materials within the construction limits of such work and the surface of the work left in a neat and workmanlike condition.

3.13 Maintenance

- (a) All excavated areas, backfills, embankments, trenches, access roads, grading, and ditches shall be maintained by the Contractor in good condition at all times until final acceptance by the Owner. Where trench backfill has settled, trenches shall be re-backfilled.

3.14 Special Conditions

- (a) The Special Conditions may contain specifications regarding the use of crushed stone, payment for rock excavation, and construction methods for any unusual excavation work not included in the above specifications.

3.15 Pipe Embedment Materials

- (a) Pipe embedment materials when required shall be Class I material. Where pipes are installed below groundwater levels or where the trench is subject to inundation, Class I material shall be placed to the top of the pipe. Class I materials shall be graded crushed limestone, or granite, 1/4" to 3/4" in size. Materials under 1/4" shall be limited to no more than 3% by weight.
- (b) Pipe embedment materials shall be placed to support the full length of the barrel

of the pipe at exact line and grade.

- (c) Pipe embedment materials shall be placed in the pipe trench to the trench width and depth shown on the plans. Where rock has been removed from the pipe trench, it shall be placed to a minimum depth of six (6) inches below the bottom of pipe.
- (d) Class I materials when placed in the pipe trench do not require compaction.
- (e) All other materials shall be mechanically tamped and compacted to the percent required herein, as noted in the special conditions, or as shown on the drawings.

3.16 Backfill Material

- (a) Backfill material shall be of a relatively non-plastic nature and shall be sufficiently close to optimum moisture content to achieve specified compaction requirements. Backfill material shall exhibit no tendency to flow or behave in a plastic manner under blows of a mechanical tamp. Material which does not meet these requirements shall be removed from the site and replaced with suitable backfill materials.
- (b) Initial backfill material and Select material shall consist of fine loose earth, free of large clods, stones, vegetable matter, debris, and/or other objectionable material.
- (c) The remainder of the backfill shall be the same type material as the initial backfill except that a broken stone content of not more than fifty (50) percent by volume will be allowed provided that the stones are thoroughly mixed with earth. Maximum individual stone size shall be 0.75 cubic feet.

3.17 Pipe Foundation Material

- (a) Pipe foundation material shall be quarry run crushed limestone or granite ranging in size from fines to a maximum size of six (6) inches. The material shall be power tamped in six (6) inch layers.
- (b) Pipe foundation material shall be used in local areas where unsuitable materials such as muck, quicksand, soft clay, or swampy material make it necessary to provide a satisfactory pipe foundation.
- (c) Pipe foundation material used as described above will be measured for payment only in specific locations where its use is authorized in writing by the Engineer before this work is performed.

4.02 QUALITY CONTROL

A. TESTING

1. Line Cleaning

- a. Prior to inspection of any section(s) of gravity sanitary sewer pipe or force main the Contractor shall completely clean the lines of all debris, silt, etc. The pipe line shall be ready for use by the Owner and shall be proved to be in first class condition and constructed properly in accordance with the drawings and specifications.
- b. The Contractor shall maintain the project, insofar as his construction work is concerned, in first class condition for such time as is necessary to satisfy the Engineer that all installations are correct and acceptable.

2. Inspection and Testing (Gravity Sewer)

- a. Alignment and grade between manholes shall be tested by the Engineer by flashing a light between manholes. A full circle of light shall be seen when reviewed from the adjoining end of the line. All defects disclosed as a result of this test shall be corrected by the Contractor at his expense.
- b. PVC pipe shall pass a go-no go Mandrel sized to 95% of the pipe diameter with the pipe in place and properly backfilled. All pipe which will not pass the Mandrel shall be relaid or replaced by the Contractor at no additional cost. The allowable deflection (less than 5%) shall be calculated using the pipe stiffness formula in ASTM D 2321. The mandrel test shall not take place until the final backfill has been in place for 30 days (minimum).
- c. When the sewers are completed they shall be inspected by the Engineer for conformance with the provisions of the plans and specifications, particularly line and grade, and tested to determine the amount of ground water infiltration into the sewer. All visible and audible leaks will be stopped and the remaining infiltration will be measured using a V-notch weir and/or other devices, which shall be furnished by the Contractor. The Contractor shall also furnish all required assistance for measuring the infiltration.
- d. If infiltration into the whole system or any segment thereof exceeds 100 gallons per 24 hours per inch of diameter per mile of sewer, necessary corrective measures shall be taken by the Contractor to limit the infiltration to the maximum specified above. The Engineer shall decide the number and length of segments of sewer line on which the testing shall be performed.
- e. All gravity sanitary sewer lines shall be subjected to a low pressure air test to determine the presence of damaged pipe or faulty

installation. The Contractor will furnish all facilities and personnel for conducting the test(s).

- f. The acceptance air test shall be made after backfilling has been completed and compacted and in the presence of the Engineer. The test shall be performed as described under state and local municipality standards and specifications.
- i. Compressor capacity shall be sufficient to pressurize the sewer main to 4 PSIG within a time equal to or less than the required test time. The following equation may be used to insure compliance with this requirement:

$$C = \frac{0.17 \times D^2 \times L}{T} + Q$$

Where: C=Required Compressor Capacity (cfm)
T=Required Test Time (min)
D=Pipe Internal Diameter (feet)
L=Length of Test Section (feet)
Q=Allowable Air Loss Rate (cfm)

The following allowable air loss rates will be used for all pipe tests:

PIPE SIZE	Q (cfm)	PIPE SIZE	Q(cfm)
4"	2.0	15"	4.0
6"	2.0	18"	5.0
8"	2.0	21"	5.5
10"	2.5	24"	6.0
12"	3.0		

- ii. The sewer section shall be plugged at both ends and air pressure shall be applied until the pressure inside the pipe reaches 4 PSIG. When a stable condition has been reached, the pressure shall be bled back to 3.5 PSIG. At 3.5 PSIG, the time and pressure shall be observed and recorded. If groundwater is present at the sewer, the height of the groundwater above the top of the pipe shall be added to the above air pressure readings (height of water in feet X 0.433 = air pressure in psig). A minimum of five (5) readings will be required for each test.
- iii. If the time for the air pressure to decrease from 3.5 PSIG to 2.5 PSIG is equal to or greater than that shown in the following table, the pipe shall be presumed to be free from defect. When these times are not attained, pipe breakage, joint leakage, or leaking plugs are indicated and the cause

must be determined and corrected. After repairs have been made, the sewer sections shall be retested. This process shall be repeated until all sewer sections pass the air tests.

		Minimum Test Time for Pipe								
LENGTH TESTED	Pipe Size	4"	6"	8"	10"	12"	15"	18"	21"	24"
	25	0:04	0:10	0:17	0:22	0:26	0:31	0:36	0:44	0:53
	50	0:09	0:20	0:35	0:44	0:53	1:02	1:12	1:29	1:47
	75	0:13	0:30	0:53	1:06	1:20	1:34	1:48	2:14	2:40
	100	0:17	0:40	1:11	1:29	1:47	2:05	2:24	2:58	3:33
	125	0:22	0:50	1:29	1:51	2:13	2:36	3:00	3:43	4:27
	150	0:26	1:00	1:47	2:13	2:40	3:07	3:36	4:27	5:20
	175	0:31	1:10	2:04	2:35	3:07	3:39	4:12	5:12	6:14
	200	0:35	1:20	2:22	2:58	3:33	4:10	4:48	5:57	7:07
	225	0:40	1:30	2:40	3:20	4:00	4:41	5:24	6:41	8:00
	250	0:44	1:40	2:58	3:42	4:27	5:13	6:00	7:26	8:54
	275	0:49	1:50	3:16	4:05	4:53	5:44	6:36	8:10	9:47
	300	0:53	2:00	3:33	4:27	5:20	6:15	7:12	8:55	10:41
	325	0:58	2:10	3:51	4:49	5:47	6:47	7:48	9:40	11:34
	350	1:02	2:20	4:09	5:11	6:14	7:18	8:25	10:24	12:28
	375	1:06	2:30	4:27	5:34	6:40	7:49	9:01	11:09	13:21
	400	1:11	2:40	4:45	5:56	7:07	8:21	9:37	11:54	14:14
	425	1:15	2:50	5:02	6:18	7:34	8:52	10:13	12:38	15:08
	450	1:20	3:00	5:20	6:40	8:00	9:23	10:49	13:23	16:01
	475	1:24	3:10	5:38	7:03	8:27	9:54	11:25	14:07	16:55
	500	1:29	3:20	5:56	7:25	8:54	10:26	12:01	14:52	17:48
	525	1:33	3:30	6:14	7:47	9:21	10:57	12:37	15:37	18:42
	550	1:38	3:40	6:31	8:09	9:47	11:28	13:13	16:21	19:35
	575	1:42	3:50	6:49	8:32	10:14	12:00	13:49	17:06	20:28
	600	1:47	4:00	7:07	8:54	10:41	12:31	14:25	17:51	21:22

- iv. For testing a sewer system with one or more installed service lateral pipes, an effective pipe length shall be added to the total sewer main pipe length. The equation used to calculate Effective Pipe Length is as follows:

$$L_e = \frac{d^2 \times l}{D^2}$$

Where: L_e =Effective Pipe Length (added to Total Test Length)
 d =Diameter of Service Lateral Pipe
 l =Length of Sewer Lateral
 D =Diameter of Sewer Main Pipe being tested

- g. Failure of any section of the pipeline to meet the requirements of this test shall cause the Contractor to determine, at his own expense, the source(s) of leakage, and repair or replace all defective materials or workmanship. The repaired section(s) of line shall be re-tested to insure conformance with the requirements of these contract specifications.
- h. Other tests may be required by the Engineer, such as exfiltration and compaction of backfill over pipes. In this event the results shall meet the minimum standards that the manufacturer states are obtainable.

3. Inspection and Testing (Force Main)

- a. When the sanitary sewer force main is completed, the Engineer shall inspect the line for conformance with the provisions of the drawings and specifications, particularly with respect to alignment and depth.
- b. All newly constructed sanitary sewer force main and valved sections shall be subjected to a hydrostatic pressure-leakage test. Force mains shall be tested in sections not to exceed 4,00 lineal feet per test section. The Contractor shall install sufficient additional valves if not shown on the drawings to allow testing.
- c. Each completed section of the pipeline shall be plugged at both ends and slowly filled with water. As the main is being filled with water in preparation of the test, all air shall be expelled from the pipe. The main shall be subjected to hydrostatic pressure of 100 pounds per square inch for a period of two hours unless otherwise specified. Pressure shall be applied to the main by means of a hand pump for small lines or by use of a gasoline pump or fire engine for larger lines.
- d. The rate of leakage shall be determined at 15 minute intervals by means of volumetric measure of the water added during the test until the rate has stabilized at the constant value for three consecutive 15 minute periods.
- e. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage is less than ten (10) gallons per inch of pipe diameter per mile of pipe per 24 hours.

- f. Cracked or defective pipe, joints, fittings, or valves discovered in consequence of this test shall be removed and replaced with sound materials, and the test shall be repeated until the test results are satisfactory. Precautions shall be taken to remove or otherwise protect equipment in, or attached to, pipe to prevent damage or injury thereto.
- g. Tests of insulated and concealed piping shall be made before the piping is covered or concealed. No leakage will be allowed under the above tests for piping in buildings, structures or on bridges.
- h. The Contractor shall notify the Engineer when the work is ready for testing with all testing done in the presence of the Engineer. All labor, equipment, water and materials, including meters and gauges, shall be furnished by the Contractor at his own expense.

4. Inspection and Testing (Manholes)

Manholes shall be constructed to provide a true circular inside diameter with properly corbeled tops, satisfactory inverts and properly placed steps and castings. Any visible leaks in the manholes shall be completely stopped to the satisfaction of the Engineer.

B. FINAL ACCEPTANCE

- 1. The Engineer will notify the Contractor, in writing, as to the satisfactory completion of the work in any or all sections of gravity sanitary sewer pipe, force main and manholes, included in the project.
- 2. Upon such notification, the Contractor shall immediately remove all construction equipment, excess materials, tools, debris, etc. from the site(s) and leave the same in a neat, orderly condition acceptable to the Engineer.
- 3. Final landscaping requirements and restoration of surfaces shall then be completed by the Contractor in accordance with their respective specifications and as shown on the drawings.
- 4. "As-built" information shall be provided to Engineer from Contractor's North Carolina registered Surveyor at completion of project. As-built data shall be marked on the plans and turned over to the Owner at the end of the project. As-built information shall be kept up on a day to day basis and be available for review by Engineer at any time.

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Norton Intramural Fields
22-24232-01A

END OF SECTION

SECTION 33 36 00 - PRE-CAST CONCRETE STRUCTURES

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. This section covers the furnishing of all labor, equipment and materials necessary for the number, size, and type of pre-cast concrete structures to be installed as shown on the Contract Drawings.
- B. Installation of pre-cast concrete structures, manholes, and vaults involves, but is not limited to, the following:
 - 1. Preparation of the sub-grade.
 - 2. Installation.
 - 3. Pipe connection and sealing.
 - 4. Waterproofing.
 - 5. Frames, covers, and steps/ladders.
 - 6. Backfilling.
- C. Excavation and backfilling, as it relates to the installation of pre-cast concrete structures, are specified in Section 31 23 00 of these Contract Specifications.

1.02 Related Documents

- A. The general provisions of the Construction Contract, including the General and Supplemental General Conditions and the General Requirements (if any), apply to the work specified in this section
- B. Related work specified elsewhere in these Contract Specifications include:
 - 1. Section 31 23 00 – Excavation for Utilities
 - 2. Section 33 34 00 – Force mains and Gravity Sewers

1.03 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for all pre-cast concrete structures for approval by the Engineer. Details of the underground structures, metal accessories, fittings, and connections shall be included in the submittals.
- B. If dimensions proposed for underground structures differ from those shown on the Contract Drawings, Contractor shall also submit flotation calculations for Engineer's review.

1.04 Quality Assurance

- A. All pre-cast concrete structures used in the work shall be manufactured by a supplier approved by the Engineer and septic and pump tanks shall bear the seal of approval from the Division of Environmental Health of the North Carolina Department of Environment & Natural Resources (NCDENR-DEH).

1.04 WARRANTY

All materials shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year after final acceptance by the Owner.

PART 2: PRODUCTS

2.01 Pre-Cast Concrete Structures

- A. Concrete Base: Pre-cast with extended footing where shown on the Contract Drawings.
- B. Pre-Cast Concrete Structures: Pre-cast underground structures shall conform to American Society of Testing and Materials (ASTM) C 913-89 with respect to design, materials, and manufacture as well as being capable of withstanding, at a minimum, HS-20 loads.
 - 1. Size shall be as shown on the Contract Drawings. Tanks shall be cast with a positive seal gasket system at all pipe penetrations. For pipe penetrations, use flexible connectors with dual stainless steel pipe clamps meeting ASTM C 923 for all pipe diameters. Rubber gaskets shall conform to ASTM C 433.
 - 2. Minimum acceptable wall thickness of pre-cast concrete structures shall be six (6) inches.
 - 3. All pre-cast concrete structures shall be certified by the manufacturer as sufficient for the service conditions, and as having been fitted at the plant site to assure proper joining and fitting of mating sections for a successful installation at the job site.

2.01 Accessories

- A. Cast-in vault hatches shall be fiberglass and of the size shown on the Contract Drawings. For submersible pump tanks and tanks with effluent filter installations, Contractor shall coordinate between the pre-caster and the respective equipment Manufacturer's to ensure the proper location and size of the access hatch frames.

- B. Submersible pump tanks and valve vaults shall be provided with either cast-in manhole-type steps or a permanent aluminum ladder for operator access to the interior of the structure.
 - 1. Manhole steps shall be of steel-reinforced, molded polypropylene plastic, designed for a 400-pound maximum vertical load and a 1,000-pound horizontal pull-out load. Steps shall be set 16 inches on center from the top of the cone to the invert shelf, integrally cast into sidewalls, and shall not penetrate through the wall. Unless otherwise indicated, steps shall have at least a 10-inch clear width and shall project at least four (4) inches from the wall into which they are embedded. Do not locate steps over influent or effluent pipe.
- C. All aluminum accessories associated with pre-cast concrete structures shall be coated with bituminous mastic where in contact with concrete.

PART 3: EXECUTION

3.01 Delivery, Storage, and Handling

- A. Upon delivery, the Contractor shall inspect all pre-cast concrete structures and components and arrange, with the manufacturer, for the replacement of any found to be damaged and/or deformed.
- B. The structures shall be stored in a manner to prevent damage as a result of Construction activities, weather, or lack of ventilation.
- C. Extreme care shall be exercised in handling all materials. The Contractor shall use manufacturer-supplied steel lift rings when moving the structures.

3.02 Installation

- A. All pre-cast concrete structures shall be installed in the positions and orientations and to the depths and elevations indicated on the Contract Drawings, in accordance with manufacturer's instructions, and in conformance with the requirements of ASTM C891-90.
 - 1. Each structure shall be installed upon a 12-inch minimum layer of No. 57 washed stone aggregate.
 - 2. Place bell ends of pre-cast sections or the groove end of the concrete facing down. In preparation for making joints, all surfaces of the portion of the section to be jointed and the factory-made jointing materials shall be clean and dry. Each joint, seam, and pipe penetration inside and outside of joints shall receive liberal applications of non-shrink grout as well as liberal applications of

bitumastic waterproof sealant. This will be in addition to the positive seal gasket system of flexible connectors specified in Section 03314-2.01(B).

3. Lifting holes and other penetrations of the pre-cast structure wall shall be sealed with non-shrinking grout. Pipe connections shall be made so that the pipe does not project beyond the inside wall of the structure. Grout connections as necessary to make smooth and uniform surfaces on the inside of the structure.
4. Before placing any tank or vault system into operation, remove any dropped grout, sand, or other imperfections and obstructions from the interior of the structure. Specifically, the inside walls of the installed structure shall be smooth and uniform. Smooth-finish inverts, so that wastewater flow is confined and directed through inlet and outlet pipes with easy transition.
5.
 - a. All access points to the tanks shall be backfilled such that precipitation flows away from the tank entrances.
 - b. Tanks shall be backfilled in accordance with the applicable specifications herein before prescribed.
6. A 24-hour static water test, in accordance with ASTM standards, shall be performed on all pre-cast concrete tanks in order to ensure their water-tightness.
 - a. The testing shall be performed in the presence of the Engineer or his representative.
 - b. Each tank shall be filled with water, and the initial water level shall be accurately measured.
 - c. At the end of a 24-hour test period, the level of the water remaining in the tank shall be measured again.
 - d. The Engineer shall pass the tank, if the difference between the initial and final water levels is less than 0.5 inch or if the total volume of water displaced is less than one (1) percent of the total effective liquid capacity of the tank being tested.
 - e. Each failed tank shall be tested again. In the event that the tank does not pass the second static water test, the Contractor shall remove and replace the tank installation at no additional cost to the Owner.
7. Vacuum testing may be required by the engineer in addition to the 24 hour static water test.

WCU
Norton Intramural Fields
22-24232-01A

END OF SECTION

SECTION 33 41 00

DRAINAGE MATERIALS

PART 1: GENERAL

1.01 SCOPE OF WORK

This section covers providing and installing the storm drainage and underdrainage collection systems, including pipe culverts, French drains and appurtenant structures. Storm drainage systems shall be constructed as shown on the Contract drawings and as specified herein.

1.02 DELIVERY, STORAGE AND HANDLING

A. UNLOADING AND HANDLING

All pipe and storm drainage material shall be unloaded and handled with reasonable care. Pipe shall not be rolled or dragged over gravel or rock during handling. When any joint or section of pipe is damaged during unloading or handling, the undamaged portions of the joint or section may be used where partial lengths are needed, or if damaged sufficiently, the Engineer will reject the joint or section as being unfit for installation and the Contractor shall remove such rejected pipe from the project.

1.03 SUBMITTALS

- A. The Contractor shall submit for approval of the Engineer shop drawings, which describe in detail the materials to be utilized before ordering. Six (6) copies of shop drawings shall be submitted. Prior to submittal all shop drawings are to be reviewed by the Contractor, and shall be stamped and signed as to compliance with the referenced specification. Any variance to the specification shall be noted.

The following shop drawings shall be submitted:

1. Drainage Pipe
2. Underdrain Pipe
3. Underdrain or Pipe Bedding
4. Drainage Structure Castings
5. Precast Drainage Structures
6. Frame, grate and hoods

1.04 WARRANTY

All pipe and materials shall be warranted for a period of one (1) year following installation and acceptance by the Owner.

PART 2: PRODUCTS

2.01 REINFORCED CONCRETE PIPE

- A. Reinforced concrete pipe shall conform to ASTM C-76, latest revision. Pipe shall be Table III or Table IV with Wall B, unless otherwise noted. All pipe shall have interior surfaces free from roughness, projection, indentations, offset or irregularities of any kind.
- B. Joints shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant. Joint material for reinforced concrete pipe shall comply with ASTM C 443 and shall be either "O" ring type joints utilizing a rubber "O" ring, or bell and spigot type utilizing a mastic joint material equal to Ram-Neck.

2.02 CORRUGATED METAL PIPE

- A. All corrugated metal pipe shall be aluminized type 2 corrugated steel conforming to AASHTO M-274 latest revision unless otherwise called out on the design drawings. If called out as bituminous coated, pipe will conform to AASHTO M190, latest revision. Pipe shall be fully bituminous coated with an asphalt paved invert. Bituminous coating, shall consist of asphalt cement having a minimum thickness of 0.04" measured at the crest of the corrugations. Paved inverts in corrugated metal pipe, shall consist of asphalt cement applied on the inside of the pipe for one quarter of its circumference (bottom of pipe when installed). The pavement shall have a minimum thickness of 0.50" tapering to 0.1" at the sides. If pipe is called out as plain, non-coated, it shall conform to AASHTO M-36 latest revision.
- B. Corrugated metal pipe shall have 2-2/3" x 1/2" corrugations and shall be of the following minimum gauges:

18" and smaller pipes	16 gauge
21" - 30" pipes	14 gauge
36" - 48" pipes	12 gauge
56" and larger pipes	10 gauge

Corrugated Metal Pipe shall have rerolled ends to accommodate corrugated coupling bands. Coupling bands shall conform to NCDOT 932-3(A) installed with a minimum of two corrugations per pipe. Dimple bands shall not be used.

2.03 HIGH DENSITY POLYETHYLENE PIPE

All HDPE shall be water tight type "S" Hancor Blue Seal or approved equivalent and installed according to manufacturers specifications. Pipe manufactured for this specification shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252, M294, and MP7. Pipe and fittings shall be made from virgin PE compounds which conform with the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM F667. Pipe shall have smooth wall interior unless otherwise specified.

The fittings shall not reduce or impair the overall integrity of function of the pipeline. Fittings may be either molded or fabricated. Common corrugated fittings include in-line joint fittings, such as couplers and reducers, and branch or complimentary assembly fittings such as tees, wyes and end caps. These fittings may be installed by various methods such as snap-on, bell and spigot, bell – bell and wrap around couplers. Couplers shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation of the joints. Only fittings supplied or recommended by the manufacturer shall be used. Where designated on the plans or project specifications, an elastomeric gasket meeting the requirements of ASTM F477 shall be supplied.

Installation of the pipe specified above shall be in accordance with either AASHTO 30 or ASTM D2321 and as recommended by the manufacturer, with the exception that minimum cover in traffic load areas shall be 12" for pipe diameters between 4" and 48" and 18" for pipe diameters 60" and greater.

2.04 CASTINGS

Castings shall be sound and free from warp, holes and other defects that impair their strength or appearance. Exposed surfaces shall have a smooth finish and sharp, well defined lines and arises. Machined joints, where required, shall be milled to a close fit. Provide all necessary lugs and brackets so that work can be assembled in a neat, substantial manner.

2.05 AGGREGATE FOR UNDERDRAINS

Aggregate for underdrains shall be washed stone, standard size number 67 per North Carolina Department of Transportation specifications, Section 905.

PART 3: EXECUTION

3.01 PREPARATION OF PIPE FOUNDATION

A. LINES AND GRADES

The pipe foundation shall be prepared to be uniformly firm and shall be true to the lines and grades as shown on the plans. Any deviation or field adjustments will require the approval of the Engineer. When an Inspector is present on the site and is so requested by the Contractor, he shall check the position of grades and lines;

but the Contractor shall be responsible for the finished drain line being laid to exact and proper line and grade.

B. PIPE FOUNDATION

1. Whenever the nature of the ground will permit, the excavation at the bottom of the trench shall have the shape and dimensions of the outside lower third of the circumference of the pipe, care being taken to secure a firm bearing support uniformly throughout the length of the pipe. A space shall be excavated under and around each bell to sufficient depth to relieve it of any load and to allow ample space for filling and finishing the joint. The pipe, when thus bedded firmly, shall be on the exact grade. In case the bed shaped in the bottom of the trench is too low, the pipe shall be completely removed from position, and earth of suitable quality shall be placed and thoroughly tamped to prepare a new foundation for the pipe.
2. In no case shall the pipe be brought to grade by blocking up under the barrel or bell of same, but a new and uniform support must be provided for the full length of the pipe. Where rock or boulders are encountered in the bottom of the trench, the same shall be removed to such depth that no part of the pipe, when laid to grade, will be closer to the rock or boulders than 6". A suitably tamped and shaped foundation of suitable earth shall be placed to bring the bottom of the trench to proper subgrade over rock or boulders.
3. Where the foundation material is found to be of poor supporting value, the Engineer may make minor adjustment in the location of the pipe to provide a more suitable foundation. Where this is not practical, the foundation shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the Engineer, within the limits established on the plans, and backfilling with either a suitable local material secured from unclassified excavation or borrow excavation at the nearest accessible location along the project, or foundation conditioning material consisting of crushed stone or gravel or a combination of sand and crushed stone or gravel approved by the Engineer as being suitable for the purpose intended. The selection of the type of backfill material to be used for foundation conditioning will be made by the Engineer.

C. WATER IN TRENCHES

The Contractor shall remove all water which may be encountered or which may accumulate in the trenches by pumping or bailing; and no pipes shall be laid until the water has been removed from the trench. The Contractor will not be permitted to drain water through the storm drain within a period of twenty-four (24) hours after the pipe has been laid, and the open end of the pipe in the trench shall be kept closed with a tight fitting plug to prevent washing of dirt or debris

into the line. Water so removed from the trench must be disposed of in such manner as not to cause injury to work completed or in progress.

D. SPECIAL FOUNDATIONS

Whenever the bottom of the trench shall be of such nature as to provide unsatisfactory foundation for the pipe, a Geotechnical Materials Testing Engineer will be required to examine the materials and make recommendations for necessary repairs to subgrade.

3.02 LAYING PIPE

A. GENERAL

All piping is to be installed in strict accordance with the manufacturer's recommendations. Installation manuals from various material suppliers shall be furnished to the Engineer for his review and approval prior to installation of any material. The Engineer may augment any manufacturer's installation recommendations, if in his opinion it will best serve the interest of the Owner.

B. LAYING PIPE

1. No pipe shall be laid except in the presence of the Engineer or his inspector, or without special permission from the Engineer. Proper tools, implements, and facilities satisfactory to the Engineer shall be provided and used for the safe and convenient prosecution of pipe laying. All pipe, fittings, valves, and other materials used in the laying of pipe will be lowered into the trench piece by piece by means of suitable equipment in such a manner to prevent damage to the pipe materials, to the protective coating on the pipe materials, and to provide a safe working condition to all personnel in the trench. Each piece of pipe being lowered into the trench shall be carefully given a final inspection to see that it is clean, sound and free of defects. It shall be laid on the prepared foundation to produce a straight line on a uniform grade, each pipe being laid as to form a close abutted joint with a preceding pipe, so as to form a smooth and straight inside flow line. Each pipe will be tested for its exact position after it is in its final position. The pipes shall be fitted together in order to insure sufficient space for joint gaskets, and other jointing material. Pipe shall be removed at any time if broken, injured or displaced in the process of laying same, or of backfilling the trench.
2. When cutting short lengths of pipe, a pipe cutter as approved by the Engineer will be used, and care will be taken to make the cut at right angles to the center line of the pipe, or on the exact skew as shown on the plans. In the case of push-on pipe, the cut ends shall be tapered with a portable grinder, or course file to match the manufactured taper.

3. When coupling bands for annular or helical corrugated metal pipe are used, the pipe sections shall be joined and fully bolted so that the circumferential and longitudinal strength will be sufficient to preserve the alignment, prevent separation of the sections, and to prevent infiltration of backfill material.

3.03 BACKFILLING

- A. The backfill around the pipe shall be placed in layers not to exceed 6" loose and compacted to 95% Standard Proctor test for all areas and 98% for top 24" below subgrade directly beneath subgrade in paved areas. From the bottom of the trench to the centerline of the pipe the backfill material shall be compacted by approved hand tamps. From the centerline of the pipe to the top of the trench other mechanical tamps as approved by the Engineer may be used. The Engineer shall approve all backfill material. Select backfill material shall be used when called for on the plans.
- B. Care shall be taken during backfill and compaction operations to maintain alignment and prevent damage to the joints. The backfill shall be kept free from stones, frozen lumps, roots and limbs, chunks of highly plastic clay, or other objectionable materials.
- C. All pipe backfill areas shall be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill.
- D. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a minimum cover as required by the plans. Where any part of the required cover is above the proposed finish grade, the Contractor shall place, maintain, and finally remove such material at no cost to the Owner. Pipe, which becomes misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations shall be removed and replaced by the Contractor at no cost to the Owner.

3.04 TESTING

- A. Upon completion, installed lines shall show a full circle of light when "Lamped" between catch basins. This test shall be performed by the Engineer.
- B. Other tests may be required by the Engineer, such as exfiltration and compaction of backfill over pipes. In this event the results shall meet the minimum standards that the manufacturer states are obtainable.
- C. One compaction test performed directly above storm pipe placed in areas under pavement shall be conducted every 300 LF of storm pipe placed and shall meet testing requirements noted in section 2220 of the specifications.

END OF SECTION

SECTION 33 47 26

BIORETENTION SYSTEM

PART 1: GENERAL

1.01 SCOPE OF WORK

This section covers providing and installing the storm drainage and underdrainage collection systems, including excavation, drainage layer, adsorption, ground cover, control structure, outfall, filtration material, and design elements. Bioretention systems shall be constructed as shown on the Contract drawings and as specified herein.

1.02 DELIVERY, STORAGE AND HANDLING

A. UNLOADING AND HANDLING

All pipe and storm drainage material shall be unloaded and handled with reasonable care. Pipe shall not be rolled or dragged over gravel or rock during handling. When any joint or section of pipe is damaged during unloading or handling, the undamaged portions of the joint or section may be used where partial lengths are needed, or if damaged sufficiently, the Engineer will reject the joint or section as being unfit for installation and the Contractor shall remove such rejected pipe from the project.

B. MIX STORAGE AND HANDLING

Pipe, soil media, concrete storm structures, and all other materials shall be delivered to the Project Site properly tagged, bundled, and ready to place. Materials delivered to the Project Site, and not immediately placed, shall be protected from mud, rainfall erosion, oil, grease, and distortion.

1.03 SUBMITTALS

- A. The Contractor shall submit for approval of the Engineer shop drawings, which describe in detail the materials to be utilized before ordering. Six (6) copies of shop drawings shall be submitted. Prior to submittal all shop drawings are to be reviewed by the Contractor, and shall be stamped and signed as to compliance with the referenced specification. Any variance to the specification shall be noted.

The following shop drawings shall be submitted:

1. Drainage Pipe
2. Underdrain Pipe
3. Underdrain or Pipe Bedding

4. Drainage Structure Castings
5. Media Mix
6. Frame, grate and hoods

1.04 WARRANTY

All pipe, materials, and workmanship shall be warranted for a period of one (1) year following installation and acceptance by the Owner.

PART 2: PRODUCTS

2.01 SOIL MEDIA TYPE

- A. The soil mix should be uniform and free of stones, stumps, roots or other similar material greater than 2 inches. It should be a homogenous soil mix of 85-88 percent by volume sand (USDA Soil Textural Classification), 8 to 12 percent fines (silt and clay), and 3 to 5 percent organic matter (such as peat moss) shall be used. In areas where phosphorus is the target pollutant, lower (8 percent) fines should be used. Additionally, the soil mix should have a P-index between 10 and 30.

2.02 PLANTING MATERIALS

- A. Plant Material:
 1. Definition: Trees and shrubs listed in the Plant Schedule in the Drawings.
 2. General:
 - a. Species, sizes, manner in which to be planted, and approximate quantities to complete the planting as indicated are included in the Plant Schedule.
 - b. Scientific and common plant names conform to those given in Hortus Third, or are those generally accepted in the nursery trade.
 3. Quality:
 - a. Conform to the standards set forth in American Standard for Nursery Stock.
 - b. Standard quality and first-class representatives of their species or variety and true to name and type.
 - c. Nursery-grown, unless specified otherwise.
 - d. In compliance with State and Federal laws relating to disease and insect infestation; file certificates with Landscape Architect.
 - e. Having normal, well developed branches and vigorous root systems, free from defects, decay, disfigurements, sun scald, bark abrasions, plant diseases, insect pests or eggs, borers and any and all infestations.

4. Plant material will be rejected for:
 - a. Lack of compactness or proper proportion;
 - b. Weak, thin growth in rows too close together;
 - c. Cut back from larger stock to meet specified requirements;
 - d. Undersized, dry, cracked or broken balls, or plants that are loose in their ball.
 - e. Any balled & burlapped material not root-pruned within the last two years.
 - f. Root bound within container or ball;
 - g. Lacking proper proportion as to height and spread and specified characteristics or plant material;
 - h. Not acceptable to Landscape Architect; or Owner
5. Size:
 - a. Sizes and proportions of all plant materials shall equal those recommended by the American Standard for Nursery Stock for specified grades.
 - b. Measure plants before pruning and with branches in normal position.
 - c. Equal or exceed measurements specified in Plant Schedule, which are the minimum acceptable; provide 50% of plant material maximum size specified.
 - d. Height and spread dimensions: General body mass of plant, not from branch tip to tip.
 - e. Well-proportioned as to height; reject plants which meet specified measurements but do not possess an overall balance.
 - f. Take caliper measurements on trunk 6 inches above natural ground level up to and including 4-inch caliper size; 12 inches above natural ground level for larger sizes.
 - g. B&B plants shall have firm natural balls of a diameter and depth not less than that recommended in American Standard for Nursery Stock.
 - h. Container-grown plants: Conform to standards set forth in American Standard for Nursery Stock for container-grown plants.
6. Quantity: Furnish plants in sufficient quantity to satisfy the intent of the Drawings and Specifications. Locate in sufficient quantity so that time is not lost if some plants are rejected.

2.03 UNDERDRAIN PIPE

- A. Six (6) Inch diameter pipe for underdrain systems. An up-turned elbow may be used. Clean-out pipes must be provided per plan. Clean out pipes must be capped, four (4) inches above finished grade

2.04 HIGH DENSITY POLYETHYLENE PIPE

All HDPE shall be water tight type "S" Hancor Blue Seal or approved equivalent and installed according to manufacturers specifications. Pipe manufactured for this specification shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252, M294, and MP7. Pipe and fittings shall be made from virgin PE compounds which conform to the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM F667. Pipe shall have smooth wall interior unless otherwise specified.

The fittings shall not reduce or impair the overall integrity of function of the pipeline. Fittings may be either molded or fabricated. Common corrugated fittings include in-line joint fittings, such as couplers and reducers, and branch or complimentary assembly fittings such as tees, wyes and end caps. These fittings may be installed by various methods such as snap-on, bell and spigot, bell – bell and wrap around couplers. Couplers shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation of the joints. Only fittings supplied or recommended by the manufacturer shall be used. Where designated on the plans or project specifications, an elastomeric gasket meeting the requirements of ASTM F477 shall be supplied.

Installation of the pipe specified above shall be in accordance with either AASHTO 30 or ASTM D2321 and as recommended by the manufacturer, with the exception that minimum cover in traffic load areas shall be 12” for pipe diameters between 4” and 48” and 18” for pipe diameters 60” and greater.

2.07 CASTINGS

Castings shall be sound and free from warp, holes and other defects that impair their strength or appearance. Exposed surfaces shall have a smooth finish and sharp, well defined lines and arises. Machined joints, where required, shall be milled to a close fit. Provide all necessary lugs and brackets so that work can be assembled in a neat, substantial manner.

2.08 AGGREGATE FOR UNDERDRAINS

Aggregate for underdrains shall be washed stone, standard size number 67 per North Carolina Department of Transportation specifications, Section 905.

2.09 FILTER FABRIC

AASHTO M288 Class 2 Non-woven geotextile Filter Fabric shall be used. Must maintain 125 gpm per sq. ft. flow rate. Note: a 4” pea gravel layer may be substituted for geotextiles meant to separate sand filter layers.

PART 3: EXECUTION

3.01 PREPARATION OF PIPE FOUNDATION AND POND EXCAVATION

A. LINES AND GRADES

The pipe or pond foundation shall be prepared to be uniformly firm and shall be true to the lines and grades as shown on the plans. Any deviation or field adjustments will require the approval of the Engineer. When an Inspector is present on the site and is so requested by the Contractor, he shall check the position of grades and lines; but the Contractor shall be responsible for the finished drain line being laid to exact and proper line and grade.

B. SYSTEM FOUNDATION

1. Whenever the nature of the ground will permit, the excavation at the bottom of the trench shall have the shape and dimensions depicted on the project details, care being taken to secure a firm bearing support uniformly throughout the area of the system. The system shall be on the exact grade. In case the bottom of the excavation is too low, earth of suitable quality shall be placed and compacted per project specifications to prepare a new foundation for the system.
2. In no case shall pipe be brought to grade by blocking up under the barrel or bell of same, but a new and uniform support must be provided for the full length of the pipe. Where rock or boulders are encountered in the bottom of the excavation, the same shall be removed to such depth that no part of the system, when laid to grade, will be closer to the rock or boulders than 6". A suitably tamped and shaped foundation of suitable earth shall be placed to bring the bottom of the excavation to proper subgrade over rock or boulders.
3. Where the foundation material is found to be of poor supporting value, the Engineer may make minor adjustment in the location of the system to provide a more suitable foundation. Where this is not practical, the foundation shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the project Geotechnical Engineer, within the limits established on the plans, and backfilling with either a suitable local material secured from unclassified excavation or borrow excavation at the nearest accessible location along the project, or foundation conditioning material consisting of crushed stone or gravel or a combination of sand and crushed stone or gravel approved by the project geotechnical Engineer as being suitable for the purpose intended. The selection of the type of backfill material to be used for foundation conditioning will be made by the Engineer.

C. POND EXCAVATION - See Grading Specification.

D. WATER IN EXCAVATIONS

The Contractor shall remove all water which may be encountered or which may accumulate in the excavation by pumping or bailing; and no pipes shall be laid until the water has been removed. The Contractor will not be permitted to drain water through the storm drain within a period of twenty-four (24) hours after the pipe has been laid, and the open end of the pipe in the trench shall be kept closed with a tight fitting plug to prevent washing of dirt or debris into the line. Water so removed from the excavation must be disposed of in such manner as not to cause injury to work completed or in progress.

3.06 LAYING PIPE

See Drainage Materials specification

3.07 BACKFILLING

- A. The backfill of 67 stone around the underdrainage shall be placed in layers not to exceed 6" loose. Soil media shall be placed in a manner that does not damage or disturb the drainage layer or filter fabric. The project geotechnical Engineer shall approve soil media material provided by the contractor.
- B. Care shall be taken during soil media backfill and maintain alignment and prevent damage to the drainage layer. The soil media shall be protected from stones, frozen lumps, roots and limbs, chunks of highly plastic clay, or other objectionable materials.
- C. All soil media and surrounding area shall be graded and maintained in such a condition that erosion or siltation will not damage backfill material.
- D. Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a one (1) foot minimum cover. Where any part of the required cover is above the proposed finish grade, the Contractor shall place, maintain, and finally remove such material at no cost to the Owner. Underdrain, which becomes misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations shall be removed and replaced by the Contractor at no cost to the Owner.

3.08 TESTING

- A. A draw down test per the permit shall be performed by the contractor. Draw down test will be documented by contractor and provided as part of the project closeout requirements.

END OF SECTION

SECTION 33 49 00

MINOR DRAINAGE STRUCTURES

PART 1: GENERAL

1.01 SCOPE OF WORK

The work covered by this section consists of the construction of reinforced concrete or brick masonry inlets, catch basins, junction boxes, and other minor drainage structures, excluding headwalls, together with all necessary metal grates, covers, frames, and other hardware, in accordance with the requirements shown on the plans and the provisions of these specifications.

1.02 QUALITY ASSURANCE

All precast concrete structures and other fabricated materials shall be manufactured by suppliers with at least five (5) years of experience in the manufacture of similar materials.

1.03 SUBMITTALS

SHOP DRAWINGS

The Contractor shall submit at least six (6) copies of shop drawings to the Engineer, including dimensional drawings, materials of construction; catalogue cut sheets, and other pertinent information.

1.04 DELIVERY, STORAGE AND HANDLING

All materials shall be delivered, stored and handled in strict accordance with the manufacturer's recommendations, and in a manner, which preserves the structural integrity of the materials.

1.05 WARRANTY

All materials and equipment shall be warranted to be free from defects in workmanship and materials for one (1) year after final acceptance.

PART 2: PRODUCTS

2.01 MATERIALS

A. CONCRETE AND MASONRY

1. Concrete and masonry shall meet the requirements of the appropriate section of NCDOT Standard Specifications for Roads and Structures (latest Edition). All concrete shall be Class A or B 4000 psi minimum unless otherwise indicated on the plans, meeting the requirements of Section 900 and constructed in accordance with Section 825. Masonry

shall meet the requirements of Section 940 and construction in accordance with Section 830 and/or 834.

2. Where necessary to fit field conditions, the dimensions of the structure and footings shall be varied as directed by the Engineer.

B. FITTINGS AND CONNECTIONS

1. Where fittings enter the masonry, they shall be placed as the work is built up, thoroughly bonded, and accurately spaced and aligned.
2. Pipe connections shall be cut off flush with the inside wall of the drainage structure and grouted as necessary to make smooth and uniform surfaces on the inside of the structure and to withstand any infiltration of ground water.
3. Metal frames for grates and covers shall be set in full mortar beds or secured by methods approved by the Engineer.

C. BACKFILL

After the structure has been completed, and all forms, falsework, sheeting, and bracing have been removed, the excavation shall be backfilled with approved material compacted to a density of 95% standard proctor for areas unpaved and 98% for areas under pavement, and 100% for the last 9" under paving. Backfilling shall not be done until the concrete or brick masonry has cured for at least seven (7) curing days, unless otherwise permitted by the Engineer.

D. PIPE COLLARS AND PIPE PLUGS

Pipe collars and pipe plugs shall be constructed in accordance with the details shown on the plans or as directed by the Engineer.

E. FRAME, GRATE, AND HOOD

Frame, grate and hood shall be Neenah R-3233 Type D, Products by Dewey Bros. U.S. Foundry or approved equivalent. Drop inlet frame and grade shall be Neenah R-3433 or approved equivalent. Field inlet cover shall conform to NCDOT Standard Detail 840.04 with the opening facing upstream.

PART 3: EXECUTION

3.01 INSTALLATION

- A. Drainage structures shall be built to the lines, grades and dimensions as shown on the plans. The Contractor shall adjust the final grades in the field as necessary to provide positive drainage to the structures or to match final pavement or grade elevation.

- B. Excavations for drainage structures shall be made with care so as not to disturb the surrounding areas more than necessary. All excavations shall be maintained water free until completion of the drainage structure, including backfilling. The Contractor shall provide adequate pumping capacity as required.
- C. Place 6" of #57 washed stone under structures when working in the City of Asheville. Where the foundation material is found to be of poor supporting value, the existing foundation material shall be removed by undercutting to the depth directed by the Engineer and backfilled with suitable material secured from locations along the project or from a borrow pit. The backfill placed in the undercut area shall be compacted to a degree satisfactory to the Engineer.
- D. For cast-in-place structures the Contractor shall use care in placing rebar and concrete. All rebar is to be approved by the Engineer prior to pouring concrete. Unless otherwise approved, the bottom slabs shall be poured separate from the walls. A minimum of seven (7) days cure time shall be provided between completion of pouring the bottom and the walls. Cast-in-place catch basins shall conform to the requirements of NCDOT Standard Specifications for Roads and Structures (Latest Edition) Articles 840-1 through 840-3. Curb inlet catch basins shall conform to NCDOT Standard Details 840.02 through 840.04. Drop inlets shall conform to Standard Detail 840.14. Junction boxes shall conform to standard detail 840.31.
- E. When drainage structures are constructed with concrete brick, only new, sound brick shall be used. Mortar mix shall be mixed on site using an approved mortar mix consisting of Portland Cement (Type S), and clean sand. Following construction of the drainage boxes, both the interior and exterior shall be plastered with a minimum 1/2" thick coat of Portland Cement and sand mixture.

3.02 QUALITY CONTROL AND FIELD TESTING

The Contractor shall demonstrate to the Owner and Engineer that all drainage structures operate as intended and designed. All drainage structures shall be field tested by the Contractor in the presence of the Engineer prior to final acceptance. All drainage structures are to be free of debris before being turned over to the owner.

END OF SECTION