

**DOBO HALL RENOVATION
PACKAGE A**

**THE UNIVERSITY OF NORTH CAROLINA WILMINGTON
WILMINGTON, NORTH CAROLINA
SCO ID: 18-19798-01A**

EMERGENCY DECLARATION STATUS



**PROJECT MANUAL
BID DOCUMENTS**

Volume 2

March 27, 2019

MOSELEYARCHITECTS

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

TABLE OF CONTENTS

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

SEALS PAGE

ADVERTISEMENT	REFER TO CMR's MANUAL
NOTICE TO BIDDERS	REFER TO CMR's MANUAL

000101	GENERAL CONDITIONS OF THE CONTRACT (0C-15CM)
000102	SUPPLEMENTAL GENERAL CONDITIONS
000103	GUIDELINES FOR SELECTION OF MINORITY BUSINESS PARTICIPATION IN STATE CONSTRUCTION CONTRACTS

BID FORMS	REFER TO CMR's MANUAL
-----------	-----------------------

DIVISION 01 – GENERAL REQUIREMENTS

011000	Summary
012500	Substitution Procedures
013100	Project Management and Coordination
013200	Construction Progress Documentation
013300	Submittal Procedures
014000	Quality Requirements
014200	References
014520	Testing, Adjusting and Balancing (TAB)
015000	Temporary Facilities and Controls
016000	Product Requirements
017300	Execution
017419	Construction Waste Management and Disposal
017700	Closeout Procedures
017839	Project Record Documents

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

DIVISION 2 - EXISTING CONDITIONS

None

DIVISION 3 - CONCRETE

033000	Cast-In-Place Concrete
034900	Glass-Fiber Reinforced Concrete (GFRC)

DIVISION 4 - MASONRY

042000	Unit Masonry
047200	Cast Stone Masonry

DIVISION 5 - METALS

054000	Cold Formed Steel Framing - Structural (CFSF-S)
--------	---

DIVISION 6 - WOOD, PLASTICS, AND COMPOSITES

061000	Rough Carpentry
061600	Sheathing
064023	Interior Architectural Woodwork

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

072726	Fluid-Applied Vapor-Retarding Membrane Air Barriers
073113	Asphalt Shingles
074213	Metal Wall Panels
074646	Fiber Cement Panels
077200	Roof Accessories
078100	Applied Fireproofing
078413	Penetration Firestopping
078426	Thermal Barriers for Plastic
078446	Fire-Resistive Joint Systems
079200	Joint Sealants

DIVISION 8 - OPENINGS

081113	Steel Door Frames
081416	Flush Wood Doors
081613	Fiberglass Reinforced Polyester (FRP) Flush Doors
084000	Aluminum Storefronts

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

087100	Door Hardware
088000	Glazing
089000	Louvers and Vents

DIVISION 9 - FINISHES

092216	Cold Formed Steel Framing - Non-Structural
092900	Gypsum Board
095113	Acoustical Panel Ceilings
096513	Resilient Base and Accessories
096519	Resilient Floor Tile
096813	Tile Carpeting
098433	Sound Absorbing Wall Units
099100	Painting

DIVISION 10 - SPECIALTIES

101400	Signage
102600	Wall Protection
104313	Defibrillators and Cabinets
104400	Fire-Protection Specialties

DIVISION 11 - EQUIPMENT

Not Used

DIVISION 12 - FURNISHINGS

122113	Horizontal Louver Blinds
--------	--------------------------

DIVISION 13 - SPECIAL CONSTRUCTION

Not Used

DIVISION 14 - CONVEYING EQUIPMENT

140120	Traction Elevator
--------	-------------------

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SPECIFICATIONS – VOLUME 2

DIVISION 21 - FIRE SUPPRESSION

210500	Common Work Results for Fire-Suppression
211000	Water-Based Fire-Suppression Systems
213113	Electric-Drive, Horizontal Split Case Fire Pumps

DIVISION 22 - PLUMBING

220500	Common Work Results for Plumbing
220513	Motor for Plumbing Equipment
220516	Expansion Fitting and Loops for Plumbing Piping
220517	Sleeves and Sleeve Seals for Plumbing Piping
220519	Meters and Gages for Plumbing Piping
220523	General-Duty Valves for Plumbing Piping
220529	Hangers and Supports for Plumbing Piping and Equipment
220553	Identification for Plumbing Piping and Equipment
220700	Plumbing Insulation
221113	Facility Natural Gas
221116	Domestic Water Piping
221119	Domestic Water Piping Specialties
221125	Circulating Pumps
221316	Sanitary Waste and Vent Piping
221319	Sanitary Waste Piping Specialties
221413	Facility Storm Drainage Piping
221423	Storm Drainage Piping Specialties
223400	Fuel Fired, Domestic-Water Heaters
224000	Plumbing Fixtures
226113	Compressed Air Piping for Laboratory and Healthcare Facilities
226119	Compressed Air Equipment for Laboratory and Healthcare Facilities
226113	Vacuum Piping for Laboratory and Healthcare Facilities
226119	Vacuum Equipment for Laboratory and Healthcare Facilities
226700	Processed Water System for Laboratory and Healthcare Facilities

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

226719 Processed Water Equipment for Laboratory and Healthcare Facilities

DIVISION 23 - MECHANICAL

230130 Existing HVAC Air Distribution Cleaning
230500 Common Work Results for HVAC
230513 Motors for HVAC Equipment
230514 Variable Speed Drives
230516 Expansion Fittings and Loops for HVAC Piping
230517 Sleeves and Sleeve Seals for HVAC Piping
230519 Meters and Gages for HVAC Piping
230523 General-Duty Valves for HVAC Piping
230529 Hangers and Supports for HVAC Piping and Equipment
230548 Vibration Control for HVAC
230553 Identification for HVAC Piping and Equipment
230700 HVAC Insulation
230713 Fire Rated Insulation
230800 HVAC / Plumbing Commissioning Requirements
230900 Building Management System
230993 Sequences of Control
232113 Hydronic Piping
232123 Hydronic Pumps
232350 Refrigerant Detection and Alarm
232500 HVAC Water Treatment
233113 Metal Ducts
233300 Air Duct Accessories
233423 HVAC Power Ventilators
233600 Air Terminal Units
233614 Laboratory Temperature and Airflow Control System
233713 Diffusers, Registers, and Grilles
233723 HVAC Gravity Ventilators
234100 Particulate Air Filtration
235100 Breechings, Chimneys, and Stacks
235113 Draft Control System

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

235216	Condensing Boilers
236416	Centrifugal Water Chillers
237200	High Efficiency Energy Recovery System
237323	Custom Air Handling Units
237513	Custom Energy Recovery Units
238126	Ductless Min-Split Air Conditioning Units
238219	Fan Coil Units
238239	Unit Heaters

DIVISION 26 - ELECTRICAL

260519	Low-Voltage Electrical Power Conductors
260526	Grounding and Bonding for Electrical Systems
260529	Hangers and Supports for Electrical Systems
260533	Raceway and Boxes for Electrical Systems
260544	Sleeves and Sleeve Seals for Electrical Raceways and Cabling
260553	Identification for Electrical Systems
260923	Lighting Control Devices
262200	Low Voltage Transformers
262416	Panelboards
262713	Electricity Metering
262726	Wiring Devices
262816	Enclosed Switches and Circuit Breakers
262913	Enclosed Controllers
263213	Engine Generators
263600	Transfer Switches
264113	Lightning Protection for Structures
264313	Surge Protection for Low-Voltage Electrical Power Circuits
265119	LED Interior Lighting

DIVISION 27 – COMMUNICATIONS

270500	Common Work Results for Communications
271500	Communications Cabling

DIVISIONS 28 - ELECTRONIC SAFETY AND SECURITY

283111 Digital, Addressable Fire-Alarm System

DIVISION 31 - EARTHWORK

None

DIVISION 32 - EXTERIOR IMPROVEMENTS

None

DIVISION 33 - UTILITIES

None

SCHEDULE OF DRAWINGS

COVER

LIFE SAFETY

LS1.0 CODE SUMMARY
LS1.1 LIFE SAFETY INFORMATION
LS1.1.1 FIRE RESISTANCE ASSEMBLIES
LS1.1.2 FIRE RESISTANCE ASSEMBLIES
LS1.1.3 FIRE RESISTANCE ASSEMBLIES
LS2.1.1 FIRST FLOOR LIFE SAFETY PLANS
LS2.1.2 SECOND FLOOR LIFE SAFETY PLANS
LS2.1.3 ATTIC LIFE SAFETY PLANS

ARCHITECTURAL

A0.1 GENERAL ARCHITECTURAL INFORMATION
A0.2 WALL/PARTITION TYPES, WALL JOINTS AND TERMINATIONS
A1.2.1a FIRST FLOOR DEMOLITION PLAN
A1.2.2a SECOND FLOOR DEMOLITION PLAN
A2.0.0 CRAWLSPACE PLAN – OVERALL
A2.0.1 FIRST FLOOR PLAN – OVERALL
A2.0.2 SECOND FLOOR PLAN - OVERALL
A2.0.3 ATTIC FLOOR PLAN – OVERALL
A2.1.1 FIRST FLOOR PLAN – AREA A
A2.1.2 FIRST FLOOR PLAN – AREA B
A2.1.3 SECOND FLOOR PLAN – AREA A
A2.1.4 SECOND FLOOR PLAN – AREA B
A2.1.5 ATTIC FLOOR PLAN – AREA A
A2.1.6 ATTIC FLOOR PLAN – AREA B
A3.0.1 FINISH SCHEDULE
A3.0.2 FIRST FLOOR ACCENT FINISH PLANS
A3.0.3 SECOND FLOOR ACCENT FINISH PLANS
A3.0.4 INTERIOR SIGNAGE
A3.1.1 DOOR FRAME AND SCHEDULE

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

A3.2.1	DOOR AND FRAME DETAILS
A4.2.1	DETAILS AND ENLARGED ELEVATIONS
A6.1.1	ELEVATOR PLAN DETAILS
A6.1.2	STAIR DETAILS
A7.4.1	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.2	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.3	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.4	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.5	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.6	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.7	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.8	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.9	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.10	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.11	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.12	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.13	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.14	ENLARGED LAB PLANS AND ELEVATIONS
A7.4.15	ENLARGED LAB PLANS AND ELEVATIONS
A8.1.1	MILLWORK ELEVATIONS AND DETAILS
A9.1.1	REFLECTED CEILING PLAN – FIRST FLOOR PLAN AREA A
A9.1.2	REFLECTED CEILING PLAN – FIRST FLOOR PLAN AREA B
A9.1.3	REFLECTED CEILING PLAN – SECOND FLOOR PLAN AREA A
A9.1.4	REFLECTED CEILING PLAN – SECOND FLOOR PLAN AREA B
A10.1.1	ROOF PLAN
A10.2.1	ROOF DETAILS
A10.2.2	ROOF DETAILS

STRUCTURAL

S2.1.1	BOTTOM CHORD FRAMING PLAN - WEST
S2.1.2	BOTTOM CHORD FRAMING PLAN - EAST
S2.1.3	TOP CHORD FRAMING PLAN - WEST
S2.1.4	TOP CHORD FRAMING PLAN - EAST
S2.2.5	3D VIEWS
S4.1.1	FRAMING SECTIONS
S4.1.2	FRAMING SECTIONS
S5.1.1	MOMENT FRAME ELEVATIONS
S5.1.2	MOMENT FRAME ELEVATIONS

PLUMBING

P0.1	LEGENDS, ABBREVIATIONS AND GENERAL NOTES
P1.0.A	FOUNDATION PLAN – AREA A – DEMOLITION
P1.0.B	FOUNDATION PLAN – AREA B – DEMOLITION
P1.1.A	FIRST FLOOR PLAN – AREA A – DEMOLITION
P1.1.B	FIRST FLOOR PLAN – AREA B – DEMOLITION
P1.2.A	SECOND FLOOR PLAN – AREA A – DEMOLITION
P1.2.B	SECOND FLOOR PLAN – AREA B – DEMOLITION
P1.3	ATTIC FLOOR PLAN - DEMOLITION
P2.0.A	FOUNDATION PLAN – AREA A – PLUMBING
P2.0.B	FOUNDATION PLAN – AREA B – PLUMBING

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

P2.1.A FIRST FLOOR PLAN – AREA A – PLUMBING
P2.1.B FIRST FLOOR PLAN – AREA B – PLUMBING
P2.2.A SECOND FLOOR PLAN – AREA A – PLUMBING
P2.2.B SECOND FLOOR PLAN – AREA B – PLUMBING
P2.3 ATTIC FLOOR PLAN – PLUMBING
P2.4.A ROOF PLAN – AREA A – PLUMBING
P2.4.B ROOF PLAN – AREA A – PLUMBING
P4.1 ENLARGED PLANS – DEMOLITION
P4.2 ENLARGED PLANS
P4.3 ENLARGED PLANS
P5.1 DETAILS
P6.1 SCHEDULES
P9.1 GAS PIPING DIAGRAM

FIRE PROTECTION

FP0.1 LEGENDS, ABBREVIATIONS AND GENERAL NOTES
FP1.1.A FIRST FLOOR PLAN – AREA A – DEMOLITION – FIRE PROTECTION
FP1.1.B FIRST FLOOR PLAN – AREA B – DEMOLITION – FIRE PROTECTION
FP1.2.A SECOND FLOOR PLAN – AREA A – DEMOLITION – FIRE PROTECTION
FP1.2.B SECOND FLOOR PLAN – AREA B – DEMOLITION – FIRE PROTECTION
FP1.3.A ATTIC FLOOR PLAN – AREA A – DEMOLITION – FIRE PROTECTION
FP1.3.B ATTIC FLOOR PLAN – AREA B – DEMOLITION – FIRE PROTECTION
FP2.1.A FIRST FLOOR PLAN – AREA A – FIRE PROTECTION
FP2.1.B FIRST FLOOR PLAN – AREA B – FIRE PROTECTION
FP2.2.A SECOND FLOOR PLAN – AREA A – FIRE PROTECTION
FP2.2.B SECOND FLOOR PLAN – AREA B – FIRE PROTECTION
FP2.3.A ATTIC FLOOR PLAN – AREA A – FIRE PROTECTION
FP2.3.B ATTIC FLOOR PLAN – AREA B – FIRE PROTECTION

MECHANICAL

M0.1A LEGENDS, ABBREVIATIONS AND GENERAL NOTES
M0.2 SCHEDULES
M0.3 SCHEDULES
M0.4 SCHEDULES
M2.1.1 FIRST FLOOR PLAN – PART A – DUCTWORK
M2.1.2 FIRST FLOOR PLAN – PART A – PIPING
M2.2.1 FIRST FLOOR PLAN – PART B – DUCTWORK
M2.2.2 FIRST FLOOR PLAN – PART B – PIPING
M2.2.3 FIRST FLOOR PLAN – AIR BALANCE
M2.3.1 SECOND FLOOR PLAN – PART A – DUCTWORK
M2.3.2 SECOND FLOOR PLAN – PART A – PIPING
M2.4.1 SECOND FLOOR PLAN – PART B – DUCTWORK
M2.4.2 SECOND FLOOR PLAN – PART B – PIPING
M2.4.3 SECOND FLOOR PLAN – AIR BALANCE
M2.5.1 ATTIC FLOOR PLAN – PART A
M2.5.2 ATTIC FLOOR PLAN – PART B
M2.7 ROOF PLAN
M3.1 ENLARGED PLANS
M3.2 ENLARGED PLANS
M3.3 ENLARGED PLANS

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

M3.4	ENLARGED PLANS
M4.1	SECTIONS
M4.2	SECTIONS
M5.1	DETAILS
M5.2	DETAILS
M5.3	DETAILS
M5.4	DETAILS
M5.5	DETAILS
M5.6	DETAILS
M6.1	SCHEMATICS
M6.2	SCHEMATICS
M6.3	SCHEMATICS
M7.1	CONTROLS
M7.2	CONTROLS

ELECTRICAL

E0.2	LEGENDS, ABBREVIATIONS AND GENERAL NOTES
E1.1	FIRST FLOOR PLAN – PART A - ELECTRICAL DEMOLITION
E1.2	FIRST FLOOR PLAN – PART B - ELECTRICAL DEMOLITION
E1.3	SECOND FLOOR PLAN – PART A - ELECTRICAL DEMOLITION
E1.4	SECOND FLOOR PLAN – PART B - ELECTRICAL DEMOLITION
E2.1.1	FIRST FLOOR PLAN – PART A -LIGHTING
E2.1.2	FIRST FLOOR PLAN – PART A – ELECTRICAL
E2.1.4	FIRST FLOOR PLAN – PART A – MECHANICAL POWER
E2.2.1	FIRST FLOOR PLAN – PART B -LIGHTING
E2.2.2	FIRST FLOOR PLAN – PART B – ELECTRICAL
E2.2.4	FIRST FLOOR PLAN – PART B – MECHANICAL POWER
E2.3.1	SECOND FLOOR PLAN – PART A -LIGHTING
E2.3.2	SECOND FLOOR PLAN – PART A – ELECTRICAL
E2.3.4	SECOND FLOOR PLAN – PART A – MECHANICAL POWER
E2.4.1	SECOND FLOOR PLAN – PART B -LIGHTING
E2.4.2	SECOND FLOOR PLAN – PART B – ELECTRICAL
E2.4.4	SECOND FLOOR PLAN – PART B – MECHANICAL POWER
E2.5.2	ATTIC FLOOR PLAN – PART A- ELECTRICAL
E2.5.4	ATTIC PLAN – PART A – MECHANICAL POWER
E2.6.2	ATTIC FLOOR PLAN – PART B - ELECTRICAL
E2.6.4	ATTIC FLOOR PLAN – PART B – MECHANICAL POWER
E4.1	ELECTRICAL DETAILS
E4.2	LIGHTNING PROTECTION PLAN
E5.1	POWER ONE-LINE DIAGRAM
E5.2	ELECTRICAL SCHEDULES
E5.3	ELECTRICAL SCHEDULES
E5.4	ELECTRICAL SCHEDULES
E5.5	ELECTRICAL SCHEDULES
E5.6	ELECTRICAL SCHEDULES

END OF TABLE OF CONTENTS

SECTION 210500 - COMMON WORK RESULTS FOR FIRE-SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors.
- C. Exposed, Exterior Installations: Exposed to view outdoors.
- D. Subject to Freezing: Subject to temperatures below 40 degrees F.
- E. Concealed, Interior Installations: Concealed from view and protected from physical contact by occupants.
- F. Concealed, Exterior Installations: Concealed from view and protected from physical contact by occupants.
- G. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
- H. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.3 QUALITY ASSURANCE

- A. Equipment and appliances comprising portions of the mechanical systems regulated by the International Mechanical Code shall be listed and labeled in accordance with the current edition of the North Carolina Building Code.
- B. Equipment and appliances comprising portions of the fire suppression systems regulated by the NFPA 13 shall be installed in accordance with the listing and the manufacturer's installation instructions. Manufacturer's installation instructions shall be available on the job site for use and inspection.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Fire-suppression piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.5 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.6 INTENT OF CONTRACT DOCUMENTS

- A. Fire Suppression/Protection drawings are diagrammatic, indicating general locations and arrangements of pipe, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.
- B. Coordinate work to achieve proper operation and to provide a maintainable installed condition.
- C. Notify the Architect's representative immediately of conditions which do not comply or will not produce this result.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

PART 2 - PRODUCTS

2.1 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match fire-suppression piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180°F.
- D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225°F.]

2.2 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 JOINING MATERIALS

- A. Pipe Joint Compound for Threaded Pipe: UL listed.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around fire-suppression piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install fire-suppression piping according to the following requirements and Division 21 Sections specifying fire-suppression piping systems.
- B. Install fire-suppression piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install fire-suppression piping indicated to be exposed and fire-suppression piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Diagonal runs are permitted in the attic spaces.
- D. Install fire-suppression piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install fire-suppression piping to permit valve servicing.
- F. Install fire-suppression piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. Fire-suppression piping:
 - a. Fire-suppression piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Fire-suppression piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Fire-suppression piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Fire-suppression piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Fire-suppression piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Fire-suppression piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - g. Bare Fire-suppression piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Fire-suppression piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- J. Sleeves are not required for core-drilled holes.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- K. Permanent sleeves are not required for holes formed by removable PE sleeves.
- L. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- M. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- N. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 FIRE-SUPPRESSION PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying fire-suppression piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or pipe joint compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Grooved Joints: Assemble joints with listed coupling, gasket, lubricant, and bolts.
 - 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
 - 2. Steel Pipe: Roll-groove piping. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
- F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Plastic Fire-suppression piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Fire-suppression piping: Join according to ASTM D 2846/D 2846M Appendix.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- I. Plastic Pressure Fire-suppression piping Gasketed Joints: Join according to ASTM D 3139.

3.3 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.5 GROUTING

- A. Mix and install grout for fire suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.6 EXCAVATION AND BACKFILL

- A. Excavation and backfill shall be as indicated in Division 1 specifications and on the drawings. If excavation and backfill is not otherwise indicated the following shall apply:
1. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below minimum depth of cover based on locality or 1'-0" below frost line whichever is lower.
 2. Excavate trenches to uniform widths to provide twelve inches clear on each side of pipe. Excavate trench walls vertically from trench bottom.
 3. Trench Bottoms: Excavate trench bottoms to provide flat surface. Place and compact six inches of sand. Excavate and shape sand to provide uniform bearing and support of pipes. Shape sand to provide continuous support for bells, joints, fittings, and barrels of pipes. Sand shall be free of projecting stones and sharp objects.
 4. Backfill and hand tamp to 95% proctor to six inches above the top of the pipe.
 5. Backfill and machine tamp the remainder of the trench to 95% proctor in twelve-inch lifts.

END OF SECTION 210500

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

-- THIS PAGE INTENTIONALLY LEFT BLANK --

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Description of Work:

1. The work includes removal and replacement of existing piping, valves, tamper switches, and sprinklers as indicated on the drawings, the removal of the existing dry pipe sprinkler system in the attic, and the installation of a new wet pipe sprinkler system in the attic. The design, equipment, materials, installation and workmanship shall be in strict accordance with the Owner's insurance underwriter's requirements, the current edition of the North Carolina Building Code, the local authority having jurisdiction, and the required and advisory provisions of NFPA.
2. Piping shall not traverse spaces containing electrical equipment in the form of transformers, panel-boards, switchgear, or computer servers.
 - a. Exceptions:
 - 1) Personal computers (PCs)
 - 2) Spaces whose name does not include the term "Electrical", "Data", or "Computer."
3. Each system shall include materials, accessories and equipment necessary to provide each system complete and ready for use.
4. The design of each system shall give full consideration to blind spaces, piping, electrical equipment, ductwork, and all other construction and equipment to afford complete coverage.
5. Devices and equipment for fire protection service shall be of an approved make and type listed by the Underwriters' Laboratories, Inc., or approved by the Factory Mutual System.
6. In the publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears.
7. Reference to the "authority having jurisdiction" shall be interpreted to mean the Local Fire Marshal.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

8. Calculations shall include delivering water from the point of the fire hydrant flow test through the site piping.
9. Consideration shall be given to all unheated areas such as attics, utility rooms, loading docks, outdoor storage spaces with canopies, etc., to provide freeze protection in accordance with NFPA 13. This shall include the installation of dry sprinklers where necessary.

1.3 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride plastic.
- B. Email: for the purposes of this section email shall be considered “in writing”

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device.

1.5 PERFORMANCE REQUIREMENTS

- A. Component Working Pressure: Listed for at least 175 psig.
- B. Design shall be approved by authorities having jurisdiction.
- C. Fire-suppression system design shall include the following:
 1. Margin of Safety for Available Water Flow and Pressure: As required by the local Fire Marshal's Office.
 2. Sprinkler Occupancy Hazard Classifications shall be as indicated on the drawings. Where not indicated, comply with NFPA 13.
 3. Maximum Protection Area per Sprinkler shall be in accordance with NFPA 13 and its UL listing.

1.6 SUBMITTALS

- A. Product Data: For the following:
 1. Piping materials, including flexible connections, and sprinkler specialty fittings.
 2. Pipe hangers and supports.
 3. Valves, including listed fire-protection valves, unlisted general-duty valves, specialty valves and trim.
 4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- 5. Alarm devices, including electrical data.
- B. Fire-hydrant flow test report.
- C. Approved Sprinkler Piping Shop Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations. Diagram power, signal, and control wiring.
 - 1. Include shop drawings indicating location of all sprinkler heads and all other construction that penetrates ceilings, including light fixtures, HVAC equipment, speakers, fire alarm devices, partition assemblies, etc.
 - 2. Sprinklers shall be referred to on drawings, submittals and other documentation, by the sprinkler identification or Model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.
- D. Welding certificates.
- E. Operation and Maintenance Data to include in emergency, operation, and maintenance manuals.

1.7 CLOSEOUT SUBMITTALS

- A. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. A Professional Engineer registered in the state where the project is constructed shall stamp and seal the Shop Drawings.
- B. Flow test:
 - 1. Bid shall be based on the indicated fire-hydrant flow and pressure.
 - 2. Design calculations shall be based on the results of a confirming fire-hydrant flow test performed or caused to be performed by the contractor.
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- D. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 - 1. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.
 - 2. Any couplings requiring a torque wrench, per manufacturer installation instruction, must have a test tag attached to each bolt showing torque used for each. Tags shall be date stamped and initialed by the installer.
- E. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. 2013 NFPA 13: "Standard for the Installation of Sprinkler Systems."

1.9 COORDINATION

- A. Relocate piping to clear the path of ductwork.
- B. Relocate piping to clear the path of conduit.
- C. Relocate piping to clear the path of cable tray.
- D. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 SPRINKLER CABINET(S) AND SPARE SPRINKLERS

- A. Provide finished, wall-mounted, steel sprinkler cabinet with hinged cover.
- B. Provide number of sprinklers required by NFPA 13.
- C. Provide separate cabinet with sprinklers and wrench for each type of sprinkler on Project.
- D. Provide products packaged with protective covering for storage. Identify contents with label.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.
 - 1. Mechanical-Joint, Ductile-Iron Fittings AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.
 1. Push-on-Joint, Ductile-Iron Fittings AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 2. Gaskets: AWWA C111, rubber.
- C. Grooved-End, Ductile-Iron Pipe: AWWA C151, with factory formed, radius-cut-grooved ends according to AWWA C606.
 1. Grooved-Joint Piping Systems:
 - a. Manufacturers including but not limited to:
 - 1) Victaulic Co. of America.
 - b. Grooved-End Fittings: ASTM A 536, ductile-iron casting with OD matching ductile-iron-pipe OD.
 - c. Grooved-End-Pipe Couplings: AWWA C606, gasketed fitting matching ductile-iron-pipe OD. Include ductile-iron housing with keys matching ductile-iron-pipe and fitting grooves, prelubricated rubber gasket with center leg, and steel bolts and nuts. Basis of Design: Victaulic Style 31.
 - d. Grooved-End-Pipe Transition Coupling: UL 213 and AWWA C606, gasketed fitting with end matching ductile-iron-pipe OD and end matching steel-pipe OD. Include ductile-iron housing with key matching ductile-iron-pipe groove and key matching steel-pipe groove, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts. Basis of Design: Victaulic Style 307.

2.2 STEEL PIPE AND FITTINGS

- A. Threaded-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or shop-formed threaded ends.
 1. Cast-Iron Threaded Flanges: ASME B16.1.
 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 3. Gray-Iron Threaded Fittings: ASME B16.4.
 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 5. Steel Threaded Couplings: ASTM A 865.
- B. Plain-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized where indicated.
 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 2. Steel Flanges and Flanged Fittings: ASME B16.5.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- C. Grooved-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, square-cut- or roll-grooved ends.

1. Grooved-Joint Piping Systems:

- a. Manufacturers including but not limited to:

- 1) Shurjoint.
- 2) Victaulic Co. of America.
- 3) Viking.

- b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.

- c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and ASTM A449 compliant steel bolts and nuts.

- D. Grooved-End, Schedule 10 Steel Pipe: Schedule 10 in NPS 2-1/2 to NPS 5; and NFPA 13-specified wall thickness in NPS 6 to NPS 10; with factory- or field-formed, roll-grooved ends.

1. Grooved-Joint Piping Systems:

- a. Manufacturers including but not limited to:

- 1) Shurjoint.
- 2) Victaulic Co. of America.
- 3) Viking.

- b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.

- c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

- d. In lieu of rigid pipe offsets or return bends for sprinkler drops, the Victaulic VicFlex™ Multiple-Use Flexible Stainless Steel Sprinkler Drop System may be used to locate sprinklers as required by final finished ceiling tiles and walls. The drop system shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel Male threaded nipple or Victaulic FireLock IGS Groove Style 108 coupling for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head.

- 1) The drop shall include a UL approved Series AH1 with 3" bend radius; AH2 or AH2-CC braided hose with a bend radius to 2" to allow for proper installation in confined spaces.
- 2) Union joints shall be provided for ease of installation.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- 3) The flexible drop shall attach to the ceiling grid using a one-piece open gate Series AB1 or AB2 bracket. The bracket shall allow installation before the ceiling tile is in place.
 - a) Grooving Tool: Victaulic RG2100, with IGS Confirmation Gauge.

2.3 PLASTIC PIPE AND FITTINGS

- A. CPVC Pipe and Fittings: UL-Listed for fire protection use, 175 psi rated, installed in accordance with NFPA 13 and manufacturers listing requirements.

2.4 FLEXIBLE CONNECTORS

- A. Flexible connectors shall have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
 - 1. NPS 2 and Smaller: Threaded or grooved.
 - 2. NPS 2-1/2 and Larger: Flanged or grooved.
 - 3. Option for NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.
- B. Manufacturers including but not limited to:
 - 1. Flex Head Co., Inc.
 - 2. Flex-Hose Co., Inc.
 - 3. Victaulic Co. of America
 - 4. Metraflex, Inc.
- C. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.5 CORROSION-PROTECTIVE ENCASEMENT FOR PIPING

- A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

2.6 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have
- B. Outlet Specialty Fittings:
 - 1. Manufacturers including but not limited to:
 - a. Central Sprinkler Corp.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- b. Victaulic Co. of America.
 - c. Ward Manufacturing.
 - 2. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and grooved outlets.
 - 3. Snap-On and Strapless Outlet Fittings: UL 213, ductile-iron housing or casting with gasket and threaded or grooved or grooved outlet.
- C. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded, grooved or locking-lug inlet and outlet, test valve, and orifice and sight glass.
- 1. Manufacturers including but not limited to:
 - a. AGF Manufacturing, Inc.
 - b. Central Sprinkler Corp.
 - c. Viking Corp.
 - d. Victaulic Co. of America.
 - e. Approved equal.

2.7 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- 1. Manufacturers including but not limited to:
 - a. Grinnell Fire Protection.
 - b. NIBCO.
 - c. Stockham.
 - d. Victaulic
 - e. Anvil
- B. Ball Valves: Comply with UL 1091, except with ball instead of disc.
- 1. Manufacturers including but not limited to:
 - a. NIBCO.
 - b. Victaulic Co. of America.
 - 2. NPS 1-1/2 and Smaller: Bronze or brass body with threaded or grooved ends. Basis of Design: Victaulic Series 728.
 - 3. NPS 2 and NPS 2-1/2: Ductile-iron body with grooved ends.
 - 4. NPS 3: Ductile-iron body with grooved ends.
- C. OS&Y Gate Valves: UL 262.
- 1. Cast-iron, or ductile-iron body with flanged or grooved ends.
 - a. Manufacturers including but not limited to:
 - 1) Central Sprinkler Corp.
 - 2) McWane, Inc.; Kennedy Valve Div.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- 3) Mueller Company.
- 4) NIBCO.
- 5) Victaulic Co. of America.

D. Butterfly Valves: UL 1091.

- 1. NPS 2 and Smaller: Bronze body with grooved ends.
 - a. Manufacturers including but not limited to:
 - 1) Global Safety Products, Inc.
 - 2) Victaulic Co. of America.
 - 3) Milwaukee Valve Company.
- 2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends. Valve seat shall be pressure-responsive, and the stem offset from the disc centerline to provide complete 360-degree circumferential seating. Basis of Design: Victaulic Series 705. Each valve must be individually tested at factory to include electronics.
 - a. Manufacturers including but not limited to:
 - 1) Mueller Company.
 - 2) NIBCO.
 - 3) Victaulic Co. of America.

E. Check Valves NPS 2 and Larger: UL 312, spring-assisted swing type for vertical or horizontal installation, cast- ductile iron body with flanged or grooved ends. Basis of Design: Victaulic Series 717.

- 1. Manufacturers including but not limited to:
 - a. NIBCO.
 - b. Victaulic Co. of America.
 - c. Watts Industries, Inc.; Water Products Div.

F. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

- 1. Indicator: Weatherproof actuator housing with electrical, 15 amp @125-VAC 60 HZ, prewired, single-pole-single-throw, supervisory switches
- 2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded or grooved or grooved ends. Basis of Design: Victaulic Series 728.
 - a. Available Manufacturers:
 - 1) Milwaukee Valve Company.
 - 2) NIBCO.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- 3) Victaulic Co. of America.
- 3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.
 - a. Manufacturers including but not limited to:
 - 1) Milwaukee Valve Company.
 - 2) Grinnell Fire Protection.
 - 3) NIBCO.
 - 4) Victaulic Co. of America.
- G. Double Check Backflow Preventers:
 - 1. Manufacturers including but not limited to:
 - a. Ames Co.
 - b. Conbraco.
 - c. Febco.
 - d. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1015
 - 3. Application: continuous-pressure.
 - 4. Pressure Loss: 8 psig maximum, through middle 1/3 of flow range.
 - 5. Size: ¾" thru 10" as required to match connected piping.
 - 6. Body: Brass or bronze for NPS 2 and smaller; cast iron or steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 - 7. Configuration: As needed for installation.
 - 8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of 2" and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of 2 ½" and larger.

2.8 GENERAL-DUTY VALVES

- A. Manufacturers including but not limited to:
 - 1. Crane Co.; Crane Valve Group; Crane Valves.
 - 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 - 3. Jamesbury; a subsidiary of Metso Automation.
 - 4. Milwaukee Valve Company.
 - 5. NIBCO INC.
 - 6. Red-White Valve Corporation.
 - 7. Victaulic Company.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded or grooved ends.
- C. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded or grooved ends.

2.9 SPECIALTY VALVES

- A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.
 - 1. Manufacturers including but not limited to:
 - a. Grinnell Fire Protection.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Victaulic Co. of America.
 - d. Viking Corp.
 - 2. Riser Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for drain and pressure gages. Basis of Design: Victaulic Series 717R.
- B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded or grooved ends.
 - 1. Manufacturers including but not limited to:
 - a. Grinnell Fire Protection.

2.10 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.
- B. Manufacturers including but not limited to:
 - 1. Reliable Automatic Sprinkler Co., Inc.
 - 2. Victaulic Co. of America.
 - 3. Viking Corp.
- C. Automatic Sprinklers: UL-Listed with quick response glass bulb type heat-responsive element complying with the following:
- D. Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss integrally cast in the sprinkler body.
- E. Sprinkler types, features, and options as follows:
 - 1. Brass upright sprinklers.
 - 2. Specific application attic sprinklers
 - 3. Extended-coverage sprinklers.
 - 4. Concealed pendent sprinklers, including cover plate.
 - 5. Pendent sprinklers.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

6. Pendent, dry-type sprinklers.
7. Quick-response sprinklers.
8. Recessed sprinklers, including escutcheon.
9. Sidewall sprinklers.
10. Sidewall, dry-type sprinklers.
11. Upright sprinklers.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: 2 piece, with 1-inch vertical adjustment.
2. Sidewall Mounting: 2 piece, with 1-inch horizontal adjustment.

G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

H. In lieu of rigid connections to dry sprinkler heads, a Victaulic VicFlex™ dry sprinkler, Model VS1, may be used. The sprinkler shall provide a vertical or horizontal flexible connection with a bend radius to 2" and allow for up to 4 bends.

2.11 FIRE DEPARTMENT CONNECTIONS

A. Manufacturers:

1. Central Sprinkler Corp.
2. Elkhart Brass Mfg. Co., Inc.
3. Fire-End and Croker Corp.
4. Guardian Fire Equipment Incorporated.
5. Potter-Roemer; Fire-Protection Div.

B. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with storz cap with chain and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."

1. Type: Two 2-1/2" hose inlets.

C. At the low point near each fire department connection, install a 90-degree elbow with drain connection to allow for localized system drainage to prevent freezing. Basis of Design: Victaulic #10-DR.

2.12 FIRE PUMP TEST HEADER

A. Manufacturers:

1. Elkhart Brass Mfg. Co., Inc.
2. Fire-End and Croker Corp.
3. Guardian Fire Equipment Incorporated.
4. Potter-Roemer; Fire-Protection Div.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

B. Hose Valve Manifold Assembly:

1. Header Pipe: Schedule 10, black steel.
2. Hose Valves: Polished chrome or brass with cap and chain. Include NFPA 1963 hose thread that complies with local fire department standards.
3. Nipples: Schedule 40 galvanized steel pipe with threaded ends.
4. Caps with Chain: To match hose valves.
5. Escutcheon Plate: Rectangular.
6. Exposed Parts Finish: Match hose valves.
7. Escutcheon Plate Marking: "FIRE PUMP TEST"

2.13 ALARM DEVICES

A. Alarm device types shall match piping and equipment connections.

B. Wet Pipe Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

1. Manufacturers including but not limited to:
 - a. Grinnell Fire Protection.
 - b. ITT McDonnell & Miller.
 - c. Potter Electric Signal Company.
 - d. Viking Corp.
 - e. Watts Industries, Inc.; Water Products Div.

C. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

1. Manufacturers including but not limited to:
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. Potter Electric Signal Company.
 - c. System Sensor.

2.14 PRESSURE GAGES

A. Manufacturers including but not limited to:

1. Dresser Equipment Group; Instrument Div.

B. Description: UL 393, 3-1/2" to 4-1/2" diameter dial.

C. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.15 FIRESTOP WRAP

- A. Manufacturers including but not limited to:
 - 1. 3M
- B. UL listed with minimum 1-hour fire rating

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA standards, procedures, appendices, or recommendations.
- B. Report test results no later than two days following the test in writing.

3.2 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.3 PIPING APPLICATIONS, GENERAL

- A. Provide shop-welded joints where welding is required.
- B. Provide shop or manufacturer-threaded or grooved joints where threads are required.
- C. Field-welded joints will be permitted where indicated on the drawings. Field welding is optional where indicated. Other approved or specified methods are acceptable.
- D. Do not use welded joints for galvanized-steel.
- E. Flanges, flanged fittings, unions, nipples, transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- F. Underground Piping: Ductile-iron, mechanical-joint pipe and fittings with restrained joints. Include corrosion-protective encasement.

3.4 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure:
 - 1. Sprinkler Piping NPS 2" and smaller use any of the following:
 - a. Threaded or grooved-end, black, schedule 40 steel pipe; cast- or malleable-iron threaded or grooved fittings; and threaded or grooved joints.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- b. Plain-end, black, schedule 40 steel pipe; steel welding fittings; and welded joints.
 - c. Grooved-end, black, schedule 40 steel pipe with square-cut- or roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- 2. Sprinkler Piping NPS 2 ½" and larger use any of the following:
 - a. Threaded or grooved-end, black, schedule 40 steel pipe; cast- or malleable-iron threaded or grooved fittings; and threaded or grooved joints.
 - b. Plain-end, black, schedule 10 steel pipe; steel welding fittings; and welded joints.
 - c. Grooved-end, black, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and roll grooved joints.
- 3. CPVC Pipe and Fittings are permitted to be installed in accordance with NFPA 13 and the manufacturers listing requirements.

3.5 STANDPIPE SYSTEM PIPING APPLICATIONS

- A. Wet-Pipe Standpipe System, 175-psig Maximum Working Pressure:
 - 1. Standpipe Piping NPS 2" and smaller use any of the following:
 - a. Threaded or grooved-end, black, schedule 40 steel pipe; cast- or malleable-iron threaded or grooved fittings; and threaded or grooved joints.
 - b. Plain-end, black, schedule 40 steel pipe; steel welding fittings; and welded joints.
 - c. Grooved-end, black, schedule 40 steel pipe with square-cut- or roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
 - 2. Standpipe Piping NPS 2 ½" and larger use any of the following:
 - a. Threaded or grooved-end, black, schedule 40 steel pipe; cast- or malleable-iron threaded or grooved fittings; and threaded or grooved joints.
 - b. Plain-end, black, schedule 10 steel pipe; steel welding fittings; and welded joints.
 - c. Grooved-end, black, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and roll grooved joints.

3.6 VALVE APPLICATIONS

- A. Where specific valve types are not indicated, the following requirements apply:
 - 1. Listed Fire-Protection Valves: UL listed and FMG approved for application.
 - a. Shutoff Duty: Use ball, or butterfly valves.

3.7 JOINT CONSTRUCTION

- A. Refer to Section "Common Work Results for Fire Suppression" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than 8" with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- C. Threads shall be checked by a ring gage and shall comply with ASME B1.20.1.
- D. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts in accordance with the manufacturer's published installation instructions.
 - 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
 - 2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
 - 3. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.
 - 4. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.
- E. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
 - 1. NPS 2 and Smaller: Use dielectric unions, couplings, or nipples.
 - 2. NPS 2-1/2 to NPS 4: Use dielectric flanges.
 - 3. NPS 5 and Larger: Use dielectric flange insulation kits.

3.8 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.9 PIPING INSTALLATION

- A. Refer to Section "Common Work Results for Fire Suppression" for basic piping installation.
- B. Locations and Arrangements: Drawing plans, shop drawings, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated.
 - 1. Deviations from approved working drawings for piping require written approval from authorities having jurisdiction and Architect. File written approval with Architect before deviating.
- C. Install underground piping according to NFPA 13, NFPA 24 and Drawings. Provide restrained joints. Provide corrosion-protective encasement.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- D. Provide approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Provide unions adjacent to each valve in pipes 2" and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- F. Provide flanges or flange adapters on valves, and equipment having 2-1/2" and larger pipe connections.
- G. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.
- H. Provide "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve. Test connections that discharge to the exterior shall discharge 1'-0" above a concrete splash block. Provide splash block under this section of the specifications. Pipe penetration shall be installed to coursing dimensions where concrete masonry units are utilized to construct wall.
- I. Provide sprinkler piping with drains for complete system drainage.
- J. Provide alarm devices.
- K. Install sprinkler system piping according to NFPA 13.
- L. Install pressure gages on each riser or feed main, and at each sprinkler test connection. Include pressure gages with connection not less than 1/4" and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where not subject to freezing.
- M. Fill wet-pipe sprinkler and standpipe system with water.

3.10 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install backflow preventer in potable-water supply sources.

3.11 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space wherever possible.
- C. Do not install sprinklers that have been dropped, damaged, show a visible loss of fluid, or a cracked bulb.
- D. The sprinkler bulb protector shall be removable by hand, without tools or devices that may damage the bulb.

3.12 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping.
- C. Install ball drip valves at each check valve for fire department connection. Drain as indicated. If not indicated otherwise, drain to floor drain or outside building.
- D. Coordinate connection of alarm devices to fire alarm.
- E. Ground equipment. Grounding shall be in accordance with section "Grounding and Bonding for Electrical Systems."
- F. Coordinate connection of wiring.
- 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.

3.13 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.14 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Energize circuits to electrical equipment and devices.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- 4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 5. Coordinate with fire alarm tests. Operate as required.
 - 6. Verify that equipment hose threads are same as local fire department equipment.
- B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.15 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.
- B. Provide sprinklers to replace sprinklers with paint or coating other than the original factory finish.
- C. Protect sprinklers from damage and debris until Substantial Completion.
- D. Protect the building exterior when operating drains and test connections discharging to the building exterior.
- E. Dirt and stains on any surfaces resulting from the work of this section shall be cleaned and removed under this section.

3.16 DEMONSTRATION

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

END OF SECTION 211000

SECTION 213113 - ELECTRIC-DRIVE, HORIZONTAL SPLIT CASE FIRE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. Fire Pump: Assembly including fire pump, driver, controller, pressure-maintenance pump, pressure-maintenance pump driver, pressure-maintenance pump controller, and related accessories.
- B. In-Line Fire Pump: Same as above but fire pump is vertical with drive unit supported by pump suction and discharge flanges on same centerline. Pump shaft in vertical position.
- C. Pressure-maintenance pump (Jockey Pump): Electric-drive pump used to maintain water pressure in fire-suppression piping system.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Fire Pump Systems: Fire pumps and components that comply with performance requirements specified and are compatible with building fire-suppression systems.
- B. Pump, Equipment, Accessory, and Piping Pressure Rating: 175-psig minimum working-pressure rating, unless higher rating is indicated.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities; certified pump performance curves with each selection point indicated; shipping, installed, and operating weights; furnished specialties; and accessories for each fire pump and pressure-maintenance pump unit and flow-measuring system.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, and location and size of each field connection for each fire pump and pressure-maintenance pump unit.
 - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- D. Operation and Maintenance Data: For each fire pump and pressure-maintenance pump unit to include in operation and maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- A. Manufacturer Qualifications: Firms whose fire pumps, pressure-maintenance pumps, drivers, controllers, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with requirements indicated.
 - 1. UL listing and FM approval of pressure-maintenance pumps.
- B. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of fire pump and pressure-maintenance pump units and are based on specific models indicated. Other manufacturers' pump units with equal performance characteristics may be considered. Refer to Instructions to Bidders.
- C. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- E. Comply with standards of authorities having jurisdiction pertaining to materials, hose threads, and installation.
- F. Comply with 2013 NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection," requirements for fire pumps, drivers, controllers, accessories, fittings, and installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Shipping: After assembling and testing pressure-maintenance pumps, protect flanges and exposed machined metal surfaces, pipe openings, and nozzles.
- B. Retain shipping flange protective covers and protective coatings during storage.
- C. Protect bearings and couplings against damage from sand, grit, or other foreign matter.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Horizontal Split Case Fire Pump components:
 - a. Provide new components compatible with the existing fire pump and motor manufactured by:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- 1) Fire Pump: ITT A-C PUMP
 - 2) Fire Pump Motor: U.S. Electrical Motors, Division of Emerson Electric Co
 2. Multistage, Pressure-Maintenance Pumps:
 - a. Grundfos Pumps Corp.
 - b. ITT Fluid Technology Corp.; ITT A-C Pump Unit.
 - c. Peerless Pump Co.
 3. Fire pump Controllers:
 - a. Firetrol, Inc.
 - b. Hubbell Industrial Controls, Inc.
 - c. Joslyn Clark Controls, Inc.
 - d. Master Control Systems, Inc.
 - e. Metron, Inc.
 - f. Eaton
 4. Pressure-maintenance pump Controllers:
 - a. Firetrol, Inc.
 - b. Hubbell Industrial Controls, Inc.
 - c. Joslyn Clark Controls, Inc.
 - d. Master Control Systems, Inc.
 - e. Metron, Inc.
 - f. Eaton
- 2.2 HORIZONTAL SPLIT CASE FIRE PUMP
- A. Description: Existing fire pump with electric-motor driver:
 1. Existing Fire Pump Characteristics:
 - a. CENTRIFUGAL FIRE PUMP, HORIZONTAL SPLIT CASE
 - b. TYPE 8100, 8X6X12 F
 - c. RATED 750 GPM AT 50 PSI
 - d. 1765 RPM, IMPELLER DIAMETER 11.60, 1 STAGE
 - e. MAXIMUM BRAKE HORSEPOWER 37.2
 2. Existing Fire Pump Motor Characteristics:
 - a. MODEL G203A, 40 HP, 3 PHASE, 60Hz
 - b. FRAME 324T, Type D
 - c. ENCLOSURE: DP
 - d. SERVICE FACTOR 1.15
 - e. 1775 RPM
 - f. 230V, 102.4 AMPS; 460V, 51.2 AMPS
 3. Refurbish existing fire pump as indicated on the drawings; provide components compatible with existing fire pump.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.3 PRESSURE-MAINTENANCE PUMPS

- A. Description: Factory-assembled and -tested, electric-drive pumps with cast-iron or stainless-steel casing and bronze or stainless-steel impellers and mechanical seals. Include flanged suction and discharge flanges machined to ASME B16.1, Class 125 dimensions, unless Class 250 flanges are indicated and except that connections may be threaded in sizes where flanges are not available.
1. Multistage, Pressure-Maintenance Pumps: Multiple-impeller type complying with HI 1.1-1.5 requirements for multistage centrifugal pumps. Include base.

2.4 PUMP DRIVERS

- A. Description: NEMA MG 1, totally-enclosed fan-cooled (TEFC), squirrel-cage, induction motor. Include construction complying with NFPA 20 and NFPA 70, and include wiring compatible with controller used.
1. Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
 2. Nameplate: Complete with motor horsepower, characteristics, and other pertinent data.

2.5 PUMP CONTROLLERS, GENERAL

- A. Description: Combined automatic and nonautomatic operation; factory assembled and wired; factory tested for capacities and electrical characteristics; and with the following features:
1. Enclosure: Minimum UL 50, Type 2, dripproof, indoor, unless special-purpose enclosure is indicated.
 2. Controls, devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used, and specific items listed for each controller type.
 3. Nameplate: Complete with capacity, characteristics, approvals and listings, and other pertinent data.
 4. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with nonferrous-metal sensing piping, NPS 1/2 (DN15), with globe valves for testing controller mechanism from system to pump controller as indicated. Include bronze check valve with 3/32-inch (2.4-mm) orifice in clapper or ground-face union with noncorrosive diaphragm having 3/32-inch (2.4-mm) orifice.

2.6 FULL-SERVICE, FIRE PUMP CONTROLLERS

- A. Description: UL 218 and NFPA 20; listed for electric-drive, fire pump service and service entrance.
1. Type Starting: Soft Start.
- B. Rate controllers for scheduled horsepower. Include short-circuit withstand rating at least equal to short-circuit current available at controller location. Take into account cable size and distance from substation or supply transformers.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- C. Automatic Transfer Switches: UL 218 and UL 1008 and requirements for and attached to fire pump controllers. Include enclosure complying with minimum UL 50, Type 2, with automatic transfer switch with rating at least equal to fire pump driver-motor horsepower. Include ampere rating not less than 115 percent of motor full-load current and suitable for switching motor-locked rotor current.
- D. Controllers: As follows:
 - 1. Isolating means and circuit breaker.
 - 2. "Power on" pilot lamp.
 - 3. Fire alarm system connections for indicating the following:
 - a. Motor running condition
 - b. Loss-of-line power
 - c. Line-power phase reversal
 - d. Controller connected to alternate power source (generator).
 - 4. Automatic and manual operation, and minimum run-time relay to prevent short cycling.
 - 5. Water-pressure-actuated switch with independent high and low calibrated adjustments responsive to water pressure in fire-suppression system.
 - 6. Automatic and manual shutdown.
 - 7. System pressure recorder, electric ac driven with spring backup.
 - 8. Mounting: Floor mount type.
 - 9. Enclosure Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.

2.7 PRESSURE-MAINTENANCE PUMP CONTROLLERS

- A. Description: UL 508; factory-assembled, -wired, and -tested across-the-line type for combined automatic and nonautomatic operation.
 - 1. Enclosure: UL 508 and NEMA 250, Type 2, wall-mounting type for field electrical wiring.
- B. Rate controller for scheduled horsepower and include the following:
 - 1. Fusible disconnect switch.
 - 2. Pressure switch.
 - 3. Hand-off-auto selector switch.
 - 4. Pilot light.
 - 5. Running period timer.
 - 6. Enclosure Finish: Manufacturer's standard color paint applied to factory-assembled and -tested unit before shipping.

2.8 FIRE PUMP SPECIALTIES AND ACCESSORIES

- A. Match fire pump suction and discharge ratings as required for fire pump capacity rating. Include the following:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Test-Header Manifold: Provide exposed-type header with hose valve outlets and rectangular escutcheon plate with lettering equivalent to " FIRE PUMP TEST."
2. Hose Valves: Polished chrome or brass with cap and chain. Include NFPA 1963 hose thread that complies with local fire department standards and finish same as for test-header-manifold escutcheon plate.
3. Ball Drip Valve: UL 1726.
4. Finish: Polished chrome or brass.

2.9 PRESSURE-MAINTENANCE PUMP SPECIALTIES AND ACCESSORIES

- A. Match pressure-maintenance pump suction and discharge ratings as required for pump capacity rating. Include the following:
 1. Circulation relief valve.
 2. Suction and discharge pressure gages.

2.10 GROUT

- A. Description: ASTM C 1107, Grade B, factory-mixed and -packaged nonshrink and nonmetallic grout; suitable for interior and exterior applications.
- B. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout.
- C. Properties: Nonstaining, noncorrosive, and nongaseous.
- D. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment foundations, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting fire pump performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine roughing-in of fire-suppression piping systems. Verify actual locations of piping connections before pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

- A. Install concrete bases as required for pressure-maintenance pump and pump controllers. Refer to Division 3 Section "Cast-in-Place Concrete" and Division 21 Section "Common Work Results for Fire-Suppression"

3.3 INSTALLATION

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- A. Provide 36 inches minimum clearance in front of all valves and equipment.
- B. Comply with fire pump, pressure-maintenance pump, and controller manufacturers' written installation and alignment instructions, and with NFPA 20.
- C. Install pumps and controllers to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
- D. Install suction and discharge piping equal to or greater than diameter of fire pump nozzles.
- E. Install valves that are the same size as piping connecting fire pumps, bypasses, test headers, and other piping systems.
- F. Support pumps and piping separately so weight of piping does not rest on pumps.
- G. Install piping accessories, hangers and supports, anchors, valves, meters and gages, and equipment supports.
- H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Furnish copies of manufacturers' wiring diagram Submittals to electrical Installer.
 - 1. Verify that electrical wiring is installed according to manufacturers' submittal and installation requirements in Division 26 Sections. Proceed with equipment startup only after wiring installation is satisfactory.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 21 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
 - 1. Install piping adjacent to fire and pressure-maintenance pumps to allow service and maintenance.
 - 2. Connect water supply to fire and pressure-maintenance pumps.
 - 3. Connect fire pump and pressure-maintenance pump discharge piping to building fire-suppression piping.
 - 4. Connect relief-valve discharge to point of disposal.
- B. Connect fire pump controllers to building fire alarm system. Refer to Division 28 Section "Fire Alarm Systems."
- C. Connect controllers to pumps.
- D. Electrical wiring and connections are specified in Division 16 Sections.
- E. Ground equipment.
 - 1. 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.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including fire pump and pressure-maintenance pump units, piping, and electrical connections. Report results in writing.
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Check suction line connections for tightness so no air gets into pumps.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 5. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire pump test water. Fire hoses are for field-acceptance tests only and are not property of Owner.
 6. Final Checks before Startup: Perform the following preventive-maintenance operations and checks:
 - a. Lubricate oil-lubrication-type bearings.
 - b. Remove grease-lubrication-type bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
 - c. Disconnect coupling and check electric motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
 - d. Verify that pump is free to rotate by hand. If pump is bound or if it drags even slightly, do not operate until cause of trouble is determined and corrected.
 7. Starting procedure for pumps is as follows:
 - a. Prime pump by opening suction valve and closing drains, and prepare pump for operation.
 - b. Open sealing liquid supply valves if pump is so fitted.
 - c. Start motor.
 - d. Open discharge valve slowly.
 - e. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Do not tighten gland immediately but let packing run in before reducing leakage through stuffing boxes.
 - f. Check general mechanical operation of pump and motor.
- B. Perform field tests for each fire pump unit and system piping when installation is complete. Comply with operating instructions and procedures in NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or that does not perform as indicated, then retest to demonstrate compliance. Verify that each fire pump unit performs as indicated. Report test results in writing.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units as specified below:
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining units.
 - 2. Review data in maintenance manuals. Refer to Division 1 Section "Closeout Procedures".
 - 3. Schedule training with Owner with at least seven days' prior notice.

END OF SECTION 213113

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

4. Escutcheons.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.7 INTENT OF CONTRACT DOCUMENTS

- A. Plumbing drawings are diagrammatic, indicating general locations and arrangements of pipe, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- B. Coordinate work in order to achieve proper operation and to provide a maintainable installed condition.
- C. Notify the Architect's representative immediately of conditions which do not comply or will not produce this result.
- D. Indicated configurations were used to size pipes, pumps, expansion tanks and other devices. Install piping and equipment generally as indicated. Minor deviations are permitted in the course of necessary coordination. Major changes shall be submitted for approval by the Architect's representative. Additional fittings and offsets not shown on the drawings are expected, anticipated by the design, and shall be provided. If more than 5% of the indicated number of fittings are required or if one change in direction is within six inches of another change in direction and this "Z" shape is not indicated notify the Architect's representative immediately. Provide necessary additional fittings and offsets. Changes in pipe size shall be made only with written approval from the Architect's representative.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to other Division 22 piping sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping sections for joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions inside & outside pipe and:
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8-inch-thick, unless otherwise indicated, and full-face or ring type, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free (95% Tin, 5% Antimony) alloy. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 MECHANICAL GROOVED JOINT COUPLINGS

- A. Manufacturer: Victaulic
- B. Description: Pipe joint consisting of a grooved pipe, EPDM gasket, steel housing, 2 bolts and 2 nuts.
- C. Gasket Material: Grade “E” EPDM suitable for use up to 250 degrees F.
- D. Housing: Carbon steel

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig working pressure, as required to suit system pressures.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

- a. Calpico, Inc.
- b. Lochinvar Corp.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PE: Reusable, PE, tapered-cup-shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 2 Sections "Site and Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Remove equipment and associated piping back to main unless otherwise indicated. Cap services.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services. Remove, clean, and store equipment. When appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Remove equipment and associated piping back to main unless otherwise indicated. Cap services. Remove equipment, clean, and store as directed (May be off-site). Make available to owner at time of the owner's choosing.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following and Division 22 Sections specifying piping systems.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at the minimum slopes required by authorities having jurisdiction unless otherwise indicated.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. Exposed, Interior Installations/Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - 2. Exposed, Interior Installations/Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish and set-screw.
 - 3. Exposed, Interior Installations/Insulated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - 4. Exposed, Interior Installations/Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with finish to match surrounding surfaces.
 - 5. Exposed, Interior Installations/Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with finish to match surrounding surfaces.
 - 6. Exposed, Interior Installations/Piping in Unfinished Service Spaces: None, provide sealant.
 - 7. Exposed, Interior Installations/Piping in Equipment Rooms: None, provide sealant.
 - 8. Exposed, Interior Installations/Piping at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces: None - provide sealant and sleeve extending 2" above floor to prevent liquid leaking to floor below
- L. Sleeves are not required for core-drilled holes.
 - 1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.
- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
 - 1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.
- N. Install sleeves for pipes passing through walls, floors, or roofs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2. Install sleeves as walls and slabs are constructed.
 - a. PVC Pipe Sleeves: Permitted for pipes smaller than NPS 6 except aboveground, exterior-walls.
 - b. Steel Sheet Sleeves: Permitted for pipes NPS 6 and larger, penetrating gypsum-board partitions except aboveground, exterior-walls.
 - c. Stack Sleeve Fittings: For pipes penetrating floors. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor. Seal space outside sleeve fittings with grout.
3. Except for penetrations where mechanical sleeve seals are used, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants".
- O. Aboveground Exterior Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.
 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 4. Sleeves from an approved sleeve seal manufacturer shall be acceptable.
- P. Underground Exterior Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.
- Q. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section "Penetration Firestopping" for materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Non-pressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
- N. Mechanical Joints: Prepare pipe ends and fittings, apply coupling, and join according to joint manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping 2" and smaller, one adjacent to each valve and at final connections to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2" and larger, adjacent to final connections to each piece of equipment.
 - 3. Install dielectric unions or flanges for connections of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 HOUSEKEEPING PADS AND EQUIPMENT PADS

- A. Housekeeping pads and equipment pads: Anchor equipment to concrete according to equipment manufacturer's written instructions and according to seismic codes at project location.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. Construct concrete pads in accordance with drawing details.
2. Details may be found on structural drawings. If details are not provided comply with the following:
 - a. Housekeeping pads inside the building shall be 4" thick and 6" larger all around than supported equipment. Provide a 1" chamfer on all edges.
 - b. If details are not provided, equipment pads outside the building shall be 8" thick with a 24" deep 12" wide turndown (footing) all around the outside edge of the pad. Provide welded wire mesh reinforcement. Pad shall be 12" larger all around than supported equipment.
 - c. Install dowel rods to connect housekeeping pad to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the pad. Provide a 1" chamfer on all edges.
 - d. Install epoxy-coated anchor bolts. For equipment on housekeeping pads bolts shall extend through housekeeping pad, and anchor into structural concrete floor.
 - e. Place and secure anchor bolts using supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions for placement.
 - f. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - g. Install anchor bolts according to anchor bolt manufacturer's written instructions.
 - h. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete".

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.9 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

H. Cure placed grout.

3.10 EXCAVATION AND BACKFILL

- A. Excavation and backfill shall be as indicated in Division 1 specifications and on the drawings. If excavation and backfill is not otherwise indicated the following shall apply:
1. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below frost line.
 2. Excavate trenches to uniform widths to provide twelve inches clear on each side of pipe. Excavate trench walls vertically from trench bottom.
 3. Trench Bottoms: Excavate trench bottoms to provide flat surface. Place and compact six inches of sand. Excavate and shape sand to provide uniform bearing and support of pipes. Shape sand to provide continuous support for bells, joints, fittings, and barrels of pipes. Sand shall be free of projecting stones and sharp objects.
 4. Backfill and hand tamp to 95% proctor to six inches above the top of the pipe.
 5. Backfill and machine tamp the remainder of the trench to 95% proctor in twelve inch lifts.

END OF SECTION 220500

SECTION 220513 – MOTORS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

- A. Manufacturer's catalog and efficiency data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.4 COORDINATION

- A. Equip all motors with overload protection.
 - 1. Locate overload protection near the motor.
 - 2. Overload protection:
 - a. Locate between the circuit breaker/fuse provided under Division 26 and the motor windings.
 - b. Comply with one of the following:
 - 1) Locate in motor by motor manufacturer. (Design Standard)
 - 2) Locate separate overload device near motor.
 - 3) Locate in, or with, disconnect switch by equipment manufacturer. Provision of such switch shall not modify, change, or eliminate Division 26 requirements. Provide indicated disconnecting means.
- B. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
- C. Compatible with controller.
- D. Matched to torque and horsepower requirements of the load.
- E. Matched to ratings and characteristics of supply circuit and required control sequence.
- F. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
- G. Belt tension must be wrench and socket adjustable.
- H. Belt tensioning device must accommodate adjustable sheaves.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- A. Motor requirements apply except as follows:
- B. Ratings, performance, or characteristics for a motor are specified in another Section or are scheduled on the drawings.
- C. Motor manufacturer requires ratings, performance, or characteristics, other than those specified to meet indicated performance.

2.2 MOTOR CHARACTERISTICS

- A. Frequency Rating: 60 Hz.
- B. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- C. Duty: Continuous at 105 deg F and 3300 feet above sea level.
- D. Capacity and Torque sufficient to:
- E. Start, accelerate, and operate connected load.
- F. Maintain designated speeds.
- G. Operate at installed altitude and environment.
- H. Operate with indicated operating sequence.
- I. Operate without exceeding nameplate ratings.
- J. Operate without utilizing service factor.
- K. Enclosure: Open drip-proof unless otherwise indicated.
- L. Minimum Service Factor: 1.15 unless otherwise indicated.
- M. Acceptable VFD Manufacturers:
 - 1. Danfoss Graham
 - 2. Square D
 - 3. ABB
 - 4. Honeywell
 - 5. Cutler Hammer

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Premium efficiency motors shall meet the following full load efficiency:

HP	ODP			TEFC		
	6 Pole	4 Pole	2 Pole	6 Pole	4 Pole	2 Pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0

- C. Efficiency: Premium
- D. Stator: Copper windings, unless otherwise indicated.
- E. Rotor: Squirrel cage, unless otherwise indicated.
- F. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating, unless otherwise indicated.
- H. Insulation: Class F, unless otherwise indicated.
- I. Code Letter Designation: NEMA starting Code F or G.
- J. Enclosure: Cast iron.
- K. Finish: Gray enamel.
- L. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- M. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
- N. Measure winding resistance.
- O. Read no-load current and speed at rated voltage and frequency.
- P. Measure locked rotor current at rated frequency.
- Q. Perform high-potential test.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Perform the following:
 1. Run each motor with its controller at load.
 2. Demonstrate correct rotation, alignment, and speed.
 3. Test interlocks and control features for proper operation.
 4. Verify that current in each phase is within nameplate rating.
 5. Verify RPM is in accordance with nameplate.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

6. Where a generator is provided, run each motor on the generator with its controller and load. Demonstrate correct rotation, alignment, and speed.

3.2 ADJUSTING

- A. Align motors, bases, and shafts.

3.3 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 210550

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Maintenance Data: For expansion joints to include in maintenance manuals.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

- A. Flexible-Hose Packless Expansion Joints:
 - 1. Available Manufacturers:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Flex Pression Ltd.
 - d. Metraflex, Inc.
 - e. Unisource Manufacturing, Inc.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
 - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
 - b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
5. Expansion Joints for Copper Tubing 2-1/2" to 4": Copper-alloy fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Available Manufacturers:
 - a. Adscro Manufacturing LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Flex-Hose Co., Inc.
 - d. Flexicraft Industries.
 - e. Flex-Weld, Inc.
 - f. Hyspan Precision Products, Inc.
 - g. Metraflex, Inc.
 - h. Unisource Manufacturing, Inc.
2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
- 5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install rubber packless expansion joints according to FSA-NMEJ-702.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Connect risers and branch connections to mains with a minimum of 5 (five) pipe fittings including tee in main.
- B. Connect risers and branch connections to terminal units with a minimum of 4 (four) pipe fittings including tee in riser.
- C. Connect mains and branch connections to terminal units with a minimum of 4 (four) pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four Insert number pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

- A. Available Manufacturers:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Wade
 - 3. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. GPT, EnPro Industries
 - d. Metraflex Co.
 - e. Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Plastic. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4" clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants.
- E. Fire Ratings: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 1. Install fittings that are large enough to provide ¼" clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire Rating: Maintain indicated fire rating at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 SLEEVE-SEAL SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building unless otherwise indicated.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 1. Exterior Concrete Walls above Grade, below Grade, Concrete Slabs-on-Grade, and Concrete Slabs above Grade:
 - a. Piping Smaller Than 6": Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for one inch (1") annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping 6" and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

END OF SECTION 220517

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

1.3 ABBREVIATIONS:

- A. AFF Above finished floor
- B. F Fahrenheit
- C. SS Stainless Steel

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Available Manufacturers:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
 - 4. Case Form: Adjustable angle unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue or red organic liquid.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in degrees F.
7. Window: Glass
8. Stem: Aluminum length = 1/2 pipe diameter, 1/2 duct width or 12" whichever is less.
 - a. Air-Duct Installation: Provide ventilated shroud.
 - b. Thermowell Installation: Provide Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into threaded fitting.
3. Material: Brass.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Available Manufacturers:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Trerice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- n. WIKA Instrument Corporation - USA.
- o. Winters Instruments - U.S.
- 2. Standard: ASME B40.100.
- 3. Case: Solid-front, lead-free, pressure relief type; stainless steel; 4-1/2-inch nominal diameter.
- 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- 6. Movement: Phosphor bronze.
- 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
- 8. Pointer: Dark-colored metal.
- 9. Window: Glass.
- 10. Ring: Brass.
- 11. Accuracy: + or – 1.0 percent of full scale.

2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 pipe threads.
- C. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Co., Inc.
 - 5. Sisco Manufacturing Company, Inc.
 - 6. Terice, H. O. Co.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.6 FLOWMETERS

A. Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Water
 - 1) Neptune Meter with Neptune: E-Coder register w/ the potted cable.
 - 2) R900i register is NOT acceptable.
 - b. Gas
 - 1) Onicon Insertion Meter with D-100 Display.
 - c. Modbus Gateway
 - 1) Scadametrix Modbus Gateway.
2. Description: Flowmeter with sensor and indicator with full-flow/full-sized bypass with output linked to BMS via Modbus Gateway. Gas shall connect display directly to BMS via Local Operating Network.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Type matching system service for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute for water and cubic feet per hour for gas.
 - a. Design: Device or pipe fitting with inline and integral direct-reading scale for water.
 - b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
 - c. Minimum Pressure Rating: 150 psig.
 - d. Minimum Temperature Rating: 180 deg F.
5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
6. Accuracy: Plus or Minus 1 percent.
7. Display, Calculation, and Relay Parameters:
 - a. Water
 - 1) Totalized Volume
 - 2) Instantaneous Flow Rate
 - b. Gas
 - 1) Totalized Volume
 - 2) Instantaneous Flow Rate
8. Operating Instructions: Include complete instructions with each flowmeter.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings to match sizes.
- C. Install thermowells with extensions on insulated piping.
- D. Install direct-mounted thermometers in thermowells and adjust positions.
- E. Install pressure gages in piping tees located between 36" and 60" above finished floor unless otherwise indicated.
- F. Install valve and snubber for each pressure gage.
- G. Install test plugs in piping tees at locations indicated.
- H. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- I. Install flowmeter elements in accessible positions in piping systems.
- J. Install permanent indicators on walls or brackets at 50" above finished floor unless otherwise indicated..
- K. Install connection fittings in accessible locations for attachment to portable indicators.
- L. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
- M. Install pressure gages in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Suction and discharge of each pump.
- N. Install a test plug at each thermometer and pressure gauge.

3.2 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-water Piping: 0 to 100 F with 2 degree scale divisions.
- B. Scale Range for Domestic Hot-water Piping 30 to 240 F with 2 degree scale divisions.

3.3 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Water Piping: 0 psi to 100 psi.

3.4 FLOWMETER SCHEDULE

- A. Flowmeters for Domestic Water Piping:
 - 1. 1-1/2" and Smaller: Positive Displacement Type.
 - 2. 2" and Larger: Compound Type with Matching Strainer.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- B. Flowmeter for Gas Piping:
 - 1. Inline Insertion Type.

END OF SECTION 220519

SECTION 220523 – GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 3. MPTFE: Modified polytetrafluoroethylene plastic.
 - 4. NBR: Acrylonitrile-butadiene rubber.
 - 5. PTFE: Polytetrafluoroethylene plastic.
 - 6. RPTFE: Reinforced polytetrafluoroethylene plastic.
 - 7. SWP: Steam working pressure.
 - 8. TFE: Tetrafluoroethylene plastic.
 - 9. WOG: Water Oil Gas.

1.3 SUBMITTALS

- A. Product Data: For each type of valve proposed. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include proposed specialties and accessories.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
 - 1. Exceptions: Domestic hot- and cold-water valves unless referenced.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance:
 - 1. NSF 61 for valve materials for potable-water service.
 - 2. NSF 372 for Lead content requirements in drinking water system components.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2. Protect threads, flange faces, grooves, and weld ends.
 3. Set ball valves open to minimize exposure of functional surfaces.
 4. Set butterfly valves closed or slightly open.
 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze & Brass: Shall be dezincification resistant. (Zinc content shall be less than 15%)
- C. Bronze Valves: 2" and smaller with threaded or soldered ends, unless otherwise indicated.
- D. Ferrous Valves: 2-1/2" and larger with flanged ends, unless otherwise indicated.
- E. Valve Pressure and Temperature Ratings: Not less than indicated for system pressure and temperature.
- F. Valve Sizes: Same as the larger of the upstream or downstream pipe, unless otherwise indicated.
- G. Valve Actuators:
1. As indicated in other Part 2 articles.
 2. Where indicated, provide a chain actuator.
 3. Chain Actuator: For attachment to valves of size and mounting height indicated.
 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
- H. Extended Valve Stems: Provide on insulated valves.
- I. Valve Flanges: Provide ASME B16.1 for cast-iron valves, ASME B16.5 for steel, and ASME B16.24 for bronze.
- J. Valve Grooved Ends: AWWA C606.
- K. Threaded: With threads according to ASME B1.20.1.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- L. Valve Bypass and Drain Connections: MSS SP-45.

2.2 COPPER-ALLOY BALL VALVES

- A. Two-Piece, Copper-Alloy Ball Valves (Full Port) (1/4" to 2-1/2"):
1. Conbraco Industries-Apollo 77CLF series with stainless steel ball & stem (Un-insulated piping)
 2. Conbraco Industries-Apollo 77CLF series with stainless steel ball & stem. Provide 2 1/4" stem extension (Insulated piping)
 3. Other Manufacturers:
 - a. Milwaukee
 - b. Watts
 - c. Nibco
 4. Handle Nut: Zinc plated steel or 300 series stainless steel.
 5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
 6. Threaded Pack Gland: Brass ASTM B-16
 7. Packing: MPTFE or TFE
 8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 1/4" stem extension for Insulated piping.
 9. Thrust Washer: MPTFE or RPTFE
 10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
 11. Seats: MPTFE or Reinforced TFE (RPTFE)
 12. Body: Bronze ASTM B-584 for solder or threaded connection.
 13. Body End Piece: Bronze ASTM B-584 for solder or threaded connection.
 14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
 15. Conform To: MSS SP-110
- B. Two-Piece, Bronze Ball Valves UL listed for shut-off gas service (Up to 2 1/2"):
1. Conbraco Industries-Apollo 80-100 series (Un-insulated piping).
 2. Conbraco Industries-Apollo 80-100 series with stainless steel ball & stem. Provide 2 1/4" stem extension (Insulated piping)
 3. Other Manufacturers:
 - a. Milwaukee
 - b. Watts
 - c. Nibco
 4. Handle Nut: Zinc plated steel or 300 series stainless steel.
 5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
 6. Threaded Pack Gland: Brass ASTM B-16
 7. Packing: MPTFE or TFE
 8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 1/4" stem extension for Insulated piping.
 9. Thrust Washer: MPTFE or RPTFE
 10. Ball: Brass ASTM B-16, chrome plated.
 11. Seats: MPTFE or Reinforced TFE (RPTFE)
 12. Body: Bronze ASTM B-584 for threaded connection.
 13. Body End Piece: Bronze ASTM B-584 for threaded connection.
 14. Rating: 150 psig saturated steam, 250 psi gas, vacuum service to 29".
 15. Conform To: MSS SP-110

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- C. Two-Piece, Copper-Alloy Ball Valves (Full Port) (2-1/2" to 4"):
1. Conbraco Industries - Apollo 94ALF-A series with stainless steel ball & stem (Un-insulated piping)
 2. Conbraco Industries - Apollo 94ALF-A series with stainless steel ball & stem. Provide 2 1/4" stem extension (Insulated piping)
 3. Other Manufacturers:
 - a. Milwaukee
 - b. Watts
 - c. Nibco.
 4. Handle Nut: Zinc plated steel or 300 series stainless steel.
 5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
 6. Threaded Pack Gland: Brass ASTM B-16 Alloy 360
 7. Packing: RPTFE or TFE
 8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 1/4" stem extension for Insulated piping.
 9. Thrust Washer: MPTFE or Reinforced TFE
 10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
 11. Seats: MPTFE or Reinforced TFE
 12. Body: Bronze ASTM B-584 for solder or threaded connection.
 13. Body End Piece: Bronze ASTM B-584 for solder or threaded connection.
 14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
 15. Conform To: MSS SP-110

2.3 LARGE GAS BALL VALVES (ABOVE 2 1/2" to 10"):

- A. Carbon Steel ANSI class 150, flanged, standard port ball valve with stainless steel ball and stem.
1. Conbraco Industries-Apollo 88A-140 series
 2. Other Manufacturers:
 - a. Milwaukee
 - b. Watts
 - c. Nibco
 3. Provide gear operator with oversized hand wheel.
 4. Packing Gland: ASTM A108 Type 1215
 5. Packing: RPTFE or TFE
 6. Stem (Blowout Proof): ASTM A108 Type 1215
 7. Ball: Standard-port, ASTM A-276 Type 316 stainless steel solid ball.
 8. Seats: RPTFE
 9. Thrust Washer: RPTFE.
 10. Body: Carbon steel ASTM A216 WCB.
 11. Body Nut: ASTM A194, grade 2H.
 12. UL (YRPV): Listed for gas shut-off service.
 13. Rating: 150 psig saturated steam

2.4 FERROUS-ALLOY BUTTERFLY VALVES

- A. General: Butterfly valves shall provide bi-directional bubble tight dead-end service without a downstream flange.
- B. Wafer-lug type butterfly valves:
 - 1. Conbraco Industries-Apollo 141(wafer)/143(lug)
 - 2. Other Manufacturers:
 - a. Stockham
 - b. Demco
 - c. Nibco
 - 3. Shaft: ASTM A-582 Type 416 Stainless steel single piece through shaft.
 - 4. Collar Bushing: ASTM B-124 Brass or PTFE.
 - 5. Stem Seal: EPDM OR Buna-N Rubber
 - 6. Body Seal: EPDM Rubber
 - 7. Upper Bushing: CDA 122 Copper or PTFE
 - 8. Liner: EPDM Rubber
 - 9. Disc: ASTM B-148 alloy 954/955 aluminum bronze.
 - 10. Lower Bushing: CDA 122 copper or PTFE.
 - 11. Body Wafer: ASTM A-536 Ductile Iron or ASTM A-126 CL. B cast iron.
 - 12. Body Lug: ASTM A-536 Ductile Iron or ASTM A-126 CL. B cast iron.
 - 13. Ratings:
 - a. 2" through 12" 200 psig CWP.
 - b. 14" through 24" 150 psig CWP.
 - 14. Conform To: MSS SP-67, MSS SP-25, API-609
 - 15. Operator:
 - a. Valves up to and including 6": Lever-lock operator.
 - b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.
- C. Grooved-End 300 psig butterfly valves:
 - 1. Conbraco Industries-Apollo SJ-900N/SJ-900N-L
 - 2. Other Manufacturers:
 - a. Victaulic
 - b. Nibco
 - 3. Upper Stem: ASTM A-582 Type 416 Stainless steel.
 - 4. Upper Bearing: Split metal.
 - 5. O-Ring: EPDM
 - 6. Body: ASTM A-395 ductile iron with polyimide coating.
 - 7. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
 - 8. Lower Bearing: Split metal.
 - 9. Dust Plug: PVC
 - 10. Rating: 300 psig CWP.
 - 11. Conform To: MSS SP-67
 - 12. Operator:
 - a. Valves up to and including 6": Lever-lock operator.
 - b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

D. Flanged 200 psig butterfly valves:

1. Conbraco Industries-Apollo SJ-200
2. Other Manufacturers:
 - a. Nibco
3. Upper Stem: ASTM A-582 Type 416 Stainless steel.
4. Upper Bushing: TFE over porous bronze, steel backed.
5. O-Ring: EPDM
6. Body: ASTM A-126 Class B cast iron with polyimide coating.
7. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
8. Lower Bushing: TFE over porous bronze, steel backed.
9. Lower Stem: ASTM A-582 Type 416 Stainless steel.
10. Dust Plug: PVC
11. Rating: 200 psig CWP.
12. Conform To: MSS SP-67 and MSS SP-25
13. Operator:
 - a. Valves up to and including 6": Lever-lock operator.
 - b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

E. Flanged 200 psig butterfly valves for Gas Service:

1. NIBCO Model FC-2765-0
2. Upper Stem: ASTM A-582 Type 416 Stainless steel.
3. Upper Bushing: TFE over porous bronze, steel backed.
4. O-Ring: EPDM
5. Body: ASTM A-126 Class B cast iron with polyimide coating.
6. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
7. Lower Bushing: TFE over porous bronze, steel backed.
8. Lower Stem: ASTM A-582 Type 416 Stainless steel.
9. Dust Plug: PVC
10. Rating: 200 psig CWP.
11. Conform To: MSS SP-67 and MSS SP-25
12. Operator:
 - a. Valves up to and including 6": Lever-lock operator.
 - b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

2.5 BRONZE CHECK VALVES

A. Bronze, Horizontal Swing Check Valves:

1. Conbraco Industries-Apollo 161S/T
2. Other Manufacturers:
 - a. Milwaukee
 - b. Stockham
 - c. Nibco
3. Bonnet: ASTM B-62 bronze.
4. Body: ASTM B-62 bronze.
5. Hinge Pin: ASTM B-140 alloy C31400 bronze, or B-134 alloy C23000 bronze.
6. Disc Hanger:

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- a. Sizes ¼" thru ¾": Type 304 stainless steel.
- b. Sizes 1" and larger: ASTM B-62 bronze.
7. Hanger Nut: ASTM B-16 bronze.
8. Disc Holder: ASTM B-62 bronze.
9. Seat Disc:
 - a. Water and Other Heat Transfer Fluids: ASTM B-62 bronze.
 - b. Steam: TFE
10. Seat Disc Nut: ASTM B-16 or B-62 bronze.
11. Hinge Pin Plug: ASTM B-140 alloy C31600 bronze.
12. Seat Disc Washer (When Provided): ASTM B-98 alloy C65500 or B-103 bronze.
13. Rating: 125 psig SWP and 200 psig CWP.
14. Conform To: MSS SP-80

B. Bronze, Inline Spring-Loaded Check Valves:

1. Conbraco Industries-Apollo 61-100 series
2. Other Manufacturers:
 - a. Milwaukee
 - b. Stockham
 - c. Nibco
3. Body: ASTM B-584 alloy C84400 bronze.
4. Retainer/Stem: ASTM B16 brass or ASTM A-582 alloy C30300 stainless steel.
5. Ball Check: RPTFE or
6. Disc Holder 316 Stainless steel
 - a. Disc:
 - 1) Water, Oil, Gas: Buna-N
 - 2) Steam: TFE
 - b. Seat Screw: ASTM A-276 alloy S43000 stainless steel.
 - c. Body End: ASTM B-584 alloy C84400 bronze.
 - d. Rating: 125 psig SWP and 250 psig CWP.
7. Guide: ASTM B16 Brass
8. Spring: Type 316 stainless steel.
9. Rating: 125 psig SWP and 400 psig WOG.

2.6 IRON BODY CHECK VALVES

A. Iron Body, Horizontal Swing Check Valves:

1. Conbraco Industries-Apollo 910F
2. Other Manufacturers:
 - a. Milwaukee
 - b. Stockham
 - c. Nibco
3. Body Bolt: ASTM A-307 steel.
4. Bonnet: ASTM A-126 class B cast iron.
5. Body Gasket: Synthetic Fibers.
6. Body Nut: ASTM A-307 steel
7. Side Plug: ASTM B-16 alloy C36000 Brass.
8. Hanger Pin: ASTM B-16 alloy C36000 Brass.
9. Hanger: ASTM B-584 alloy C84400 cast bronze.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

10. Disc: ASTM B-584 alloy C84400 cast bronze or ASTM A-536 ductile iron w/bronze face ring.
 11. Seat Ring: ASTM B-584 alloy C84400 cast bronze.
 12. Disc Nut: ASTM B-16 alloy C36000.
 13. Body: ASTM A-126 class B cast iron.
 14. Disc Bolt: ASTM B-16 alloy C36000 Brass.
 15. Disc Plate: ASTM A-126 class B cast iron.
 16. Disc Cage: ASTM A-126 class B cast iron.
 17. Rating: 125 psig SWP and 200 psig CWP.
 18. Conform To: MSS SP-71 Type 1.
- B. Grooved-End, Ductile-Iron Spring Assisted Check Valves: Apollo SJ-900N with EPDM disc seal.
- C. Spring Actuated Silent Check Valves:
1. NIBCO Model F-910
 2. Other Manufacturers:
 - a. Milwaukee
 - b. Stockham
 3. Body: ASTM A48 class 35 cast iron.
 4. Seat: ASTM B-584 alloy C83600 (B) bronze.
 5. Disc: ASTM B-584 alloy C83600 bronze.
 6. Spring: Type 302 ASTM A313 stainless steel.
 7. Bushing:
 - a. 6" and Smaller: ASTM B-16 brass
 - b. 8" and Larger: ASTM B-584 alloy C83600 bronze.
 8. Set Screws: Type 304 ASTM A-276 stainless steel.
 9. Rating: 200 psig CWP.
 10. Conform To: MIL-V-18436F

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully-open to fully-closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball and butterfly valves 4" and larger and more than 96 inches above finished floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
- G. Shutoff valves shall be located on each floor, on takeoffs from all vertical risers, branch lines from the mains, and at the connection to each fixture.

3.3 ADJUSTING

- A. Adjust valve packing after piping systems have been tested and put into service but before final testing and balancing. Replace valves if persistent leaking occurs.

3.4 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Throttling Service: Ball or butterfly valves.
 - 3. Pump Discharge: Spring-loaded, lift-disc check valves and ball or butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Compressed-Air Piping: Use the following types of valves:
 - 1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
 - 2. Equipment-Isolation Valves: Safety-Vent, Copper-Alloy Ball Valves (For Compressed Air).

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

3. Valves, NPS 2-1/2" and 3": Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
 4. Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
 5. Check Valves, NPS 2-1/2" and Larger: Spring Actuated Silent Check Valves.
- D. Domestic Water Piping: Use the following types of valves:
1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
 2. Valves, NPS 2-1/2" and 3":
 - a. Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
 - b. Wafer-Lug, grooved-end, or flanged butterfly valves.
 3. Valves, NPS 4" and Larger: Wafer-Lug, grooved-end, or flanged butterfly valves.
 4. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
 5. Horizontal Check Valves, NPS 2" and Smaller: Bronze, Horizontal Swing Check Valves.
 6. Vertical Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
 7. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.
 8. Horizontal Check Valves, NPS 2-1/2" and Larger: Bronze, Horizontal Swing Check Valves.
 9. Vertical Check Valves, NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.
- E. Gas Piping: Use the following types of valves:
1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
 2. Valves, NPS 2-1/2" and 3":
 - a. Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
 - b. Wafer-Lug, grooved-end, or flanged butterfly valves.
 3. Valves, NPS 4" and Larger: Wafer-Lug, grooved-end, or flanged butterfly valves.
 4. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
 5. Horizontal Check Valves, NPS 2" and Smaller: Bronze, Horizontal Swing Check Valves.
 6. Vertical Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
 7. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.
 8. Horizontal Check Valves, NPS 2-1/2" and Larger: Bronze, Horizontal Swing Check Valves.
 9. Vertical Check Valves, NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design Requirement: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer where using methods other than indicated.
- B. Structural Performance: Hangers and supports for Plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test medium.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment.

1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

- B. Trapeze Pipe Hanger Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

1. Assemble and provide according to manufacturer's written instructions. Center piping on channel to evenly distribute load.
2. Pipe sizes and numbers shall be in accordance with the following:

TRAPEZE PIPE HANGER TABLE								
PIPE SIZE	4"	3"	2 ½"	2"	1 ½"	1 ¼"	1"	TOTAL # of PIPES
NUMBER OF PIPES PERMITTED IN ONE CHANNEL SUPPORT	2	0	0	0	0	0	0	2
	0	2	2	0	0	0	0	4
	0	2	0	4	0	0	0	6
	0	2	0	0	6	0	0	8
	0	0	4	2	0	0	0	6
	0	0	4	0	2	2	0	8

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

	0	0	4	0	0	8	0	12
	0	0	0	6	2	2	2	12
	0	0	0	8	0	2	0	10
	0	0	0	0	14	0	0	14
	0	0	0	0	0	16	0	16

Notes:

1. Piping larger than 4" in diameter is not permitted in a channel support system.
2. Channel support systems shall be limited to eight (8) pipes per channel and two (2) channels (levels) per support system.
3. Smaller pipes can be substituted for larger pipes. For example two ¾" pipes may be installed in lieu of two 1" pipes, or 2" in lieu of 3", etc.
4. Spacing shall be in accordance with requirements for the smallest supported pipe. Refer to other specification sections for spacing requirements. If spacing requirements are not indicated comply with MSS SP-69.

C. Metal Framing Systems:

1. Available Manufacturers:

- a. Anvil International; a subsidiary of Mueller Water Products Inc.
- b. Empire Industries, Inc.
- c. ERICO International Corporation.
- d. Haydon Corporation; H-Strut Division.
- e. NIBCO INC.
- f. PHD Manufacturing, Inc.
- g. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with in-turned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

2.4 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
1. Available Manufacturers:
 - a. Cooper B-Line – Dura-Blok
 - b. MAPA Products
 - c. Mifab, Inc. – C-Port
 - d. Miro Industries, Inc.
 - e. OMG, Inc.
 - f. PHP Systems/Design
 - g. Pipe Prop
 - h. Roof Top Blox
 2. Provide pipe supports for supporting gas, condensate, refrigeration lines, or hydronic piping on flat roof surfaces. Support shall rest on roof surface without penetrating the roof surface. Supports for condensate piping shall be adjustable vertically to ensure pipe slopes as required.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Curb Mounted Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop or field fabricated equipment support made from structural carbon-steel shapes unless indicated otherwise.

2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69, MSS SP-89, and Table above. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.
- E. Pipe Stand Installation: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- F. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Provide hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Provide lateral bracing with pipe hangers and supports to prevent swaying.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- J. Provide building attachments within concrete slabs or attach to structural steel. Building attachments may not be used on steel joists unless otherwise indicated. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2" and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and provide reinforcing bars through openings at top of inserts.
- K. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

- 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Provide thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
- 2. Provide MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
- 3. Provide MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. Pipe 1/4" to 3-1/2": 12 inches long and 0.048 inch thick.
 - b. Pipe 4": 12 inches long and 0.06 inch thick.
 - c. Pipe 5" and 6": 18 inches long and 0.06 inch thick.
 - d. Pipe 8" to 14": 24 inches long and 0.075 inch thick.
- 5. Pipes 8" and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Provide materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Unless otherwise indicated clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Provide same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and immediately apply galvanizing-repair paint. Paint shall comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Provide hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Provide nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Provide copper-plated pipe hangers and copper attachments for copper piping and tubing.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- F. Provide padded hangers for piping that is subject to scratching.
- G. Provide thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated provide the following:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of stationary pipes ½" to 30".
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes 4" to 14", requiring up to 4" of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes ¾" to 14", requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes ½" to 14" if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes ½" to 4", to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes ¾" to 8".
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes ½" to 8".
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes ½" to 8".
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes ½" to 8".
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes ½" to 8".
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS ½" to 3".
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes ½" to 14".
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-½" to 14" if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 - 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1" to 14", from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2-½" to 14", from single rod if horizontal movement caused by expansion and contraction might occur.
 - 19. Complete Pipe Rolls (MSS Type 44): For support of pipes 2" to 14" if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 - 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2" to 14" if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2" to 14" if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated provide the following:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers ¾" to 14".
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers ¾" to 14" if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated provide the following:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
6. Flat Plate, Double Nut, and Washer as Detailed on Structural Drawings: For attaching to bar joists. Method of attachment to bar joists must be approved by the structural engineer and joist manufacturer.

K. Building Attachments: Unless otherwise indicated provide the following:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Flat Plate, Double Nuts, and Washer as Detailed on Structural Drawings: For use under roof installations with bar-joist construction to attach to bottom chord of joist.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Provide one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- L. Saddles and Shields: Unless otherwise indicated provide the followings:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Spring Hangers and Supports: Unless otherwise indicated provide the following:
1. Restraint-Control Devices (MSS Type 47): To control pipe movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Provide powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where indicated in concrete construction.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve Schedules: For each piping system to include in maintenance manuals.
- D. 1/16"=1'-0" scale drawing showing all valve locations to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, Aluminum, or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having 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.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Pre-coiled, semi-rigid, plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
 - 1. Stencil Material: Metal or fiberboard.
 - 2. Stencil Paint: Exterior, gloss, black, unless otherwise indicated. Paint shall be low VOC and shall meet the requirements of section 09910. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, in colors according to ASME A13.1, unless otherwise indicated. Paint shall be low VOC and shall meet the requirements of section 09910.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved on metal plates (1" x 2") or metal discs (1-1/4") in diameter with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers; and attached to the valves by 10-gauge brass "S" hooks. Provide numbering system identifying all valves

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

regardless of valve size or service, numbering scheme approved by Owner and Architect.
Provide 5/32-inch hole for fastener.

1. Material:
 - a. 0.032-inch- thick brass
 - b. 0.0375-inch- thick stainless steel or

- B. Valve-Tag Fasteners: 10-gauge S-hook.

2.6 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws and hangers.
 2. Frame: Finished hardwood or extruded aluminum.
 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.7 VALVE PLAN

- A. Valve Plan: Prepare a scale drawing. Provide the location and identity of each valve.
 1. Valve Plan Frames: Glazed display frame for removable mounting on masonry walls for each page of valve plan. Include mounting screws and hangers.
 2. Frame: Finished hardwood or extruded aluminum.
 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.8 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 1. Size: 3 by 5-1/4 inches minimum.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install and permanently fasten equipment nameplates on each major item of plumbing equipment that does not have nameplate or has a nameplate that is damaged or located where not easily visible. Locate nameplates where easily visible. Include nameplates for the following general categories of equipment:
 - 1. Fuel-burning units.
 - 2. Pumps, compressors, and other motor-driven equipment.
 - 3. Heat exchangers and similar equipment.
 - 4. Water heaters and storage tanks.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 - 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Meters, gages, and thermometers.
 - c. Fuel-burning units.
 - d. Pumps, compressors, and other motor-driven equipment.
 - e. Heat exchangers and similar equipment.
 - f. Water heaters and storage tanks.
- C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where easily visible.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 - c. Orange: For combination cooling and heating equipment and components.
 - d. Brown: For energy-reclamation equipment and components.
 - e. Blue: For equipment not listed in a through d
 2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
- E. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- F. Install access panel markers with screws on equipment access panels.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in other sections.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.
1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 25 feet.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
1. Compressed-Air Piping:

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- a. Background Color: Black.
 - b. Letter Color: White.
- 2. Domestic Cold Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
- 3. Domestic Hot Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
- 4. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 - 1. Valve-Tag Size and Shape:
 - a. Compressed Air: 1 ½", round.
 - b. Domestic Cold Water: 1 ½", round.
 - c. Domestic Hot Water: 1 ½", round.
 - d. Domestic Hot Water Recirculation: 1 ½", round.
 - e. Natural Gas: 2", round.
 - 2. Valve-Tag Color:
 - a. Compressed Air: White.
 - b. Domestic Cold Water: Blue.
 - c. Domestic Hot Water: Red.
 - d. Domestic Hot Water Recirculation: Red.
 - e. Natural Gas: Yellow.
 - 3. Letter Color:
 - a. Compressed Air: Black.
 - b. Domestic Cold Water: Black.
 - c. Domestic Hot Water: White.
 - d. Domestic Hot Water Recirculation: White.
 - e. Natural Gas: 2", Black.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

3.5 VALVE SCHEDULE INSTALLATION

- A. Mount valve schedules on wall in accessible location in each major equipment room and where directed by owner.

3.6 VALVE PLAN INSTALLATION

- A. Mount valve plans on wall in accessible location in each major equipment room and where directed by owner.

3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.8 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.9 CLEANING

- A. Clean faces of mechanical identification devices and glass fronts of valve schedules and plans.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. Outdoor pipe: Pipe located outside the building insulation envelope.
- B. Plenum: An unoccupied space or void, on the conditioned side of the building insulation and vapor barrier, being used to return conditioned air to the inlet side of a return or exhaust fan either directly or via a duct connection. An example would be a space with air handling light fixtures or openings in the ceiling used to transport air through the ceiling and then to an open duct located above the ceiling in another location.
- C. Indirectly Conditioned Space: A space having no direct conditioning but, due to air movement induced by an exhaust, or return opening, is conditioned by makeup air from an adjacent space. An example would be a small toilet. Boiler rooms, fan rooms, and mechanical rooms do not qualify as indirectly conditioned spaces.
- D. Inside the Building Insulation Envelope: For the purposes of this section, boiler rooms, fan rooms, and mechanical rooms are considered to be OUTSIDE the building insulation envelope.
- E. Exposed: Visible from any angle without removal of building element or equipment.
- F. Concealed: Enclosed in building element or above ceiling such that it is not visible from any angle without removal of building element or equipment.

1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
 - 1. Detail application of removable insulation covers.
 - 2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 3. Detail attachment and covering of heat tracing inside insulation.
 - 4. Detail insulation application at pipe expansion joints for each type of insulation.
 - 5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 6. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 7. Detail application of field-applied jackets.
 - 8. Detail application at linkages of control devices.
 - 9. Detail field application for each equipment type.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with type, grade, and maximum use temperature.
- B. Ship Insulated Piping System Components on pallets and wood supports. Securely fasten and protect from damage. Store off the ground and cover with opaque waterproof tarp to protect materials from sunlight and rain.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping installer for piping insulation, duct installer for duct insulation, and equipment installer for equipment insulation.
- C. Maintain clearances required for maintenance.
- D. Coordinate installation and testing of heat tracing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers:
 - 1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Johns Manville
 - c. Knauf FiberGlass GmbH.
 - d. Owens-Corning Fiberglas Corp.
 - e. Schuller International, Inc.
 - 2. Flexible Elastomeric Thermal Insulation:
 - a. Armstrong World Industries, Inc.
 - b. Rubatex Corp.
 - 3. Polyolefin Insulation:
 - a. Armstrong World Industries, Inc.
 - b. IMCOA.
 - 4. Closed-Cell Phenolic-Foam Insulation:

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- a. Kooltherm Insulation Products, Ltd.
- 5. Removable Insulation Covers:
 - a. Advance Thermal Corp.

2.2 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, with factory applied FSK Jacket. Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin to maximum service temperature of 250°F. Faced insulation shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E84.
- G. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, & IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
- H. Mineral-Fiber Blanket with Factory Applied FSK Jacket: Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin with a multi-purpose foil-scrim kraft (FSK) jacket to maximum service temperature of 250°F. FSK shall meet the requirements of ASTM C 1136, Type II, when surface burning characteristics are determined in accordance with ASTM E 84 with the foil surface of the material exposed to the flame as it is in the final composite. Composite (insulation, facing and adhesive) shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84. Insulation properties shall be as follows:
 - 1. Thickness: 1-1/2"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 5.0
 - c. Minimum installed R value assuming 25% compression: 4.0
 - 2. Thickness: 2"
 - a. Density: 1.0 pcf
 - b. Minimum uncompressed R value: 7.4
 - c. Minimum installed R value assuming 25% compression: 6.0
 - 3. Alternate to 2" 1.0 pcf: Thickness: 2.2"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 7.4
 - c. Minimum installed R value assuming 25% compression: 6.0
 - 4. Thickness: 3"
 - a. Density: 0.75 pcf

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- b. Minimum uncompressed R value: 10.0
 - c. Minimum installed R value assuming 25% compression: 8.3
 - I. Medium Temperature Mineral-Fiber Blanket for Operating Temperatures from 250 to 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
 - J. High Temperature Mineral-Fiber Blanket for Temperatures above 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
 - K. Mineral-Fiber Pipe Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
 - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 - 2. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
 - 3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
 - 4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 - 5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
 - 6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - L. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Adhesive: As recommended by insulation material manufacturer.
 - 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
 - M. Closed-Cell Phenolic-Foam: Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
 - N. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- 2.3 FIELD-APPLIED JACKETS
- A. General: ASTM C 921, Type 1, unless otherwise indicated.
 - B. Glass Cloth: Woven glass-fiber fabric, plain weave, minimum 8 ounces per square yard.
 - C. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
 - D. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
 - 1. Adhesive: As recommended by insulation material manufacturer.
 - 2. PVC Duct Jacket Color: White or gray.
 - 3. PVC Pipe Jacket Color: Color-code piping jackets based on materials contained within the piping system.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- E. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Factory cut and rolled to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
 - 1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
 - 2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.
- F. Stainless-Steel Jacket: Deep corrugated sheets of stainless steel complying with ASTM A 666, Type 304 or 316; 0.10 inch thick; and roll stock ready for shop or field cutting and forming to indicated sizes.
 - 1. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - 2. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.
 - 3. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.
- G. Heavy PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil-thick, high-impact, ultraviolet-resistant PVC.
 - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - 2. Adhesive: As recommended by insulation material manufacturer.
- H. Standard PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
 - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - 2. Adhesive: As recommended by insulation material manufacturer.

2.4 REMOVABLE INSULATION COVERS

- A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

2.5 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz. /sq. yd.
 - 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
 - 2. Galvanized Steel: 0.005 inch thick.
 - 3. Aluminum: 0.007 inch thick.
 - 4. Brass: 0.010 inch thick.
 - 5. Nickel-Copper Alloy: 0.005 inch thick.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 - 1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, plenum and breeching with adhesive. Pin length sufficient for insulation thickness indicated.
 - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, pipes, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.
- F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.6 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

2.7 REMOVABLE INSULATION COVERS

- A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of piping, and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each system.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with seams staggered.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- G. Keep insulation materials dry at all times. Insulation that becomes wet or is otherwise damaged beyond repair shall be removed immediately and replaced. Replacement material and installation shall be in accordance with these specifications.
- H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- I. Apply insulation with the minimum number of joints practical.
- J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- K. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
 - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
 - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to pipe joints and fittings.
- O. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- P. Install vapor-retarder mastic on pipes and equipment.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. Pipes and equipment with vapor retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
 2. Pipes and equipment without vapor retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- Q. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 3. Seal insulation to roof flashing with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- S. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- T. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.
- 3.4 MINERAL-FIBER INSULATION APPLICATION
- A. Blanket Applications for Pipes: Secure blanket insulation with adhesive, and anchor pins with speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of pipe surfaces.
 2. Apply adhesive to entire circumference of pipes and to all surfaces of fittings and transitions.
 3. Install anchor pins and speed washers on sides, top, and bottom of horizontal pipes.
 4. Impale insulation over anchors and attach speed washers.
 5. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
 6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
 8. Apply insulation on pipe fittings and transitions with a full insulation segment for each surface. Apply insulation on pipe elbows with individually mitered gores cut to fit the elbow.
 9. Insulate pipe hangers and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material as insulation. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

B. Board Applications for Equipment: Secure board insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, plenum, & equipment surfaces.
2. Apply adhesive to all surfaces of fittings and equipment.
3. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
4. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
5. Insulate equipment stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" wide strips of the insulating material. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
6. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to ducts, plenums, and equipment as follows:

1. Follow the manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the duct, plenum, and equipment surface.

3.6 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

A. Apply insulation as follows:

1. Secure each layer of insulation with stainless-steel bands at 12-inch intervals and tighten without deforming the insulation materials.
2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

3.7 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of jacket manufacturer's recommended adhesive.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.8 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as indicated.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color shall be as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.9 APPLICATIONS

- A. Insulation materials and thickness are specified at the end of this Section.
- B. Insulate all pipe and equipment:
 1. Insulate pipe in accordance with the application schedule(s) below.
 2. Exceptions: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - a. Vibration-control devices.
 - b. Testing agency labels and stamps.
 - c. Nameplates and data plates.
 - d. Manholes.
 - e. Handholes.
 - f. Cleanouts.
 - g. Plastic Condensate Drain piping.
 - h. Factory-insulated equipment.
 - i. Flexible connectors.

3.10 INDOOR APPLICATION SCHEDULE (ABOVE GRADE):

- A. Service: Domestic hot water and domestic circulated hot water.
 1. Insulation Material: Mineral fiber preformed or flexible elastomeric pipe insulation.
 2. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Copper Pipe, ½" through 1½" in diameter: 1"
 - b. Copper Pipe, 2" through 3" in diameter: 1½"
 - c. Copper Pipe, larger than 3" in diameter: 2"
 3. Vapor Retarder Required: No.
 4. Finish: Exposed = Painted, concealed = none.
- B. Service: Domestic cold water.
 1. Insulation Material: Mineral fiber preformed or flexible elastomeric pipe insulation.
 2. Insulation Thickness: ½"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- C. Service: Rainwater conductors (Including secondary roof drain conductors). Insulate first thirty linear feet of piping including vertical piping from drain body and first horizontal piping run. If a second vertical run occurs before thirty linear feet is reached, terminate insulation at end of first horizontal run.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. Insulation Material: Mineral fiber preformed pipe insulation or Mineral-Fiber Blanket with Factory Applied FSK Jacket.
 2. Insulation Thickness: 1"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- D. Service: Roof drain and overflow drain bodies.
1. Insulation Material: Semi-Rigid Mineral-Fiber Board Thermal Insulation
 2. Insulation Thickness: 1½"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- E. Service: Exposed piping:
1. Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
 2. Insulation Thickness: 1"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- F. Service: Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Drainage from any Equipment. Measurement shall be pipe length.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
 2. Insulation Thickness: 1"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- G. Service: Condensate Drains, & Traps.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
 2. Insulation Thickness: 1"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- H. Service: Equipment Non-condensate Drains, & Traps.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
 2. Insulation Thickness: 1"
 3. Vapor Retarder Required: Yes.
 4. Finish: Exposed = Painted, concealed = none.
- 3.11 INDOOR APPLICATION SCHEDULE (BELOW GRADE):
1. None required.

END OF SECTION 220700

SECTION 221113 – FACILITY NATURAL-GAS PIPING

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 65 psig minimum unless otherwise indicated.
 - 3. Service Meter: 65 psig minimum unless otherwise indicated.
- B. Gas System Pressures: Primary pressure from the utility is more than 2.0 psig and is reduced to a secondary pressure of 2.0 psig by a pressure reducing valve installed immediately downstream of the meter and is reduced again by pressure reducing valves located at each piece of equipment.

1.4 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Corrugated, stainless-steel tubing with associated components.
 - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 4. Pressure regulators. Indicate pressure ratings and capacities.
 - 5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings bypass fittings and meter bars meter bars.
 - 6. Dielectric fittings.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- B. Operation and Maintenance Data: For motorized gas valves, pressure regulators, and service meters to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components and Devices: If indicated, provide electrical components and devices that are listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Applicable Codes: Comply with the North Carolina Codes and the 2012 International Fuel Gas Code.
- C. Fuel Gas Piping: Listed and labeled as required by the 2012 International Fuel Gas Code.
- D. UL Standard: Provide components listed in UL's "Gas and Oil Equipment Directory" where UL listing is indicated.
- E. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- F. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Perform site survey: Contract with utility-locating service for area where Project is located and locate utilities.
- B. Design values of fuel gas supplied for these systems are as follows:
 - 1. Nominal Heating Value: 1000 Btu/cu.ft.
 - 2. Nominal Specific Gravity: 0.6.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- C. Interruption of Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
1. Notify Owner and Architect no fewer than two days in advance of proposed interruption of natural-gas service.
 2. Do not proceed with interruption of natural-gas service without Owner and Architect's written permission.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.3 POLYETHYLENE PIPE, FITTINGS, AND JOINING MATERIALS

- A. Available Manufacturers:
 - 1. ERS Inc.
 - 2. Titeflex Corp.
- B. Polyethylene Pipe: Pipe shall be produced for use in gas distribution systems in accordance with the latest published edition of ASTM D 2513 Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
- C. Polyethylene Fittings: Fittings shall be produced for use in gas distribution systems in accordance with the latest published edition of ASTM D 2513 Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
- D. Joining Materials: Joining materials shall be as recommended by the pipe and fitting manufacturer for service intended.

2.4 PROTECTIVE COATING

- A. Furnish pipe and fittings with factory-applied, corrosion-resistant polyethylene coating for use in corrosive atmosphere.

2.5 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.6 VALVES

- A. Refer to section "General Duty Valves for Plumbing Piping".

2.7 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated stainless-steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig
 - 6. End Fittings: Zinc-coated steel.
 - 7. Threaded Ends: Comply with ASME B1.20.1.
 - 8. Maximum Length: 72"

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

B. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for 2" and smaller; flanged ends for 2 ½" and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.8 GAS SOLENOID VALVES (Science Lab Emergency Shut Off):

A. Available Manufacturers:

1. ASCO General Controls.
2. Automatic Switch Co.

B. ASCO Model EF8215 ¾" or approved alternative. NEMA 7 explosion proof, UL and FM approved for use with propane and natural gas. Valve shall be normally closed and shall operate on 24 volts DC.

2.9 SPECIALTY VALVES

A. Available Manufacturers:

1. ASCO General Controls.
2. Automatic Switch Co.
3. Eaton Corp.; Controls Div.
4. Honeywell, Inc.
5. Johnson Controls, Inc.

B. Automatic Gas Valves: ANSI Z21.21, with electrical or mechanical operator for actuation by appliance automatic shutoff device.

2.10 Valves, 2" and Smaller: Ball valves with threaded ends according to ASME B1.20.1 for pipe threads.

2.11 Valves, 2-1/2" and Larger: Butterfly valves for use with flanged ends according to ASME B16.5 for steel flanges.

2.12 PRESSURE REGULATORS

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

A. Available Manufacturers:

1. Line Pressure Regulators:
 - a. American Meter Co.
 - b. Donkin: Bryan Donkin RMG Canada, Ltd.
 - c. Eclipse Combustion, Inc.
 - d. Equimeter, Inc.
 - e. Fisher Controls International, Inc.
 - f. Maxitrol Co.
 - g. National Meter.
 - h. Richards Industries, Inc.; Jordan Valve Div.
 - i. Schlumberger Industries; Gas Div.

B. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.

1. 2" and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
2. 2 1/2" and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
3. Line Pressure Regulators: ANSI Z21.80 with 5-psig- minimum inlet pressure rating.
4. Appliance Pressure Regulators: ANSI Z21.18 with 2-psig minimum inlet pressure. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction. If vents are required provided piping necessary to extend to termination location outside the building as approved by the architect.

C. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping. Extend to exterior of building and terminate in location approved by the architect.

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Available Manufacturers:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2.13 CONCRETE BASES

- A. Description: Reinforced concrete base formed of 3000-psi- minimum, 28-day compressive strength concrete, and measuring 6 inches thick and 6 inches larger in each dimension than equipment, unless otherwise indicated.

2.14 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Available Manufacturers:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - f. Wilkins; Zurn Plumbing Products Group.
 - g. Conbraco Industries-Apollo
2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Available Manufacturers:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - d. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Companion-flange assembly for field assembly.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.15 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off fuel gas to premises or piping section.
- B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 SERVICE ENTRANCE PIPING

- A. Extend fuel gas piping from existing service and connect to fuel gas distribution piping and equipment requiring service.
 1. Service meter will be provided by the Controls Contractor.
 2. Meter will be located inside and linked to BMS.
- B. Install dielectric fitting downstream from and adjacent to each service meter unless meter is supported from service-meter bar with integral dielectric fitting. Install shutoff valve

downstream from and adjacent to dielectric fitting. Refer to Division 22 Section "Common Work Results for Plumbing" for dielectric fittings.

3.4 CONCRETE BASE INSTALLATION

- A. Locate bases at service meters and service regulators.
- B. Excavate earth and make level beds to support bases. Form and pour concrete bases level with top surface projecting approximately 3 inches above grade.

3.5 OUTDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section "Earth Moving" for excavating, trenching, and backfilling.
 - 1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
 - 2. All underground non-metallic piping shall have tracer wire.
 - 3. All underground piping shall have warning tape installed above it at 6" below finished grade.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- E. Copper Tubing Protective Coating:
 - 1. Apply joint cover kits over tubing to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- F. Install fittings for changes in direction and branch connections.
- G. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section "Meters and Gages for Plumbing Piping."

3.6 INDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss,

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

expansion, and other design considerations. Install piping as indicated unless deviations to are accepted by architect.

- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms.
- E. Install piping indicated to be exposed and piping in equipment rooms at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Floors: Install pre-sleeved corrugated, stainless-steel tubing systems for natural-gas. Cover with minimum of 1-1/2 inches of concrete. Jacket may not be in physical contact

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- with metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives.
3. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 4. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- Q. Connect branch piping from top or side of horizontal piping.
- R. Install unions in pipes 2" and smaller, adjacent to each valve, at final connection to each piece of equipment and where otherwise indicated. Unions are not required at flanged connections.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- U. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Section "Meters and Gages for Plumbing Piping."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."
- Y. Install corrugated, stainless-steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.
- Z. Install containment casings for gas piping below slabs extending minimum of 2 inches beyond point where pipe emerges from the floor. Tightly seal ends around gas piping using mechanical sleeve seals.

3.7 SERVICE-METER ASSEMBLY INSTALLATION

- A. Provide service meter inside building where the main enters the building.
- B. Install locking shutoff valves downstream from service regulator. Shutoff valves are not required at second regulator if two regulators are installed in series.
- C. Install strainer on inlet of service-pressure regulator.
- D. Install service pressure regulator mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.
- E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

3.8 VALVE INSTALLATION

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.9 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.10 HANGER AND SUPPORT INSTALLATION

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- A. Comply with requirements for pipe hangers and supports specified in Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. 1" and Smaller: Maximum span, 96"; minimum rod size, 3/8".
 - 2. 1¼": Maximum span, 108"; minimum rod size, 3/8".
 - 3. 1½" and 2": Maximum span, 108"; minimum rod size, 3/8".
 - 4. 2½" to 3 ½": Maximum span, 10'-0"; minimum rod size, ½".
 - 5. 4" and Larger: Maximum span, 10'-0"; minimum rod size, 5/8".
- C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
 - 1. 3/8": Maximum span, 48"; minimum rod size, 3/8".
 - 2. ½": Maximum span, 72"; minimum rod size, 3/8".
 - 3. ¾" and Larger: Maximum span, 96"; minimum rod size, 3/8".

3.11 CONNECTIONS

- A. Connect to Campus gas according to Owner/Campus procedures and requirements.
- B. Install piping adjacent to appliances to allow service and maintenance of appliances.
- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72" of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.12 PIPING APPLICATIONS

- A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.
- B. Above Ground Exposed Fuel Gas Piping:
 - 1. Sizes up to 2":
 - a. Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 2. 2½" to 4":
 - a. Steel pipe, malleable-iron threaded fittings, and threaded joints, or steel pipe, steel welding fittings, and welded joints.
 - 3. Larger Than NPS 4:
 - a. Steel pipe, steel welding fittings, and welded joints.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

C. Above Ground Concealed Fuel Gas Piping:

1. Sizes up to 2":
 - a. Steel pipe, malleable-iron threaded fittings, and threaded joints.
2. 2½" to 4":
 - a. Steel pipe, malleable-iron threaded fittings, and threaded joints, or steel pipe, steel welding fittings, and welded joints.
3. Larger Than NPS 4:
 - a. Steel pipe, steel welding fittings, and welded joints.

D. Exterior Underground Fuel Gas Piping:

1. All Sizes: Polyethylene pipe, fittings and joining materials.

E. Under Slab Fuel Gas Piping: (NOTICE: Method of fuel gas piping installation below floor slab must be approved by the local code authority.)

1. Pre-Sleeved Corrugated, Stainless-Steel Tubing Systems.
2. Steel pipe, steel welding fittings, and welded joints with welded steel vented conduit.

3.13 LABELING AND IDENTIFYING

- A. Comply with requirements in Section "Identification for Plumbing Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12" minimum below finished grade.
 1. Exception: 6 minimum below sub-grade under pavements and slabs.

3.14 PAINTING

- A. Use materials and procedures in Division 9 Section "Painting," "Exterior Paint Schedule" Article, "Ferrous Metal" Paragraph, "Full-Gloss, Alkyd-Enamel Finish" Subparagraph.
- B. Paint exterior service meters, pressure regulators, and specialty valves.
 1. Color: Yellow.

3.15 FIELD QUALITY CONTROL

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- A. Inspect, test, and purge piping according to ANSI Z223.1, Part 4 "Inspection, Testing, and Purging," and requirements of authorities having jurisdiction.
- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- C. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- D. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.
- E. Verify correct pressure settings for pressure regulators.
- F. Verify that specified piping tests are complete.

3.16 ADJUSTING

- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION 221113

SECTION 221116 –DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Service Piping: 160 psig.
 - 2. Domestic Water Distribution Piping: 125 psig.
- B. Seismic Performance: Refer to structural drawings for seismic category. Domestic water piping, support, and installation shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7, state, and local codes.

1.3 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Water Samples: Specified in “Cleaning” Article.
- C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. Compressed air piping.
 - 4. HVAC hydronic piping.
- D. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. NSF/ANSI Compliance:
 - 1. NSF/ANSI 14, “Plastic Piping System Components and Related Materials”
 - 2. NSF/ANSI 61, “Drinking Water System Components – Health Effects”
 - 3. NSF/ANSI 372, “Drinking Water System Components – Lead Content”

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Architect's, Construction Manager's, and Owner's written permission.

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 (ASTM B 88M, Type B) water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - 4) Conex Banninger
 - b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - 6. Copper Push-on-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) NVent LLC.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
- B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - 4) Conex Banninger
 - b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 3 and NPS 4 (DN 80 and DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to other sections for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Grooved joints may be used on aboveground grooved-end piping.
- D. Fitting Options:
 - 1. Press Fittings: Mechanically crimped fittings with neoprene gasket.
- E. Underground Domestic Water Service Piping: Match civil materials to first flange.
- F. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
 - 1. 2" and Smaller:
 - a. Hard copper tube, Type L copper pressure fittings; and soldered joints.
 - 2. 2-1/2" and above:
 - a. Hard copper tube, Type L copper pressure fittings; and soldered joints.
- G. Underground Domestic Water Piping: Use the following piping materials for each size range:
 - 1. 2" and Smaller:
 - a. Soft copper tube, Type K copper pressure fittings; and soldered joints with no joints permitted below concrete slabs.
 - 2. 2-1/2" and above:
 - a. Soft copper tube, Type K copper pressure fittings; and soldered joints.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use gate valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Hot-Water-Piping, Balancing Duty: Use automatic flow control valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Grooved-end valves may be used with grooved-end piping.

3.4 PIPING INSTALLATION

- A. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.
- B. All underground non-metallic piping regardless of use shall have tracer wire.
- C. Install underground ductile-iron piping according to AWWA C600, and AWWA M41. Install buried piping inside building between wall and floor penetrations and connection to water service piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 - 1. Encase piping with polyethylene film according to ASTM A 674 or AWWA C105.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- D. Install underground copper according to CDA's "Copper Tube Handbook."
- E. 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.
- F. Install water-pressure regulators downstream from shutoff valves.
- G. Install aboveground domestic water piping level and plumb.
- H. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- I. Perform the following steps before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 - 5. Remove and clean strainer screens. Close drain valves and replace drain-plugs.
 - 6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.
- J. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- K. Check plumbing specialties and verify proper settings, adjustments, and operation.
 - 1. Water-Pressure Regulators: Set outlet pressure at 80 psig maximum, unless otherwise indicated.
- L. Energize pumps and verify proper operation.

Keep below for plastic piping and fittings only when plastic piping is allowed by owner.

3.5 JOINT CONSTRUCTION

- A. 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.
- B. Grooved Joints: Assemble joints with keyed-coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Mechanically Formed Outlets: Form tee in copper tube according to equipment manufacturer's written instructions. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- D. Mechanically crimped fittings shall be installed in accordance with manufacturer's installation instructions and by factory accredited installer.

- E. Fusion welded joints shall be installed in accordance with the manufacturer's installation instructions, specifications, product standards, and by factory accredited installer.

3.6 VALVE INSTALLATION

- A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use gate valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.
- B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use gate valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.
- C. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Use gate valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section 220529 "Hangers and Supports for Plumbing Piping" for pipe hanger and support devices.
- B. 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. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 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.
 - 7. NPS 8: 10 feet with 3/4-inch rod.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- F. Where hangers for piping are to be suspended from open-web steel joists, install hangers at maximum spacing that will result in hanger loads that comply with the requirements on the structural drawings.
- G. Install supports for vertical copper tubing every 10 feet.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.
- I. Where bends in the pipe occur, place hangers 1/3 of the maximum allowed spacing distance of the bend (i.e. if the maximum span is 12 feet, the hanger shall be 4 feet from the bend. Pipe shall be supported from both sides of the bend.

3.8 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.

3.9 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

3. 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.
4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.10 ADJUSTING

- A. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 1. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.

3.11 CLEANING

- A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- B. Clean and disinfect potable domestic water piping as follows:
 1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in AWWA C651, AWWA C652 or as 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.
- C. Prepare and submit reports of purging and disinfecting activities to authorities having jurisdiction.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product proposed.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance: Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
- C. Water Management Installation:
 - 1. Installer Qualifications: An installer who is authorized by the equipment manufacturer for both installation and maintenance of submitted equipment.
 - 2. Provide documentation demonstrating previous experience and successfully completing projects of similar size and scope.
 - 3. Provide a list of installations that the Installer has specifically installed for verification by the Owner. Similar installations from other vendors and/or Installers shall be accepted. The Installer's employees must meet these qualifications.
 - 4. The Installer shall demonstrate to the satisfaction of the Architect/Engineer that he has:
 - a. Adequate plant and equipment to pursue the work properly and expeditiously.
 - b. Adequate staff and technical experience to implement the work.
 - c. Suitable financial status to meet the obligations of the work.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- d. Technical capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in this project.
- 5. A contractor intending to bid on this work, not meeting the requirements of this section, may employ the services of an "Installer" meeting the requirements of this section. A "subcontractor" so employed must be acceptable to the Architect. The "Installer" shall be identified by submittal for acceptance by the Architect.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type (Anti-siphon) Vacuum Breakers:

- 1. Available Manufacturers:
 - a. Ames Co.
 - b. Apollo Valves - Conbraco Industries, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1001.
- 3. Sizes: $\frac{3}{4}$ " thru 3" as required to match connected piping.
- 4. Body: Brass or Bronze.
- 5. Inlet and Outlet Connections: Threaded.
- 6. Finish: Rough bronze or chrome plated.

B. Pressure Vacuum Breakers:

- 1. Available Manufacturers:
 - a. Ames Co.
 - b. Apollo Valves - Conbraco Industries, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1020.
- 3. Operation: Continuous-pressure applications.
- 4. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

C. Spill-Resistant Vacuum Breakers:

- 1. Available Manufacturers:
 - a. Apollo Valves - Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
- 2. Standard: ASSE 1056.
- 3. Operation: Continuous-pressure applications.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

4. Sizes: ¾" thru 1" as required to match connected piping.
5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.2 DISHWASHER AIR-GAP FITTINGS

- A. Description: ASSE 1021, fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of at least 5 gpm; and inlet pressure of at least 5 psig at temperature of at least 140 deg F. Include 5/8-inch- ID inlet and 7/8-inch- ID outlet hose connections.
- B. Hoses: Rubber and suitable for temperature of at least 140 deg F.
 1. Inlet Hose: 5/8-inch- ID and 48 inches long.
 2. Outlet Hose: 7/8-inch- ID and 48 inches long.

2.3 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Zone (RPZ) Backflow Preventers:
 1. Available Manufacturers:
 - a. Ames Co.
 - b. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1013.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 10 psig maximum, through middle 1/3 of flow range.
 5. Sizes: ¾" thru 10"
 6. Body: Brass or bronze for 2" and smaller; cast iron or steel with interior lining complying with AWWA C550 or that is FDA approved for 2 ½" and larger.
 7. Configuration: Comply with drawing requirements.
 8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of 2" and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of 2 ½" and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Double-Check Backflow Preventers:
 1. Available Manufacturers:
 - a. Ames Co.
 - b. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2. Standard: ASSE 1015
3. Application: continuous-pressure, unless otherwise indicated.
4. Pressure Loss: 8 psig maximum, through middle 1/3 of flow range.
5. Size: 3/4" thru 10" as required to match connected piping.
6. Body: Brass or bronze for NPS 2 and smaller; cast iron or steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
7. Configuration: Comply with drawing requirements.
8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of 2" and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of 2 1/2" and larger.

C. Dual-Check-Valve Backflow Preventers:

1. Available Manufacturers:
 - a. Apollo Valves - Apollo Valves - Conbraco Industries, Inc.
 - b. Mueller Co.; Water Products Div.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Sizes: 3/4" thru 1" as required to match connected piping.
5. Body: Bronze with union inlet.

2.4 WATER PRESSURE-REDUCING VALVES

A. Available Manufacturers:

1. CLA-VAL Automatic Control Valves.
2. Flomatic Corporation.
3. OCV Control Valves.
4. Watts Industries, Inc.; Ames Fluid Control Systems.
5. Watts Industries, Inc.; Watts ACV.
6. Zurn Plumbing Products Group; Wilkins Div.

B. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.

C. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.

D. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.

1. Sizes: 1/4" thru 10" as required to match connected piping.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2. Pattern: Angle or Globe-valve design.
3. Trim: Stainless steel.

2.5 AUTOMATIC FLOW CONTROL VALVES

- A. Manufacturers:
1. Bell & Gossett
 2. Flow Design, Inc.
 3. Griswold Controls
 4. Hays Fluid Controls
 5. Pro Hydronic Specialties
- B. Valves shall be factory set to maintain constant flow with plus or minus 10 percent. Each valve shall have an identification tag attached by chain, and be factory marked with the zone or equipment identification, valve number, and flow rate. Valve shall be line size and as follows:
1. Body: Gray-iron or brass, designed for 175 psig at 200 deg F; brass or ferrous-metal, designed for 300 psig at 250 deg F.
 2. Cartridge: Stainless steel or nickel chrome plated brass, tamperproof, self-cleaning, piston-spring assembly, or polyphenylsulfone orifice seat with polymer diaphragm (Hays) removable for inspection or replacement.
 3. Adjustment: Flow and pressure differential shall be adjustable by cartridge replacement.
 4. Configuration: "Y" or other permitting cartridge replacement without valve removal for sizes 2" and smaller.
 5. Sizes: Match connecting pipe.
 6. Accessories:
 - a. Provide unions and isolation valves or other configuration permitting cartridge replacement with valve removal for sizes larger than 2."
 - b. Minimum pressure differential shall not exceed 2 psi (unless otherwise indicated)
 - c. Maximum pressure differential shall not be less than 32 psi (unless otherwise indicated).
 - d. Flow rates shall be as indicated on equipment schedules on the drawings.
 - e. Valves shall be installed in return piping.
 - f. Ball valves and unions included as part of the valve package may be used in place of ball valves and unions specified and indicated on the drawings only when in positions indicated. Ball valves shall be provided with a solid stainless steel or chrome plated brass ball.
 - g. Provide a #20 mesh Y-strainer with blow-down valve and garden hose connection between the supply side valve and equipment.
 - h. Valves may be provided as part of a "hose kit."

2.6 TEMPERATURE-ACTUATED WATER MIXING VALVES

- A. Thermostatic Water Mixing Valves:
1. Refer to drawing schedule for manufacturer and operating requirements.
 2. Available Manufacturers:
 - a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- c. Powers; a Watts Industries Co.
 - d. Symmons Industries, Inc.
 - 3. Standard: ASSE 1017.
 - 4. Pressure Rating: 125 psig.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: union inlets and outlet.
 - 7. Accessories:
 - a. Check stops on hot- and cold-water supplies.
 - b. Handle.
 - c. Dial thermometer on inlets and outlet.
 - d. Pressure gauges on inlets and outlet.
 - 8. Pressure Rating: 125 psig, unless otherwise indicated.
- B. Individual-Fixture, Water Tempering Valves:
- 1. Refer to drawing schedule for manufacturer and operating requirements.
 - 2. Available Manufacturers:
 - a. Apollo Valves - Conbraco Industries, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - 3. Standard: ASSE 1070, thermostatically controlled water tempering valve.
 - 4. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 - 5. Body: Bronze body with corrosion-resistant interior components.
 - 6. Temperature Control: Adjustable.
 - 7. Inlets and Outlet: Threaded. Provide unions and valves.
 - 8. Finish: Chrome-plated bronze.

2.7 STRAINERS

A. Pattern: "Y"

- 1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
- 2. Body: Bronze for NPS 2 and smaller; cast iron or steel with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
- 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
- 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
- c. Strainers NPS 5 and Larger: 0.10 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.8 HOSE BIBBS

- A. Refer to plumbing fixture rough-in schedule on drawings.

2.9 WALL HYDRANTS

- A. Refer to plumbing fixture rough-in schedule on drawings.

2.10 WATER HAMMER ARRESTERS

- A. Available Manufacturers:

- 1. AMTROL, Inc.
- 2. Josam Company.
- 3. MIFAB, Inc.
- 4. PPP Inc.
- 5. Sioux Chief Manufacturing Company, Inc.
- 6. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- 7. Tyler Pipe; Wade Div.
- 8. Watts Drainage Products Inc.
- 9. Zurn Plumbing Products Group; Specification Drainage Operation.

- B. Standard: ASSE 1010 or PDI-WH 201.

- C. Type: Metal bellows or copper tube with piston.

- D. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.11 TRAP GUARD

- A. Available Manufacturers:

- 1. ProSet Systems, Model TG
- 2. SureSeal Manufacturing, Inline Floor Drain Trap Sealer

- B. General:

- 1. Comply with ASSE 1072-2007.
- 2. ProSet Systems: Smooth, soft, flexible, elastomeric PVC material molded into shape, open on top with curl closure at bottom.
- 3. SureSeal: ABS plastic body with neoprene rubber diaphragm and sealing gasket with 80 durometer compression fit sealing gasket on gravity drain outlet connection.
- 4. Allows wastewater to open and adequately discharge floor drain through its interior.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

5. Closes and returns to original molded shape after wastewater discharge is complete.
6. Size shall be as required to match drain in which it is installed.

2.12 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Available Manufacturers:
 - 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.

B. Drainage-Type, Trap-Seal Primer Valves:

1. Available Manufacturers:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.13 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Available Manufacturers:
2. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. PPP Inc.
3. Standard: ASSE 1044
4. Piping: ASTM B 88, Type L; copper, water tubing.
5. Cabinet: Unless otherwise indicated, recessed or surface-mounting steel box with stainless-steel cover.
6. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
7. Vacuum Breaker: ASSE 1001.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- 8. Number of Outlets: Refer to drawings.
- 9. Size of Outlets: ½"

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers where indicated: If not indicated on 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 balancing valves with-in 12" of ceiling at access door or tile where they can be reached with-out obstruction.
- D. Install thermostatic mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and pressure gauges.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as indicated.
- E. Install strainers where indicated.
- F. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Section "Rough Carpentry."
- 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 1/8" per foot, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- I. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1/8" per foot, and connect to floor-drain body, trap, or inlet fitting.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- J. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1/8" per foot, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.
- K. Install trap guards in accordance with manufacturer's instructions.
- L. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- M. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- N. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
- O. Install individual shutoff valve in each water supply to plumbing specialties. Use ball valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Section "Valves" for general-duty ball valves.
- P. Install air vents at water piping high points. Include ball valve in inlet.
- Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- R. 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 LABELING AND IDENTIFYING

- A. Indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section "Plumbing Identification"

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each reduced-pressure-principle backflow preventer, double-check backflow-preventer and double-check, detector-assembly according to authorities having jurisdiction and the device manufacturer's recommendations.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.4 ADJUSTING

- A. Set field-adjustable pressure set points.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- B. Set field-adjustable flow set points.
- C. Set field-adjustable temperature set points.

END OF SECTION 221119

SECTION 221125 - CIRCULATING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.3 ABBREVIATIONS

- A. BAS Building Automation System

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect against damage.
- C. Comply with pump manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 CIRCULATING PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Grundfos Pumps Corp.
 - 2. TACO Incorporated.
 - 3. Bell & Gossett Domestic Pump; ITT Corporation.
 - 4. Armstrong Pumps Inc.
- B. Description: Factory-assembled and -tested, in-line, wet rotor or system lubricated, close-coupled, 100% lead free, overhung-impeller, designed for circulating domestic hot water.
- C. Pump Construction:
 - 1. Pump and Motor Assembly: Hermetically sealed, cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 - 2. Motor: Non-overloading at all points on the pump curve
 - 3. Casing: Bronze, with companion-flange connections.
 - 4. Impeller: Plastic.
 - 5. Motor: Single speed, unless otherwise indicated.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.3 CONTROLS

- A. BAS: Electric, adjustable for control of water-supply pump.
 - 1. Type: Start/Stop
 - 2. Operation of Pump: Refer to Section "Sequence of Operation".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.
- B. Verify installation and location of automatic flow control valve(s). Record actual location(s) on as-built drawings.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, centrifugal pumps with shaft horizontal unless otherwise indicated.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps.
- D. Install suction and discharge piping.
- E. Install indicated valves & devices.
- F. Comply with Division 26 Sections for electrical connections.
- G. Connect controls.
- H. Interlock pump with water heater to deactivate water heater when pump is deactivated..

3.4 IDENTIFICATION

- A. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

4. Check operation of controls for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:
 - a. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - b. Verify that pump is rotating in the correct direction.
6. Prime pump.
7. Close discharge valve.
8. Start motor.
9. Open discharge valve slowly.
10. Adjust temperature settings on thermostatic mixing valves if included in design.
11. Adjust balancing valves if required by thermostatic mixing valve manufacturer.
12. Check and record pressure on inlet and outlet of pump.

END OF SECTION 221125

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. The following are industry abbreviations for plastic and rubber piping materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer.
 - 2. LEED: Leadership in Energy and Environmental Design
 - 3. NBR: Acrylonitrile-butadiene rubber.
 - 4. PE: Polyethylene plastic.
 - 5. PVC: Polyvinyl chloride plastic.
 - 6. TPE: Thermoplastic elastomer.
 - 7. USGBC: United States Green Building Council

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Submittal:
 - 1. Product Data for USGBC LEED Credit EQ 4.1: For solvent cements and adhesive primers, include printed statement of VOC content.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of testing agency.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- B. Cast iron soil pipe shall be clearly marked with the manufacturer's name, county of origin, eight-digit date code, pipe diameter and length, relevant ASTM standard and registered trademark of third part certifier.
 - 1. Third party certifier shall be IAPMO, ICC, NSF, or other organization that is accredited as an ANSI – Guide 65 organization. Reference www.ansi.org.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Flexible Transition Couplings for Underground Non-Pressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.

2.2 CAST-IRON SOIL PIPING

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Hub-and-Spigot Gaskets: ASTM C 564, rubber.
- C. Hub-less Couplings:
 - 1. All hub-less couplings shall bear the NSF trademark.
 - 2. General: CISPI 310 and ASTM C 1277 assembly of stainless steel corrugated shield, stainless steel bands and fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
 - 1) Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM C 1540, Type 304, stainless-steel shield; stainless-steel bands; and ASTM C 564, rubber sleeve.
 - a) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
 - b) NPS 5 to NPS 10: 4-inch- wide shield with 6 bands.
 - b. Heavy-Duty, Cast-Iron Couplings: ASTM A 48/A 48M, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- A. Transition fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Aboveground, Soil, Waste, and Vent Piping located inside plenum: Hub-less cast-iron soil piping with heavy duty couplings.
- C. Aboveground, Soil, Waste, and Vent Piping located outside plenum: PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Underground, Soil, Waste, and Vent Piping:
 - 1. Kitchen Waste: Extra Heavy Hub and Spigot cast-iron soil piping.
 - 2. Other than kitchen waste: Service Weight Hub and Spigot cast iron soil pipe and fittings.

3.2 PIPING INSTALLATION

- A. Refer to Section "Facility Sanitary Sewers" for Project-site sanitary sewer piping.
- B. Refer to Section "Common Work Results for Plumbing" for basic installation.
- C. Install seismic restraints on piping when indicated. Seismic-restraint devices are not required in zones A & B. Seismic-restraint devices are specified in Section "Vibration and Seismic Controls for Plumbing Piping and Equipment".
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- F. Install seismic restraints on piping when indicated. Seismic-restraint devices are specified in Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- G. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- H. 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.
- I. 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."
- J. 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

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

- K. 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.
- L. Install soil and waste drainage and vent piping at the minimum slopes required by authorities having jurisdiction.
- M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Refer to section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-less cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hub-less-coupling joints.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices in zones other than A & B.
- B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. 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.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- 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. 1 ½" and 2": 60" with 3/8" rod.
 - 2. 3": 60" with ½" rod.
 - 3. 4" and NPS 5: 60" with 5/8" rod.
 - 4. 6": 60" with ¾" rod.
 - 5. 8" to 12": 60" with 7/8" rod.
 - 6. 15": 60" with 1" rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping.

3.6 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- C. Reports: Where required or indicated prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.7 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.8 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 ABBREVIATIONS

- A. RPZ Reduced Pressure Zone
- B. FOG Fats, oils, and greases.

1.3 DEFINITIONS

- A. Withstand: Units shall remain in place without separation of any parts when subjected to seismic forces indicated. "Essential facility" units shall be fully operational after the seismic event.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.
- B. Operation and Maintenance Data: To include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical components, devices, and accessories shall be Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. Horizontal, Backwater Valves :

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Cover: Bolted or threaded access to check valve.
5. End Connections: Match connecting pipe.
6. Check Valve: Factory assembled to hang open for airflow unless subject to backflow condition.
7. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at grade; replaces backwater valve cover. Terminate in 4" thick square concrete slab 4" larger all around than cover (provide 1" chamfer on top edges)

2.2 CLEANOUTS

A. General:

1. Available Manufacturers:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Closure Material: Match pipe, brass, PVC, or ABS

B. Floor Cleanouts:

1. Housing: threaded, adjustable.
2. Type: Threaded, adjustable housing.
3. Body: Cast iron.
4. Outlet Connection: Inside calk, Spigot, or Threaded.
5. Adjustable Housing Material: Cast iron with threads.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

6. Frame and Cover Material and Finish: Satin finish nikaloy.
7. Frame and Cover Shape: Round or Square (Contractors Option).
8. Top Loading Classification: Extra Heavy Duty.
9. Riser: ASTM A 74, Service weight, cast-iron drainage pipe fitting and riser to cleanout.
10. Carpet Ring: Yes for carpeted floors.
11. Tile Recess: Yes for tiled floors.
12. Terrazzo: Yes for terrazzo floors

C. Wall Cleanouts:

1. Wall access: Yes
2. Body: Match connected piping.
3. Closure: Countersunk or raised-head, drilled-and-threaded plug.
4. Closure Plug Size: Same as cleanout size but not larger than four inches in diameter.
5. Wall Access: Round, flat, chrome-plated brass, nickel-bronze, copper-alloy, or stainless-steel cover plate with screw.

2.3 FLOOR DRAINS

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3
3. Pattern: As indicated.
4. Clamping Flange: Required.

2.4 TRENCH DRAINS

A. Trench Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Clamping Flange: Required.

5. Top Loading Classification: Extra Heavy-Duty.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Plastic Stack Fitting (For Use Where Plastic Stacks Are Indicated): ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating (For Use Where Plastic Laboratory Stacks are Indicated: Corrosion resistant on interior of fittings.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. PPP
 - b. Josam
 - c. Smith
 - d. Zurn
2. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
3. Size: Same as floor drain inlet.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2.7 SOLIDS INTERCEPTORS

A. Solids Interceptors:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Type: Factory-fabricated interceptor made for removing and retaining lint, hair, sediment, plaster, and other solids from wastewater.
3. Body Material: Cast iron or steel.
4. Interior Separation Device: Baffles or screens.
5. Interior Lining: Corrosion-resistant enamel or epoxy.
6. Exterior Coating: Corrosion-resistant enamel or epoxy.
7. Mounting: Exterior below grade. Provide extension to grade & cover. Provide 6" thick concrete slab all around extension/cover. Provide 1" chamfer on top, exterior edges.

2.8 MOTORS

A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts.
- C. Install cleanout deck plates with top flush with finished floor.
- D. For wall cleanouts located in concealed piping, install cleanout access covers, with cover tight to finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. Position floor drains as indicated. If indication is not clear, position for easy access and maintenance.
 2. Set floor drains at elevations indicated.
 3. Install floor-drain flashing flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain.
- F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
- G. Install through-penetration firestop assemblies in plastic conductors and stacks at rated penetrations.
- H. Install floor-drain, trap-seal primer fittings on inlet to floor drains indicated to receive trap-seal primer.
- I. Install air-gap fittings on RPZ backflow preventers and where indicated.
- J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- K. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction, manufacturer's recommendations/instructions, and as indicated. In case of a conflict, consult architect.
- L. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction, manufacturer's recommendations/instructions, and as indicated. In case of a conflict, consult architect. Coordinate oil-interceptor storage tank and gravity drain with Division 22 Section "Facility Fuel-Oil Piping."
- M. Install solids interceptors according to authorities having jurisdiction, manufacturer's recommendations/instructions, and as indicated. In case of a conflict, consult architect.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- D. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Solids interceptors.
- B. Distinguish among multiple units, inform operator of operational requirements, and refer to Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect grease interceptors and their installation, including piping and electrical connections, and to assist in testing.
- B. Checks and Inspections:
 - 1. Leak Check: After installation, charge system and check for leaks. Repair leaks and recheck until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

- A. Protect drains during construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of open pipes at end of each day or when work stops.

END OF SECTION 221319

SECTION 221413 – FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. The following are industry abbreviations for plastic piping materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. LEED: Leadership in Energy and Environmental Design
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
 - 5. USGBC: United States Green Building Council

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with a minimum working-pressure rating of 10-foot head of water.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of the testing agency.
- B. Cast iron soil pipe shall be clearly marked with the manufacturer's name, county of origin, eight-digit date code, pipe diameter and length, relevant ASTM standard and registered trademark of third part certifier.
 - 1. Third party certifier shall be IAPMO, ICC, NSF, or other organization that is accredited as an ANSI – Guide 65 organization. Reference www.ansi.org.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- B. Flexible Transition Couplings for Underground Non-Pressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends of same sizes as piping to be joined and include corrosion-resistant metal band on each end.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Hub-less Couplings:
 - 1. All hub-less couplings shall bear the NSF trademark.
 - 2. General: CISPI 310 and ASTM C 1277 assembly of stainless steel corrugated shield, stainless steel bands and fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.
 - 1) Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM C 1540, Type 304, stainless-steel shield; stainless-steel bands; and ASTM C 564, rubber sleeve.
 - a) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
 - b) NPS 5 to NPS 10: 4-inch- wide shield with 6 bands.
 - b. Heavy-Duty, Cast-Iron Couplings: ASTM A 48/A 48M, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Above ground Storm Drainage Piping Below Ceilings: Unless indicated otherwise use any of the following piping materials for each size range:
 - 1. 2" to 4": Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. 2" to 4": Hub-less, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- b. Couplings: Heavy-duty, cast iron.
 - 3. 5" and 6": Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 4. 5" and 6": Hubless, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
 - 5. 8" and Larger: Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 6. 8" and Larger: Hubless, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
- C. Above ground Storm Drainage piping located inside plenum: Unless indicated otherwise use any of the following piping materials for each size range:
 - 1. 2" to 4": Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. 2" to 4": Hub-less, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
 - 3. 5" and 6": Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 4. 5" and 6": Hub-less, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
 - 5. 8" and Larger: Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 6. 8" and Larger: Hub-less, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
- D. Above ground Storm Drainage piping located outside plenum: Unless indicated otherwise use any of the following piping materials for each size range:
 - 1. 2" to 4": Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. 2" to 4": Hub-less, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
 - 3. 5" and 6": Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 4. 5" and 6": Hub-less, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
 - 5. 8" and Larger: Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 6. 8" and Larger: Hub-less, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
- E. Underground Storm Drainage Piping: Use any of the following piping materials for each size range:
 - 1. 2" to 4": Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 2. 2" to 4": Hub-less, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.
 - 3. 5" and 6": Service class, cast-iron soil piping; gaskets; and gasketed joints.
 - 4. 5" and 6": Hub-less, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- b. Couplings: Heavy-duty, cast iron.
- 5. NPS 8 and Larger: Service class, cast-iron soil piping; gaskets; and gasketed joints.
- 6. NPS 8 and Larger: Hubless, cast-iron soil piping and one of the following:
 - a. Couplings: Heavy-duty, Type 304, stainless steel.
 - b. Couplings: Heavy-duty, cast iron.

3.3 PIPING INSTALLATION

- A. Refer to Section " Storm Utility Drainage Piping" for Project site storm sewer and drainage piping.
- B. Refer to Section "Common Work Results for Plumbing" for basic piping installation.
- C. Refer to Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices in zones other than A & B.
- D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Section "Storm Drainage Piping Specialties".
- 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."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- F. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. 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 storm 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. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- J. 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."
- K. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- L. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

- A. Refer to Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.5 VALVE INSTALLATION

- A. Backwater Valves: Install backwater valves in piping subject to backlog.
 - 1. Horizontal Piping: Horizontal backwater valves.
 - 2. Install backwater valves in accessible locations.
 - 3. Refer to Section "Storm Drainage Piping Specialties" for backwater valves.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices in zones other than A & B.
- B. Refer to Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. 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 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. 1 1/2" and 2": 60" with 3/8" rod.
 - 2. 3": 60" with 1/2" rod.
 - 3. 4" and 5": 60" with 5/8" rod.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

4. 6": 60" with ¾" rod.
5. 8" to 12": 60" with 7/8" rod.
6. 15": 60" inches with 1" rod.

- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.

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.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 5. 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 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 ABBREVIATIONS

- A. AFF Above Finished Floor.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 ROOF DRAINS

- A. General-Purpose Roof Drains:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.6.4, for general-purpose roof drains.
 - 3. Body Material: Cast iron.
 - 4. Combination Flashing Ring and Gravel Stop: Required.
 - 5. Underdeck Clamp: Required.
 - 6. Sump Receiver Plate: Not required.
 - 7. Dome Material: Aluminum.
 - 8. Extension collar required.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2.2 OVERFLOW ROOF DRAINS

A. General-Purpose Overflow Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Combination Flashing Ring and Gravel Stop: Required.
5. Underdeck Clamp: Required.
6. Sump Receiver Plate: Not required.
7. Dome Material: Aluminum.

2.3 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Boots:

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout and NPS 4 outlet.

B. Storm Drain and Storm Drain Overflow Nozzles:

1. Available manufacturers
 - a. JR Smith Manufacturing
 - b. Josam Company
 - c. Zurn
2. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
3. Size: Same as connected conductor
4. Basis of Design: Josam Series 25010.
5. Product is for use where storm drain piping or secondary storm drain piping exits the building above grade and shall be provided where indicated on the drawings.

2.4 CLEANOUTS

A. General:

1. Available Manufacturers:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification
- 2. Standard: ASME A112.36.2M.
- 3. Size: Same as connected drainage piping
- 4. Closure Material: Match pipe, brass, PVC, or ABS
- B. Floor Cleanouts:
 - 1. Housing: threaded, adjustable.
 - 2. Type: Threaded, adjustable housing.
 - 3. Body: Cast iron.
 - 4. Outlet Connection: Inside calk, Spigot, or Threaded.
 - 5. Adjustable Housing Material: Cast iron with threads.
 - 6. Frame and Cover Material and Finish: Satin finish nikaloy.
 - 7. Frame and Cover Shape: Round or Square (Contractors Option).
 - 8. Top Loading Classification: Extra Heavy Duty.
 - 9. Riser: ASTM A 74, Service weight, cast-iron drainage pipe fitting and riser to cleanout.
 - 10. Carpet Ring: Yes for carpeted floors.
 - 11. Tile Recess: Yes for tiled floors.
 - 12. Terrazzo: Yes for terrazzo floors
- C. Wall Cleanouts:
 - 1. Wall access: Yes
 - 2. Body: Match connected piping.
 - 3. Closure: Countersunk or raised-head, drilled-and-threaded plug.
 - 4. Closure Plug Size: Same as cleanout size but not larger than four inches in diameter.
 - 5. Wall Access: Round, flat, chrome-plated brass, nickel-bronze, copper-alloy, or stainless-steel cover plate with screw.

2.5 BACKWATER VALVES

- A. Horizontal, Backwater Valves :
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.14.1.
 - 3. Size: Same as connected piping.
 - 4. Cover: Bolted or threaded access to check valve.
 - 5. End Connections: Match connecting pipe.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

6. Check Valve: Factory assembled to hang open for airflow unless subject to backflow condition.
7. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at grade; replaces backwater valve cover. Terminate in 4" thick square concrete slab 4" larger all around than cover (provide 1" chamfer on top edges).

2.6 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Plastic Stack Fitting (For Use Where Plastic Stacks Are Indicated): ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof drains where indicated. Create low points in roof areas according to roof membrane manufacturer's written installation instructions. Install flashing ring, collar, or flange to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
- B. Install downspout boots at grade. Secure to building wall.
- C. Install storm drain and storm drain overflow nozzles at exposed bottom of storm drain and storm drain overflow conductors where they spill onto grade.
- D. Install cleanouts in aboveground piping and building drain piping according to the International Plumbing Code.
- E. Install cleanouts for piping below floors.
- F. Install cleanout deck plates with top flush with finished floor.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- G. For wall cleanouts located in concealed piping, install cleanout wall access covers with cover tight to finished wall.
- H. Install horizontal backwater valves where indicated.
- I. Install concrete slabs at backwater valves.
- J. Install cleanouts in vertical conductors at 18" AFF.
- K. Install access door in wall if required to access cleanout.
- L. Install through-penetration firestop assemblies at penetrations of rated assemblies.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 PROTECTION

- A. Protect drains during construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of open piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 BASIS OF DESIGN PRODUCT

- A. As scheduled on the drawings or as otherwise indicated.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of commercial, gas-fired, domestic-water heater, from manufacturer.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
- C. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Two year(s).
 - b. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 DOMESTIC-WATER HEATERS

A. General:

1. The basis of design for each water heater shall be as indicated on drawings. The contractor shall provide equivalent products by one of the listed manufacturers.
2. Manufacturers:
 - a. Bradford White Corporation.
 - b. Hubbell.
 - c. Lochinvar Corporation.
 - d. PVI Industries, LLC.
 - e. RECO USA.
 - f. Rheem Manufacturing Company.
 - g. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - h. State Industries.
3. Neutralization: Provide all condensing gas-fired domestic water heaters with condensate neutralization kits from water heater manufacturer. Coordinate location and drain requirements with drains and equipment indicated on plans.

2.2 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. (**GWH-1** & **GWH-2**) Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:

1. Basis of Design: PVI Conquest 20-L-100A-GCL
2. Standard: ANSI Z21.10.3/CSA 4.3.
 - a. Description: Manufacturer's proprietary design to provide at least 95 percent combustion efficiency at optimum operating conditions.
3. Storage-Tank Construction: ASME-code steel with 150-psi minimum working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. 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. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- c. Lining: Cement, Glass, or Nickel plate complying with NSF 61 Annex G barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
- 4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and natural-gas fuel.
 - g. Temperature Control: Adjustable thermostat.
 - h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - i. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- 5. Draft Hood: Draft diverter, complying with ANSI Z21.12.

B. Capacity and Characteristics: Refer to Plumbing drawings and schedules.

- 1. Minimum Vent Diameter: Refer to and coordinate with manufacturer's written installation recommendations and Mechanical drawings and schedules.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. General:

- 1. The basis of design for each water heater shall be as indicated on drawings. The contractor shall provide equivalent products by one of the listed manufacturers.
- 2. Manufacturers:
 - a. AMTROL Inc.
 - b. Honeywell International Inc.
 - c. Pentair Pump Group (The); Myers.
 - d. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - e. State Industries.
 - f. Taco, Inc.
 - g. Hubbell

B. Domestic-Water Compression Tanks:

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank or manufacturer's recommended pre-charge pressure.
 2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
- C. Capacity and Characteristics: Refer to Plumbing drawings and schedules.
- D. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than 2-4 inches beyond base of domestic-water heater, dimensions not less than 2-4 inches vertical, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- E. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- F. Manifold Piping Arrangements: For multiple grouped domestic-water heater installations, ensure equalized and balanced distribution to each water heater. Include ball or butterfly shutoff valves and unions to isolate each domestic-water heater. Coordinate with manufacturer's written installation instructions and recommendations.
1. Acceptable Balancing Arrangements:
 - a. Manufacturer provided factory-fabricated manifold kit.
 - b. Field-fabricated mechanically balanced piping arrangement with calibrated or memory-stop balancing valves.
 - c. Field-Fabricated equal-leg piping arrangement.
 - d. Reverse-return equal-leg piping arrangement.
- G. Comply with requirements for ball or butterfly-shutoff valves specified in Section 220523 "General Duty Valves for Plumbing Piping".
1. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."
- H. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.
- I. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include pressure rating as required to match gas supply.
- J. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

- K. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.
- L. Pressure Relief Valves: Include pressure settings less than domestic-water heater working-pressure rating.
 - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.
- M. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 8. Anchor domestic-water heaters to substrate.
- B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section "General Duty Valves for Plumbing Piping".
- C. Install gas-fired, domestic-water heaters according to NFPA 54.
1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
 4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 221113 "Facility Natural-Gas Piping."
- D. 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 full size and same as domestic-water piping material in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. 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 domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- G. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- H. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- I. Fill domestic-water heaters with water.

- J. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
- B. Comply with requirements for gas piping specified in Section 221113 "Facility Natural-Gas Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section "Quality Requirements" for retesting and reinspection requirements and Section "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

END OF SECTION 223400

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. PMMA: Polymethyl methacrylate (acrylic) plastic.
- D. PVC: Polyvinyl chloride plastic.
- E. RFI: Request for information.
- F. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- G. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- H. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- I. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, showerheads and tub spouts, drains and tailpieces, and traps and waste pipes.
- J. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.
- K. Other Manufacturers: Use one of those listed.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and security anchors for security plumbing fixtures.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Performance Submittals:
 - 1. Product Data: Documentation indicating flow and water consumption requirements.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For security plumbing fixtures and components to include in maintenance manuals.
- B. Faucet Cartridges, washers, aerators and O-Rings: Equal to five percent (5%) of amount of each type and size installed but not less than five (5) of each type and size.
- C. Flushometer Valve Repair Kits: Equal to ten percent (10%) of quantity of each type installed, or six (6), whichever is less.
- D. Provide Minimum number of key operators (wrenches/tools) for loose key stops, wall hydrants, aerators, security fasteners and any fixture where a key, security fastener, or special tool is required:
 - 1. One (1) for ten percent (10%) of each size or ten (10), whichever is less.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities. Comply with requirements in Public Law 102-486, "Energy Policy Act," regarding 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 standards and other requirements where applicable:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 5. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 - 6. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 7. Vitreous-China Fixtures: ASME A112.19.2M.
 - 8. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 9. Water-Closet, Flushometer Tank Trim: ASSE 1037.
 - 10. Whirlpool Bathtub Fittings: ASME A112.19.8M.
 - 11. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

12. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
13. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
14. Faucets: ASME A112.18.1.
15. Hose-Connection Vacuum Breakers: ASSE 1011.
16. Hose-Coupling Threads: ASME B1.20.7.
17. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
18. NSF Potable-Water Materials: NSF 61.
19. Pipe Threads: ASME B1.20.1.
20. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
21. Supply Fittings: ASME A112.18.1.
22. Brass Waste Fittings: ASME A112.18.2.
23. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
24. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
25. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
26. Faucets: ASME A112.18.1.
27. Hand-Held Showers: ASSE 1014.
28. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
29. Hose-Coupling Threads: ASME B1.20.7.
30. Manual-Control Antiscald Faucets: ASTM F 444.
31. Pipe Threads: ASME B1.20.1.
32. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
33. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
34. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
35. Atmospheric Vacuum Breakers: ASSE 1001.
36. Brass and Copper Supplies: ASME A112.18.1.
37. Dishwasher Air-Gap Fittings: ASSE 1021.
38. Manual-Operation Flushometers: ASSE 1037.
39. Plastic Tubular Fittings: ASTM F 409.
40. Brass Waste Fittings: ASME A112.18.2.
41. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
42. Disposers: ASSE 1008 and UL 430.
43. Dishwasher Air-Gap Fittings: ASSE 1021.
44. Flexible Water Connectors: ASME A112.18.6.
45. Floor Drains: ASME A112.6.3.
46. Grab Bars: ASTM F 446.
47. Hose-Coupling Threads: ASME B1.20.7.
48. Hot-Water Dispensers: ASSE 1023 and UL 499.
49. Off-Floor Fixture Supports: ASME A112.6.1M.
50. Pipe Threads: ASME B1.20.1.
51. Plastic Shower Receptors: ANSI Z124.2.
52. Plastic Toilet Seats: ANSI Z124.5.
53. Supply and Drain Protective Shielding Guards: ICC A117.1.
54. Whirlpool Bathtub Equipment: UL 1795.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1.6 COORDINATION

- A. Coordinate all accessories. Ensure items fit and work together as an assembly. Provide additional accessories to accommodate final installed field conditions; to include, but not limited to, offsets and other items required for ADA compliance.
- B. Coordinate roughing-in and final plumbing fixture locations and verify that fixtures can be installed to comply with design.
- C. Model numbers are intended to identify families of fixtures and may be incomplete. Refer to other contract documents for hand.
- D. Where fixtures or it's associated components are installed in rated floors, walls, or ceilings; provide rated fixtures, accessories, and components of equal rating.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Faucet Cartridges, washers, aerators and O-Rings: Equal to 5 percent of amount of each type and size installed but not less than 5 of each type and size.
 - 2. Flushometer Valve, Repair Kits: 5 of each type.

PART 2 - PRODUCTS

2.1 (**EW-1**) EMERGENCY CEILING SHOWER (ACCESSIBLE)

- A. Manufacturer & Model Number: Guardian G1658PCC
 - 1. Barrier-free accessibility
 - 2. Extended pull rod with triangular handle
 - 3. Stainless steel shower head with pipe extension
 - 4. Integral flow control
 - 5. Chrome-plated brass ½" IPS stay-open ball valves
- B. Coordinate with ceiling and install in ceiling as indicated.
- C. Emergency Mixing Valve: Guardian G3800LF
 - 1. ASSE-1071
 - 2. Adjustable set point with temperature range
 - 3. Rough bronze finish
 - 4. Positive shutoff of hot supply when cold supply is lost
 - 5. Adjustable high temperature-stop limits temperature to 90 degrees F.
 - 6. Equipped with integral check stops on hot and cold supply.
 - 7. Flow Range = 20 GPM at 5 PSID – 35 GPM at 25 PSID
- D. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
 - 1. Emergency Station
 - a. Guardian
 - b. Bradley Corporation

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2. Emergency Thermostatic Mixing Valve
 - a. Guardian
 - b. Bradley Corporation

2.2 **(EW-2)** EMERGENCY COMBINATION SHOWER AND EYEWASH (ACCESSIBLE)

- A. Manufacturer & Model Number: Guardian GBF1909SSH-BC-AP275-200
 1. Barrier-free accessibility
 2. Stainless steel push handle
 3. Face spray ring
 4. Stainless steel shower head
 5. Extended pull rod with triangular handle
 6. Integral flow control in spray-head assembly
 7. Chrome-plated brass ½" IPS stay-open ball valves
 8. Stainless steel bowl cover
 9. Audible and visual alarm system linked to BMS.
- B. Emergency Mixing Valve: Guardian G3800LF
 1. ASSE-1071
 2. Adjustable set point with temperature range
 3. Rough bronze finish
 4. Positive shutoff of hot supply when cold supply is lost
 5. Adjustable high temperature-stop limits temperature to 90 degrees F.
 6. Equipped with integral check stops on hot and cold supply.
 7. Flow Range = 20 GPM at 5 PSID – 35 GPM at 25 PSID
- C. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
 1. Emergency Station
 - a. Guardian
 - b. Bradley Corporation
 2. Emergency Thermostatic Mixing Valve
 - a. Guardian
 - b. Bradley Corporation

2.3 **(EWC-1)** BI-LEVEL WATER COOLER (ACCESSIBLE) WITH BOTTLE FILLING STATION

- A. Manufacturer & Model Number: Elkay LZSTL8WSLP
 1. Self-contained wall hung electric refrigerated water cooler
 2. Push bar activation on front, left, & right of unit.
 3. Built-in flow regulator
 4. Connect to water supply using dielectric coupling.
 5. Polyester elastomer flexible bubbler.
 6. Provide non-metallic strainer.
 7. Provide quick connect fittings.
 8. Provide cane apron on upper fountain.
 9. Provide bottle filling station.
 10. Material: Stainless steel.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

11. Color: Manufacturer's standard.
12. Electrical: 115V, 1 PH, 60 HZ, 5.0 Full load amps, 370 Watts.

B. Supply: McGuire Part Number 2165-N3-F

1. ½" IPS x 3/8" OD
2. ½" x 3" chrome plated brass nipple.
3. Heavy brass chrome plated wall flange with set-screw
4. Provide dielectric connection.

C. Provide 1½" diameter plastic tailpiece extension. Electrically isolate cooler from drainage and vent system.

D. Trap: McGuire Part Number 8912-C-F

1. Size: 1-1/2" x 1-1/2"
2. Material: Polished chrome plated cast brass.
3. Cleanout plug: Yes
4. Nuts: Polished chrome plated brass.
5. Wall bend: 17-gauge seamless tubular chrome plated brass.
6. Wall flange: Chrome plated brass with setscrew. Where drain pipe connection protrudes from wall contractor may provide deep flange.

E. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

1. Drinking Fountain:
 - a. Halsey Taylor
 - b. Haws Corp
 - c. Oasis
2. Trap:
 - a. Kohler
 - b. Cambridge Brass

2.4 **(HB-1)** HOSE BIBB

A. Manufacturer and Model Number: Zurn Z1341XL

1. Vacuum Breaker: Yes (separate). Zurn Z1399-VB
2. Outlet: ASME B1.20.7, garden-hose threads.
3. ¾" Inlet
4. Ball valve ¼ turn or compression.
5. Brass Construction
6. Aluminum, brass, stainless steel, or steel handle

B. Available Manufacturers:

1. T&S
2. Chicago
3. Arrowhead Brass

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2.5 **(MB-1)** SERVICE BASIN (24" x 24")

- A. Manufacturer & Model Number: Fiat TSB3000
- B. Shoulders shall not be less than 9" high inside measurement, and not less than 1" wide. The tiling flange shall be cast integral to the unit and shall extend 1" above the shoulder on 2 sides. Basin shall be composed of marble chips and Portland cement ground smooth and sealed to resist stains. A one piece, 20-gauge, type 302 stainless-steel cap shall be integrally cast into the unit on four sides.
 - 1. Dimensions: 24" x 24" x 12".
 - 2. Cap: Stainless steel on 4 sides.
 - 3. Tiling Flange: Yes, on two sides.
 - 4. Material: Terrazzo
 - 5. Color: Manufacturer's standard
- C. Faucet: (2) Chicago 952-1/2CP
 - 1. Provide two spouts one cold and one hot.
 - 2. 8" centers
 - 3. 2-1/4" Tee handles
 - 4. Vacuum breaker spout
 - 5. Integral supply stops
 - 6. Pail hook
 - 7. Wall support
- D. Drain: Cast brass with stainless steel strainer or equal as furnished with sink.
- E. Trap: 3" (Provide additional pipe and material transition as required make connection to sink)
- F. Stainless utility shelf with mop/broom holders and rag hooks: Bobrick Model B-239
- G. Provide the following other Accessories
 - 1. Hose Hook
 - 2. 36" long hose
- H. Other Manufacturers: Provide products, features, and accessories equal to those specified above.
 - 1. Service Sink
 - a. Fiat
 - b. Just
 - c. Florestone
 - 2. Faucet:
 - a. Chicago

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Manufacturer's roughing-in data overrides all other indicated data.
- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIXTURE INSTALLATION

- A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
- C. Install back-outlet, wall hanging 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-hanging fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounted fixtures in and attached to casework.
- H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball valve if stops are not specified with fixture. Refer to Section "Valves".

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- J. Install trap and waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. 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.
- M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- N. Install toilet seats on water closets.
- O. 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.
- P. Install water supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
- Q. 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.
- R. Install shower, flow-control fittings with specified maximum flow rates in shower arms.
- S. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- T. Install disposer in outlet of sinks indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- U. Install hot-water dispensers in back top surface of sink or in counter with spout over sink.
- V. Install escutcheons at piping wall-ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 22 Section "Common Work Results For Plumbing" for escutcheons.
- W. Set service basins in leveling bed of cement grout. Refer to Division 22 Section "Common Work Results For Plumbing" for grout.
- X. Refer to Section "Joint Sealants" for sealant and installation requirements.
- Y. Provide connection to automatic lavatories & flush valves as required via low-voltage transformer(s). Mount transformer(s) above accessible ceiling. Connect to local 120V receptacle circuit with disconnect switch adjacent to transformer. All circuitry (including low voltage) shall be run concealed & in conduit. Coordinate connection requirements.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use sizes required to match fixtures. Connect to plumbing piping.
- E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- F. Ground equipment: 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.

3.4 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

- A. Replace washers and seals or cartridges of leaking and dripping faucets, stops, and valves.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 226113 - COMPRESSED-AIR PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Compressed-air piping and specialties for non-medical laboratory facilities, designated "laboratory air."
- B. Related Requirements:
 - 1. Section 115313 "Laboratory Fume Hoods" for compressed-air outlets in laboratory fume hoods.
 - 2. Section 226119 "Compressed-Air Equipment for Laboratory and Healthcare Facilities" for air compressors and specialties.

1.3 DEFINITIONS

- A. Medical compressed-air piping systems include medical air, dental air, instrument air, and medical laboratory air.
- B. Non-medical compressed-air piping systems include laboratory air piping systems.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Material Certificates: Signed by Installer certifying that medical compressed-air piping materials comply with requirements in NFPA 99 for positive-pressure medical gas systems.
- C. Retain "Field Quality-Control Reports" Paragraph below if Contractor is retaining "Brazing" Paragraph in "Quality Assurance" Article.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

D. Field quality-control reports: Brazing certificates.

E. Source Quality Control Reports:

1. Certificates of Shop Inspection and Data Report for Bulk Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code Section VIII.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Quick-Coupler Service Connections: Furnish complete non-interchangeable Laboratory compressed-air pressure outlets.
 - a. Laboratory Air: Equal to 10-percent of amount installed, but no fewer than 10-units.
 - b. Instrument Air: Equal to 10-percent of amount installed, but no fewer than 10-units.
2. D.I.S.S. Service Connections: Furnish complete Laboratory compressed-air pressure outlets complying with CGA V-5.
 - a. Laboratory Air D.I.S.S. No. 1160: Equal to 10-percent of amount installed, but no fewer than 10-units.
 - b. Instrument Air D.I.S.S. No. 1160: Equal to 10-percent of amount installed, but no fewer than 10-units.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Medical Air Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.
2. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.
- C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Laboratory air operating at 125 psig (860 kPa).

2.2 PIPES, TUBES, AND FITTINGS

- A. Comply with ASME B31.1, "Power Piping," for laboratory air piping operating at more than 150 psig (1035 kPa).
- B. Comply with ASME B31.9, "Building Services Piping," for laboratory air piping operating at 150 psig (1035 kPa) or less.
- C. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper. Include standard color marking "MED" or "OXY/MED" in green for Type K tube and in blue for Type L tube.
- D. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type.
- E. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- F. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
 1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness, full-face type.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- G. Flexible Pipe Connectors:
 1. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - a. Working-Pressure Rating: 200 psig (1380 kPa) minimum.
 - b. End Connections: Plain-end copper tube.

2.3 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.

B. Threaded-Joint Tape: PTFE.

2.4 VALVES

A. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.

1. Steel Box with Aluminum Cover:

- a. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.
 - 1) Positive pressure compressed air valves shall have been manufacturer cleaned, purged, and sealed as for oxygen service, according to CGA G-4.1.
 - a) Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.
- b. Interior Finish: Factory-applied white enamel.
- c. Cover Plate: Aluminum with frangible or removable windows.
- d. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

2. Steel Box with Stainless-Steel Cover:

- a. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.
 - 1) Positive pressure compressed air valves shall have been manufacturer cleaned, purged, and sealed as for oxygen service, according to CGA G-4.1.
 - a) Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.
- b. Interior Finish: Factory-applied white enamel.
- c. Cover Plate: Stainless-steel with frangible or removable windows.
- d. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

B. Ball Valves:

- 1. Standard: MSS SP-110.
- 2. Description: Three-piece body, brass or bronze.
- 3. Pressure Rating: 300 psig (2070 kPa) minimum.
- 4. Ball: Full-port, chrome-plated brass.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

5. Seats: PTFE or TFE.
6. Handle: Lever.
7. Stem: Blowout proof with PTFE or TFE seal.
8. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
9. Positive pressure medical air valves shall have been manufacturer cleaned, purged, and sealed as for oxygen service, according to CGA G-4.1.
 - a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

C. Check Valves:

1. Description: In-line pattern, bronze.
2. Pressure Rating: 300 psig (2070 kPa) minimum.
3. Operation: Spring loaded.
4. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
5. Positive pressure compressed air valves shall have been manufacturer cleaned, purged, and sealed as for oxygen service, according to CGA G-4.1.
 - a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

D. Compressed-Air Safety Valves:

1. Bronze body.
2. ASME-construction, poppet, pressure-relief type.
3. Settings to match system requirements.
4. Positive pressure compressed air valves shall have been manufacturer cleaned, purged, and sealed as for oxygen service, according to CGA G-4.1.
 - a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

E. Pressure Regulators:

1. Bronze body and trim.
2. Spring-loaded, diaphragm-operated, relieving type.
3. Manual pressure-setting adjustment.
4. Rated for 250-psig (1725-kPa) minimum inlet pressure.
5. Capable of controlling delivered air pressure within 0.5 psig for each 10-psig (5.0 kPa for each 100-kPa) inlet pressure.
6. Positive pressure medical air regulators shall have been manufacturer cleaned, purged, and sealed as for oxygen service, according to CGA G-4.1.
 - a. Valves shall be delivered sealed and labeled and kept sealed until prepared for installation.

2.5 COMPRESSED-AIR-CYLINDER STORAGE RACKS

- A. Wall Storage Racks: Fabricate racks with chain restraints for upright cylinders as indicated or provide equivalent manufactured wall racks.
- B. Freestanding Storage Racks: Fabricate racks as indicated or provide equivalent manufactured storage racks.

2.6 NITROGEN

- A. Comply with USP 32 - NF 27 for oil-free dry nitrogen.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Comply with NFPA 99 for installation of compressed-air piping.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install compressed-air piping with 1 percent slope downward in direction of flow.
- H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- I. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- J. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- K. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."
- L. Install piping to permit valve servicing.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and for branch connections.
- O. Install medical air piping to medical air service connections specified in this Section, to medical air service connections in equipment specified in Section 226313 "Gas Piping for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical air service.
- P. Piping Restraint Installation: Install restraints on compressed-air piping. Restraint devices are specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- Q. Install compressed-air service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- R. Connect compressed-air piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.
- S. Install unions in copper compressed-air tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
- B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install pressure regulators on compressed-air piping where reduced pressure is required.
- F. Install flexible pipe connectors in discharge piping of each air compressor.

3.3 JOINT CONSTRUCTION

- A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- B. Threaded Joints: Apply appropriate tape to external pipe threads.
- C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" chapter. Continuously purge joint with oil-free dry nitrogen during brazing.
- D. Flanged Joints: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- E. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

3.4 COMPRESSED-AIR SERVICE COMPONENT INSTALLATION

- A. Install compressed-air pressure control panel in walls. Attach to substrate.
- B. Install compressed-air manifolds anchored to substrate.
- C. Install compressed-air cylinders and connect to manifold piping.
- D. Install compressed-air manifolds with restraints as indicated.
- E. Install compressed-air-cylinder wall storage racks attached to substrate.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Vertical Piping: MSS Type 8 or Type 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - 2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
- D. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- E. Base of Vertical Piping: MSS Type 52, spring hangers.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- F. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
- H. Support vertical runs of copper tubing to comply with MSS-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent and applicable.

3.6 IDENTIFICATION

- A. Install identifying labels and devices for nonmedical laboratory compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Install identifying labels and devices for medical compressed-air piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 - 1. Medical Air: Black letters on yellow background.
 - 2. Instrument Air: White letters on red background.
 - 3. Medical Laboratory Air: Black letters on yellow-and-white checkerboard background.

3.7 FIELD QUALITY CONTROL FOR COMPRESSED-AIR PIPING IN NON-MEDICAL LABORATORY FACILITIES

- A. Testing Agency: Engage qualified testing agency to perform tests and inspections of compressed-air piping in non-medical laboratory facilities and to prepare test and inspection reports.
- B. Tests and Inspections:
 - 1. Piping Leak Tests for Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill compressed-air piping with oil-free dry nitrogen to pressure of 50 psig (345 kPa) above system operating pressure, but not less than 150 psig (1035 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop-in pressure.
 - 2. Repair leaks and retest until no leaks exist.
 - 3. Inspect filters and pressure regulators for proper operation.
- C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.8 PROTECTION

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.9 PIPING SCHEDULE

- A. Connect new tubing to existing tubing with memory-metal couplings.
- B. Flanges may be used where connection to flanged equipment is required.
- C. Laboratory Air Piping except Laboratory Air Piping Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig (1275 kPa): Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
- D. Laboratory Air Piping Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig (1275 kPa): Type K, copper medical gas tube; wrought-copper fittings; and brazed joints.

3.10 VALVE SCHEDULE

- A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
- B. Zone Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION 226113

SECTION 226119 - COMPRESSED-AIR EQUIPMENT FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Oil-less scroll air compressors.
 - 2. Inlet-air filters.
 - 3. Compressed-air purification systems.
 - 4. Compressed-air filter assemblies.

1.3 DEFINITIONS

- A. Actual Air: Air delivered at air-compressor outlet. Flow rate is compressed air delivered and measured in acfm (actual L/s).
- B. Laboratory Air Equipment: Compressed-air equipment and accessories for nonmedical laboratory facilities.
- C. Standard Air: Free air at 68 deg F (20 deg C) and 1 atmosphere (29.92 in. Hg) before compression or expansion and measured in scfm (standard L/s).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For air compressors, compressed-air dryers, and compressed-air purification systems.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For compressed-air equipment to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Air-Compressor, Inlet-Air Filter Elements: Equal to 10-percent of quantity installed, but no fewer than 10-units.
 2. Belts: Two for each belt-driven compressor.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Laboratory Air Equipment for Nonmedical Laboratory Facilities: An employer of workers trained and approved by manufacturer.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the compressed-air equipment testing indicated, that is an NRTL and that is acceptable to authorities having jurisdiction.
 1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design compressed-air equipment mounting.

2.2 GENERAL REQUIREMENTS FOR AIR COMPRESSORS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 544, "Medical and Dental Equipment," for medical compressed-air equipment.
- C. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.
- D. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
 - 1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
 - 2. Motor Controllers: Full-voltage, combination-magnetic type with under-voltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
 - 3. Control Voltage: 120-V ac or less, using integral control power transformer.
 - 4. Motor Overload Protection: Overload relay in each phase.
 - 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
 - 6. Automatic control switches to alternate lead-lag air compressors for duplex and sequence lead-lag air compressors for multiplex air compressors.
 - 7. Instrumentation: Include discharge-air and receiver pressure gages, air-filter maintenance indicator, hour meter, air-compressor discharge-air and coolant temperature gages, and control transformer.
 - 8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.
- E. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 1. Pressure Rating: At least as high as highest discharge pressure of connected air compressors and bearing appropriate code symbols.
 - 2. Interior Finish: Corrosion-resistant coating.
 - 3. Accessories: Include safety valve, pressure gage, automatic drain, and pressure regulator.
- F. Mounting Frame: Fabricate base and attachment to air compressor and components with reinforcement strong enough to resist movement during a seismic event when base is anchored to building structure.

2.3 AIR COMPRESSORS

- A. **(EX-AC-1)** Existing Reused Air Compressors:
 - 1. Basis of Design: Chicago Pneumatics QRS-25
 - 2. Description: Packaged unit with integral refrigerated air dryer, pre and post filtration, and horizontal receiver.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

3. Air Compressor(s): Oil-free, rotary, oscillating-volute type of construction that prohibits oil from entering compression chamber.

- a. Mounting: Horizontal Receiver.

B. Capacities and Characteristics:

1. Compressed-Air Service: Non-medical laboratory air.
2. Air Compressor(s): Two.
3. Actual-Air Capacity of Each Air Compressor: 100 acfm delivered.
4. Discharge-Air Pressure: 125 psig.
5. Motor (Each Air Compressor):

- a. Horsepower: 25.
 - b. Speed: 3600 rpm.

6. Electrical Characteristics:

- a. Volts: 208.
 - b. Phases: Three.
 - c. Hertz: 60.

7. Receiver: ASME construction steel tank.

- a. Orientation: Vertical arrangement.
 - b. Capacity: 132 gal.
 - c. Interior Finish: Epoxy or galvanized.
 - d. Pressure Regulator Setting: 125 psig.
 - e. Drain: Automatic valve.

2.4 AIR FILTERS

A. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.

1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
2. Capacity: Match capacity of air compressor, with collection efficiency of 99 percent retention of particles larger than 10 micrometers.

B. Description: Combination inlet-air filter-silencer, suitable for remote installation, for multiple air compressors.

1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
2. Capacity: Match total capacity of connected air compressors, with collection efficiency of 99 percent retention of particles larger than 10 micrometers.

2.5 COMPRESSED-AIR DRYERS

A. Compressed-Air Dryers:

1. Integral to existing reused packaged compressor skid assembly.

2.6 COMPRESSED-AIR FILTER ASSEMBLIES

A. Compressed-Air Filter Assemblies:

1. Description: Filter assemblies suitable for compressed air, in parallel duplex arrangement. Size each assembly for maximum capacity of connected equipment and operating pressure of compressed-air system. Include automatic ejection of condensate from airstream, inlet and outlet pressure gages, and shutoff valves.
 - a. Option: Factory-fabricated filter system consisting of three air filters equivalent to those specified, pipe, fittings, valves, differential pressure switch, and enclosure; and with additional automatic drain traps and gages.
2. Size filter assemblies for 5-psig (34.5-kPa) maximum air-pressure drop when filters are new and clean, at system rated capacity, and at 100-psig (690-kPa) pressure.
3. Differential Pressure Switch: Adjustable, diaphragm type, with electrical connections for alarm system, to indicate when air-pressure drop through filters rises to more than 2 psig (13.8 kPa) greater than when new and clean.
4. Particulate Filters: Collection efficiency of 98 percent retention of particles 1 micrometer and larger.
5. Odor and Taste Filters: Vapor-absorbing, activated charcoal.
6. Coalescing Filters: Collection efficiency of 99.9 percent retention of particles 0.3 micrometer and smaller.
7. Include automatic drain trap for each filter.

B. Provide separate filtration for lab air and general building compressed air services

1. Lab Air
 - a. Basis of Design: Gardner-Denver FIL
 - 1) Grade A – Water Separator
 - 2) Grade F – Maximum Efficiency Oil Removal 0.01 Micron
 - 3) Grade D – Dry Particulate 0.01 Micron
2. General Compressed Air
 - a. Basis of Design: Gardner-Denver FIL
 - 1) Grade A – Water Separator
 - 2) Grade E – High Efficiency Oil Removal 0.01 Micron

2.7 MOTORS

- ### A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean compressed-air equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for laboratory air applications, according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."

3.2 COMPRESSED-AIR EQUIPMENT INSTALLATION

- A. General Requirements for Compressed-Air Equipment Installation:
 - 1. Install compressed-air equipment to allow maximum headroom unless specific mounting heights are indicated.
 - 2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces unless otherwise indicated.
 - 3. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
 - 4. Install equipment to allow right of way for piping installed at required slope.
 - 5. Install the following devices on compressed-air equipment:
 - a. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
 - b. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.
 - c. Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.
- B. Non-Medical Laboratory Compressed-Air Equipment Installation:
 - 1. Install compressed-air equipment, except wall-mounted equipment, on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Comply with requirements for vibration isolation control devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment"

3.3 CONNECTIONS

- A. Comply with requirements for water-supply piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements for drain piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- C. Comply with requirements for compressed-air piping specified in Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities." Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance.
- E. Connect compressed-air piping to compressed-air equipment, accessories, and specialties with shutoff valve and union or flanged connection.
- F. Connect water supply to compressed-air equipment that requires water. Include backflow preventer. Backflow preventers are specified in Section 221119 "Domestic Water Piping Specialties."

3.4 IDENTIFICATION

- A. Identify nonmedical laboratory compressed-air equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Identify medical compressed-air equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment." and with NFPA 99.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check for lubricating oil in lubricated-type equipment.
 - 3. Check belt drives for proper tension.
 - 4. Verify that air-compressor inlet filters and piping are clear.
 - 5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
 - 6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
 - 7. Check for proper seismic restraints.
 - 8. Drain receiver tank(s).
 - 9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 10. Test and adjust controls and safeties.
- B. Prepare written report documenting testing procedures and results.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, compressed-air dryers, compressed-air purification units, and compressed-air filter assemblies.

END OF SECTION 226119

SECTION 226213 - VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Laboratory low-vacuum piping, designated "laboratory low vacuum."
 - 2. Laboratory high-vacuum piping, designated "laboratory high vacuum."

- B. Related Requirements:

- 1. Section 115313 "Laboratory Fume Hoods" for vacuum inlets in laboratory fume hoods.
 - 2. Section 123553 "Laboratory Casework" for vacuum inlets in laboratory casework.
 - 3. Section 226219 "Vacuum Equipment for Laboratory and Healthcare Facilities" for vacuum producers and accessories.

1.3 DEFINITIONS

- A. HVE: High-volume (oral) evacuation.
- B. WAGD: Waste anesthetic gas disposal.
- C. Medical vacuum piping systems include medical vacuum, WAGD, dental vacuum, HVE, and medical laboratory vacuum piping systems.
- D. Non-medical laboratory vacuum piping systems include laboratory low-vacuum and laboratory high-vacuum piping systems.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

B. Brazing certificates.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For vacuum piping specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Quick-Coupler Service Connections: Furnish complete non-interchangeable laboratory vacuum suction inlets.

a. Laboratory Vacuum: Equal to 10-percent of amount installed, but no fewer than 10-units.

2. D.I.S.S. Service Connections: Furnish complete Laboratory vacuum suction inlets complying with CGA V-5.

a. Laboratory Vacuum D.I.S.S. No. 1220: Equal to 10-percent of amount installed, but no fewer than 10-units.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Pressure-Seal Joining Procedure for Copper Tubing: An authorized representative who is trained and approved by manufacturer.

2. Extruded-Tee Outlet Procedure: An authorized representative who is trained and approved by manufacturer.

3. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Laboratory low vacuum operating at 20 in. Hg (510 mm Hg).
- B. Laboratory high vacuum operating at 29 in. Hg (735 mm Hg).

2.2 PIPES, TUBES, AND FITTINGS

- A. Comply with NFPA 99 for medical vacuum piping materials.
- B. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.
- C. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service.
- D. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- E. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
 - 1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness, full-face type.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- F. Pressure-Seal Fittings:
 - 1. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - 2. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- G. Extruded-Tee Outlets: ASTM F 2014 procedure for making branch outlets in copper tube.
- H. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.
- I. PVC Fittings: ASTM D 2466, Schedule 40 and ASTM D 2467, Schedule 80; socket type.
- J. Transition Fittings: PVC socket type with copper threaded insert on one end.

K. Flexible Pipe Connectors:

1. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - a. Working-Pressure Rating: 200 psig (1380 kPa) minimum.
 - b. End Connections: Plain-end copper tube.

2.3 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.
- C. Threaded-Joint Tape: PTFE.
- D. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

2.4 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
 1. Exception: Factory cleaning and bagging are not required for valves for WAGD service.
- B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.
 1. Zone-Valve Boxes:
 - a. Steel Box with Aluminum Cover:
 - b. Steel Box with Stainless-Steel Cover:
 - c. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.
 - 1) Interior Finish: Factory-applied white enamel.
 - 2) Cover Plate: Aluminum or stainless-steel with frangible or removable windows.
 - 3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
- C. Copper-Alloy Ball Valves:

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. Standard: MSS SP-110.
2. Description: Three-piece body, brass or bronze.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Ball: Full-port, chrome-plated brass.
5. Seats: PTFE or TFE.
6. Handle: Lever.
7. Stem: Blowout proof with PTFE or TFE seal.
8. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

D. Check Valves:

1. Description: In-line pattern, bronze.
2. Pressure Rating: 300 psig (2070 kPa) minimum.
3. Operation: Spring loaded.
4. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

2.5 VACUUM SERVICE CONNECTIONS

A. General Requirements for Vacuum Service Connections:

1. Suitable for specific type of vacuum service listed.
2. Include roughing-in assemblies, finishing assemblies, and cover plates.
3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
4. Recessed-type units made for concealed piping unless otherwise indicated.

B. Roughing-in Assembly:

1. Steel outlet box for recessed mounting and concealed piping.
2. Brass-body inlet block.
3. Seals that will prevent vacuum leakage.
4. ASTM B 819, NPS 3/8 (DN 10) copper outlet tube brazed to valve with service marking and tube-end dust cap.

C. Finishing Assembly:

1. Brass housing with primary check valve.
2. Seals that will prevent vacuum leakage.
3. Cover plate with gas-service label.

D. Quick-Coupler Suction Service Connections:

1. Inlets for vacuum with non-interchangeable keyed indexing to prevent interchange between services.
2. Constructed to permit one-handed connection and removal of equipment.
3. With positive-locking ring that retains equipment stem in valve during use.

E. D.I.S.S. Suction Service Connections:

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. Inlets complying with CGA V-5.
 2. Threaded indexing to prevent interchange between services.
 3. Constructed to permit one-handed connection and removal of equipment.
 4. Vacuum: CGA V-5, D.I.S.S. No. 1220.
- F. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.
- G. Cover Plates:
1. One piece.
 2. Aluminum or stainless steel.
 3. Permanent, color-coded, identifying label matching corresponding service.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, vacuum producer sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Comply with NFPA 99 for installation of vacuum piping.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install vacuum piping with 1 percent slope downward in direction of flow.
- H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- I. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- J. Provide drain leg and drain trap at end of each main and branch and at low points.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- K. Install thermometer and vacuum gage on inlet piping to each vacuum producer and on each receiver and separator. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."
- L. Install piping to permit valve servicing.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.
- O. Install vacuum piping from vacuum service connections specified in this Section, to equipment specified in Section 226219 "Vacuum Equipment for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical vacuum service.
- P. Piping Restraint Installation: Install seismic restraints on vacuum piping. Seismic-restraint devices are specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- Q. Install vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- R. Install vacuum bottle bracket adjacent to each wall-mounted vacuum service connection suction inlet.
- S. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.
- T. Install unions in copper vacuum tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
- U. Install unions in PVC vacuum piping NPS 2 (DN 50) and smaller adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
- V. Install flanges in PVC vacuum piping NPS 2-1/2 (DN 65) and larger adjacent to flanged valves and at final connection to each machine, specialty, and piece of equipment.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from vacuum equipment and specialties.
- B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.

- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Apply appropriate tape to external pipe threads.
- E. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.
- F. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Join copper tube and fittings according to ASTM B 828.
- G. PVC-to-Copper Joints: Join transition fitting PVC socket end as solvent-cemented joint to PVC pipe and join fitting end with insert to copper tube as threaded joint.
- H. Extruded-Tee Outlets: Form branches in copper tube according to ASTM F 2014, with tools recommended by tube manufacturer.
- I. Flanged Joints:
 - 1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
 - 2. PVC Piping: Install PVC flange on PVC pipes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- J. Pressure-Sealed Joints: Join copper tube and copper and copper-alloy fittings with tools recommended by fitting manufacturer.
- K. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.
- L. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. Apply primer and join according to ASME B31.9 and ASTM D 2672 for solvent-cemented joints.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Vertical Piping: MSS Type 8 or Type 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
 1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
 2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
- D. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- E. Base of Vertical Piping: MSS Type 52, spring hangers.
- F. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Install vinyl-coated hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- H. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
- I. Support vertical runs of copper tubing to comply with MSS-58, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- J. Support vertical runs of PVC piping to comply with manufacturer's written instructions, NFPA 99, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 IDENTIFICATION

- A. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

- B. Install identifying labels and devices for medical vacuum piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:

- 1. Laboratory Vacuum: Black boxed letters on white-and-black checkerboard background.

3.6 FIELD QUALITY CONTROL FOR LABORATORY FACILITY NON-MEDICAL VACUUM PIPING

- A. Testing Agency: Engage qualified testing agency to perform field tests and inspections of vacuum piping in nonmedical laboratory facilities and to prepare test and inspection reports.

- B. Tests and Inspections:

- 1. Piping Leak Tests for Vacuum Piping: Test new and modified parts of existing piping. Cap and fill vacuum piping with oil-free, dry nitrogen. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop-in pressure.

- a. Test Pressure for Copper Tubing: 100 psig (690 kPa).
 - b. Test Pressure for PVC Piping: 50 psig (345 kPa).

- 2. Repair leaks and retest until no leaks exist.
 - 3. Inspect filters for proper operation.

- C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.7 PROTECTION

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.8 PIPING SCHEDULE

- A. Connect new copper tubing to existing copper tubing with memory-metal couplings.
- B. Connect PVC pipe to copper tube with transition fittings.
- C. Flanges may be used where connection to flanged equipment is required.
- D. Laboratory Low-Vacuum Piping: Use one of the following piping materials for each size range:

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. NPS 4 (DN 100) and Smaller:
 - a. Copper water tube, wrought-copper fittings, and soldered joints.
 - b. Copper water tube, press-type fittings, and pressure-sealed joints.
2. NPS 5 to NPS 8 (DN 125 to DN 200):
 - a. Copper water tube, wrought-copper fittings, and soldered joints.

E. Laboratory High-Vacuum Piping: Use one of the following piping materials for each size range:

1. NPS 4 (DN 100) and Smaller:
 - a. Copper water tube, wrought-copper fittings, and brazed joints.
 - b. Copper water tube, press-type fittings, and pressure-sealed joints.
2. NPS 5 to NPS 8 (DN 125 to DN 200):
 - a. Copper water tube, wrought-copper fittings, and brazed joints.

3.9 VALVE SCHEDULE

A. Shutoff Valves:

1. Copper Tubing: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
2. PVC Piping:
 - a. NPS 4 (DN 100) and Smaller: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
 - b. NPS 5 (DN 125) and Larger: PVC butterfly valve.

B. Zone Valves: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION 226213

SECTION 226219 - VACUUM EQUIPMENT FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Rotary, dry-claw vacuum pumps.
 - 2. Turbine exhausters.
- B. Related Requirements:
 - 1. Section 226400 "Medical Gas Alarms" for vacuum equipment local alarms.

1.3 DEFINITIONS

- A. Actual Air: Air delivered at vacuum producer inlet. Flow rate is air measured in acfm (actual L/s).
- B. HVE: High-volume oral evacuation for dental applications in healthcare facilities.
- C. Laboratory Vacuum Equipment: Vacuum producers and accessories for nonmedical laboratory facilities.
- D. Medical Vacuum Equipment: Includes medical, WAGD, dental, HVE, and healthcare laboratory vacuum producers and accessories for healthcare facilities.
- E. Standard Air: Free air at 68 deg F (20 deg C) and 1 atmosphere (29.92 in. Hg) before compression or expansion and measured in scfm (standard L/s).
- F. WAGD: Waste anesthetic gas disposal for medical-surgical applications in healthcare facilities.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For vacuum producers.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For vacuum equipment to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Belts: Two for each belt-driven vacuum producer.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Laboratory Vacuum Equipment for Nonmedical Laboratory Facilities: An employer of workers trained and approved by manufacturer.
 2. Medical Vacuum Equipment for Healthcare Facilities: Qualify installers according to ASSE 6010.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum equipment testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.
 1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vacuum equipment mounting.

2.2 GENERAL REQUIREMENTS FOR VACUUM PUMPS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 99, "Health Care Facilities," for vacuum equipment and accessories for medical vacuum systems.
- C. Comply with UL 544, "Medical and Dental Equipment," for medical vacuum equipment.
- D. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty vacuum pumps and receivers.
- E. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
 - 1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
 - 2. Motor Controllers: Full-voltage, combination-magnetic type with under-voltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
 - 3. Control Voltage: 120-V ac or less, using integral control power transformer.
 - 4. Motor Overload Protection: Overload relay in each phase.
 - 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
 - 6. Automatic control switches to alternate lead-lag vacuum pumps for duplex and sequence lead-lag vacuum pumps for multiplex vacuum pumps.
 - 7. Instrumentation: Include vacuum pump inlet and receiver vacuum gages, hour meter, vacuum pump discharge-air and coolant temperature gages, and control transformer.
 - 8. Alarm Signal Devices: For connection to alarm system to indicate when backup vacuum pump is operating.
- F. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1; bearing appropriate code symbols.
 - 1. Interior Finish: Corrosion-resistant coating.
 - 2. Accessories: Include vacuum relief valve, vacuum gage, and drain.
- G. Mounting Frames: Fabricate base and attachment to vacuum pump and components with reinforcement strong enough to resist movement during a seismic event when base is anchored to building structure.

2.3 ROTARY, DRY-CLAW VACUUM PUMPS

A. Rotary, Dry-Claw Vacuum Pumps:

1. Basis of Design: Beacon Medaes LVHV04D-060H-D
2. Description: Packaged unit.
3. Vacuum Pump(s): Single-stage, rotary, dry-claw type.
 - a. Coupling: Non-lubricated, flexible type.
 - b. Cooling System: Air-cooled.
 - c. Capacity Control: Capacity modulation between zero and 100 percent vacuum delivery. Include necessary control to hold constant vacuum. When vacuum demand is zero, unload unit by using vacuum switch and blowdown valve.
4. Receiver: ASME construction steel tank with vacuum relief valve.
5. Outlet silencers on discharge connections.

B. Capacities and Characteristics:

1. Vacuum Service: Non-medical laboratory vacuum.
2. Vacuum Pump(s): Two.
3. Standard-Air Capacity of Each Vacuum Pump: 79 scfm free air.
4. Vacuum Required: 19 in. Hg.
5. Motor (Each Vacuum Pump):
 - a. Horsepower: 5.
6. Receiver:
 - a. Orientation: Horizontal arrangement.
 - b. Capacity: 60 gal.
 - c. Pressure Rating: 100 psig (690 kPa) minimum.
 - d. Interior Finish: Epoxy or galvanized.
 - e. Drain: Automatic valve.

2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean vacuum equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for laboratory vacuum applications, according to CGA G4.1, "Cleaning Equipment for Oxygen Service."

3.2 VACUUM EQUIPMENT INSTALLATION

- A. Install vacuum equipment for healthcare facilities according to ASSE 6010 and NFPA 99.
- B. Equipment Mounting:
 - 1. Install vacuum producers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete" or Section 033053 "Miscellaneous Cast-in-Place Concrete."
 - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment"
- C. Install vacuum equipment anchored to substrate.
- D. Orient equipment so controls and devices are accessible for servicing.
- E. Maintain manufacturer's recommended clearances for service and maintenance.
- F. Install the following devices on vacuum equipment:
 - 1. Thermometer, Vacuum Gage, and Pressure Relief Valve: Install on each vacuum pump receiver.
 - 2. Drain Valves: Install on receivers and separators. Discharge receiver condensate over nearest floor drain. Discharge separator oral evacuation fluids by direct connection into sanitary waste piping system.

3.3 CONNECTIONS

- A. Comply with requirements for water-supply piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements for drain piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Comply with requirements for vacuum piping specified in Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities." Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance.
- E. Connect vacuum piping to vacuum equipment, accessories, and specialties with shutoff valve and union or flanged connection.
- F. Connect water supply to vacuum equipment that requires water. Include backflow preventer. Backflow preventers are specified in Section 221119 "Domestic Water Piping Specialties."

3.4 IDENTIFICATION

- A. Identify non-medical laboratory vacuum equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Identify medical vacuum equipment system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment." and with NFPA 99.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check for lubricating oil in lubricated-type equipment.
 - 3. Check belt drives for proper tension.
 - 4. Verify that vacuum producer outlet piping is clear.
 - 5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
 - 6. Check safety valves for correct settings.
 - 7. Check for proper seismic restraints.
 - 8. Drain receiver and separator tank(s).
 - 9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 10. Test and adjust controls and safeties.
- B. Verify that vacuum equipment is installed and connected according to the Contract Documents.
- C. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in electrical Sections.
- D. Prepare written report documenting testing procedures and results.

3.6 DEMONSTRATION

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

END OF SECTION 226219

SECTION 226700 - PROCESSED WATER SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes reagent-water, deionized-water, distilled-water, and reverse-osmosis-water piping, fittings, and valves, including the following:
 - 1. CPVC pipe and fittings.
 - 2. PP pipe and fittings for heat-fusion joints.
 - 3. PP pipe and fittings for electro-fusion joints.
 - 4. PVC pipe and fittings.
 - 5. PVDF pipe and fittings.
 - 6. Stainless steel tubing and fittings.
 - 7. CPVC valves.
 - 8. PP valves.
 - 9. PVC valves.
 - 10. PVDF valves.
 - 11. Stainless steel ball valves.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- B. ASME Compliance: Comply with ASME B31.3 for piping conveying fluid at a pressure of 15 psig (105 kPa) or greater.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure Ratings:
1. Reagent-Water Piping: 100 psig (690 kPa) unless otherwise indicated.
 2. Deionized-Water Piping: 150 psig (1035 kPa) unless otherwise indicated.
 3. Distilled-Water Piping: 150 psig (1035 kPa) unless otherwise indicated.
 4. Reverse-Osmosis Water Piping: 150 psig (1035 kPa) unless otherwise indicated.

2.2 PLASTIC PIPE AND FITTINGS

- A. Standards: Comply with NSF 14, NSF 61, and NSF 372.
- B. CPVC Pipe and Fittings, Schedule 40: ASTM F441/F441M pipe; with plain ends for solvent-cemented joints and ASTM F438 socket-type fittings.
- C. CPVC Pipe and Fittings, Schedule 80: ASTM F441/F441M pipe; with plain ends for solvent-cemented joints and ASTM F439, socket-type fittings.
- D. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.
- E. PP Pipe and Fittings for Heat-Fusion Joints: Made from ASTM D4101, PP resin.
- F. PP Pipe and Fittings, Schedule 40: Schedule 40 or SDR 11 dimensions; with socket- or butt-fusion fittings matching pipe dimensions.
- G. PP Pipe and Fittings for Electro-Fusion Joints: Made from ASTM D4101, PP resin.
1. PP Pipe and Fittings, Schedule 80: Schedule 80 or SDR dimensions; with socket fittings matching pipe dimensions.
 2. Electro-Fusion Fitting: Electrical-resistance heating coil for PP piping joints.
- H. PVC Pipe and Fittings, Schedule 40: ASTM D1785 pipe; with plain ends for solvent-cemented joints and ASTM D2466, socket-type fittings.
- I. PVC Pipe and Fittings, Schedule 80: ASTM D1785 pipe; with plain ends for solvent-cemented joints and ASTM D2467 socket-type fittings.
- J. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer according to ASTM F656.
- K. PVDF Pipe and Fittings: Made from ASTM D3222, PVDF resin.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

1. PVDF Pipe and Fittings, Schedule 40: Schedule 40 or SDR 11 dimensions; with socket- or butt-fusion fittings matching pipe dimensions.
2. PVDF Pipe and Fittings, Schedule 80: Pipe made according to ASTM D3222, Schedule 80 or SDR; with socket-fusion fittings matching pipe dimensions.

2.3 STAINLESS STEEL TUBING

- A. Stainless Steel Tube: ASTM A270/A270M, Grade TP304L or TP316L, seamless, sanitary tube of pharmaceutical quality, with wall thickness not less than ASTM A312/A312M, Schedule 5 unless otherwise indicated; with seamless, stainless steel fittings matching tube thickness and grade, for welded joints.
- B. Stainless Steel Tube Fittings: Fabricated of same material and thickness as tubing for butt welding.
- C. Finish on Inside Surface of Tubes and Fittings: Ra 20 micro-inch (Ra 0.5 micro-m) maximum roughness.

2.4 TRANSITION FITTINGS

- A. Couplings, flanges, or other manufactured fittings; same size as, with pressure rating at least equal to, and ends compatible with piping to be joined.

2.5 CPVC VALVES

A. CPVC Ball Valves:

1. Description:
 - a. Standards: Comply with MSS SP-122 and ASTM F1970.
 - b. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - c. Body Material: ASTM D1784 CPVC compound.
 - d. Body Design: Union type.
 - e. End Connections: Detachable, socket.
 - f. Ball: ASTM D1784 CPVC compound.
 - g. Port: Full.
 - h. Seats: PTFE.
 - i. Stem: ASTM D1784 CPVC compound.
 - j. Stem Seals: EPDM or FKM-rubber O-rings.
 - k. Handle: Tee shaped.

B. CPVC Butterfly Valves:

1. Description:
 - a. Standard: Comply with ASTM F1970.
 - b. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - c. Body Material: ASTM D1784 CPVC compound.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- d. Body Design: Lug or wafer type.
- e. Seat: EPDM or FKM rubber.
- f. Disc: ASTM D1784 CPVC compound or ASTM D4101 PP resin.
- g. Stem: Stainless steel.
- h. Stem Seals: EPDM or FKM-rubber O-rings.
- i. Handle: Lever type with locking device.

C. CPVC Ball-Check Valves:

- 1. Description:
 - a. Standard: Comply with ASTM F1970.
 - b. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - c. Body Material: ASTM D1784 CPVC compound.
 - d. Body Design: Union type.
 - e. End Connections: Detachable, socket.
 - f. Ball: ASTM D1784 CPVC compound.
 - g. Seat and Seals: EPDM or FKM-rubber O-rings.

D. CPVC Swing-Check Valves:

- 1. Description:
 - a. Standard: Comply with ASTM F1970.
 - b. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - c. Body Material: ASTM D1784 CPVC compound.
 - d. Body Design: Bolted-bonnet type.
 - e. End Connections: Flanged.
 - f. Shaft: ASTM D1784 CPVC compound.
 - g. Disc and Arm: ASTM D1784 CPVC compounds.
 - h. Gasket and Seals: EPDM or FKM rubber.

E. CPVC Diaphragm Valves:

- 1. Description:
 - a. Standard: Comply with ASTM F1970.
 - b. Pressure Rating: 150 psig (1035 kPa) 73 deg F (23 deg C).
 - c. Body Material: ASTM D1784 CPVC compound.
 - d. Body Design: Bolted-bonnet type.
 - e. End Connections for NPS 2 (DN 50) and Smaller: Detachable, socket.
 - f. End Connections for NPS 2-1/2 and NPS 3 (DN 65 and DN 80): Flanged.
 - g. Diaphragm: EPDM or FKM rubber.
 - h. Seals: EPDM or FKM-rubber O-rings.
 - i. Handle: Wheel type.

2.6 PP VALVES

A. PP Ball Valves:

- 1. Description:

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- a. Standard: MSS SP-122.
- b. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
- c. Body Material: ASTM D4101 PP resin.
- d. Body Design: Union type.
- e. End Connections: Detachable, butt or socket.
- f. Ball: ASTM D4101 PP resin.
- g. Port: Full.
- h. Seats: PTFE.
- i. Stem: ASTM D4101 PP resin.
- j. Stem Seals: FKM-rubber O-rings.
- k. Handle: Tee shaped.

B. PP Butterfly Valves:

- 1. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - b. Body Material: ASTM D4101 PP resin.
 - c. Body Design: Lug or wafer type.
 - d. Seat: FKM rubber.
 - e. Disc: ASTM D4101 PP resin.
 - f. Stem: Stainless steel.
 - g. Stem Seals: FKM-rubber O-rings.
 - h. Handle: Lever type with locking device.

C. PP Ball-Check Valves:

- 1. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - b. Body Material: ASTM D4101 PP resin.
 - c. Body Design: Union type.
 - d. End Connections: Detachable, socket.
 - e. Ball: ASTM D4101 PP resin.
 - f. Seat and Seals: FKM-rubber O-rings.

D. PP Swing-Check Valves:

- 1. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - b. Body Material: ASTM D4101 PP resin.
 - c. Body Design: Bolted-bonnet type.
 - d. End Connections: Flanged.
 - e. Shaft: ASTM D4101 PP resin.
 - f. Disc and Arm: ASTM D4101 PP resin.
 - g. Gasket and Seals: FKM rubber.

E. PP Diaphragm Valves:

- 1. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- b. Body Material: ASTM D4101 PP resin.
- c. Body Design: Bolted-bonnet type.
- d. End Connections for NPS 2 (DN 50) and Smaller: Detachable, socket.
- e. End Connections for NPS 2-1/2 and NPS 3 (DN 65 and DN 80): Flanged.
- f. Diaphragm: FKM rubber.
- g. Seals: FKM-rubber O-rings.
- h. Handle: Wheel type.

2.7 PVC VALVES

A. PVC Ball Valves:

- 1. Description:
 - a. Standards: Comply with MSS SP-122 and ASTM F1970.
 - b. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - c. Body Material: ASTM D1784 PVC compound.
 - d. Body Design: Union type.
 - e. End Connections: Detachable, socket.
 - f. Ball: ASTM D1784 PVC compound.
 - g. Port: Full.
 - h. Seats: PTFE.
 - i. Stem: ASTM D1784 PVC compound.
 - j. Seals: EPDM or FKM-rubber O-rings.
 - k. Handle: Tee shaped.

B. PVC Butterfly Valves:

- 1. Description:
 - a. Standard: Comply with ASTM F1970.
 - b. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - c. Body Material: ASTM D1784 PVC compound.
 - d. Body Design: Lug or wafer type.
 - e. Seat: EPDM or FKM rubber.
 - f. Disc: ASTM D1784 PVC compound or ASTM D4101 PP resin.
 - g. Stem: Stainless steel.
 - h. Stem Seals: EPDM or FKM-rubber O-rings.
 - i. Handle: Lever type with locking device.

C. PVC Ball-Check Valves:

- 1. Description:
 - a. Standard: Comply with ASTM F1970.
 - b. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - c. Body Material: ASTM D1784 PVC compound.
 - d. Body Design: Union type.
 - e. End Connections: Detachable, socket.
 - f. Ball: ASTM D1784 PVC compound.
 - g. Seat and Seals: EPDM or FKM-rubber O-rings.

D. PVC Swing-Check Valves:

1. Description:
 - a. Standard: Comply with ASTM F1970.
 - b. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - c. Body Material: ASTM D1784 PVC compound.
 - d. Body Design: Bolted-bonnet type.
 - e. End Connections: Flanged.
 - f. Shaft: ASTM D1784 PVC compound.
 - g. Disc and Arm: ASTM D1784 PVC compounds.
 - h. Gasket and Seals: EPDM or FKM rubber.

E. PVC Diaphragm Valves:

1. Description:
 - a. Standard: Comply with ASTM F1970.
 - b. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - c. Body Material: ASTM D1784 PVC compound.
 - d. Body Design: Bolted-bonnet type.
 - e. End Connections for NPS 2 (DN 50) and Smaller: Detachable, socket.
 - f. End Connections for NPS 2-1/2 and NPS 3 (DN 65 and DN 80): Flanged.
 - g. Diaphragm: EPDM or FKM rubber.
 - h. Seals: EPDM or FKM-rubber O-rings.
 - i. Handle: Wheel type.

2.8 PVDF VALVES

A. PVDF Ball Valves:

1. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - c. Body Material: ASTM D3222 PVDF resin.
 - d. Body Design: Union type.
 - e. End Connections: Detachable, butt or socket.
 - f. Ball: ASTM D3222 PVDF resin.
 - g. Port: Full.
 - h. Seats: PTFE.
 - i. Stem: ASTM D3222 PVDF resin.
 - j. Stem Seals: FKM-rubber O-rings.
 - k. Handle: Tee shaped.

B. PVDF Butterfly Valves:

1. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - b. Body Material: ASTM D3222 PVDF resin.
 - c. Body Design: Lug or wafer type.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- d. Seat: FKM rubber.
- e. Disc: ASTM D3222 PVDF resin.
- f. Stem: Stainless steel.
- g. Stem Seals: FKM-rubber O-rings.
- h. Handle: Lever type with locking device.

C. PVDF Ball-Check Valves:

- 1. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - b. Body Material: ASTM D3222 PVDF resin.
 - c. Body Design: Union type.
 - d. End Connections: Detachable, socket.
 - e. Ball: ASTM D3222 PVDF resin.
 - f. Seat and Seals: FKM-rubber O-rings.

D. PVDF Swing-Check Valves:

- 1. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - b. Body Material: ASTM D3222 PVDF resin.
 - c. Body Design: Bolted-bonnet type.
 - d. End Connections: Flanged.
 - e. Shaft: ASTM D3222 PVDF resin.
 - f. Disc and Arm: ASTM D3222 PVDF resins.
 - g. Gasket and Seals: FKM rubber.

E. PVDF Diaphragm Valves:

- 1. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at 73 deg F (23 deg C).
 - b. Body Material: ASTM D3222 PVDF resin.
 - c. Body Design: Bolted-bonnet type.
 - d. End Connections for NPS 2 (DN 50) and Smaller: Detachable, socket.
 - e. End Connections for NPS 2-1/2 and NPS 3 (DN 65 and DN 80): Flanged.
 - f. Diaphragm: FKM rubber.
 - g. Seals: FKM-rubber O-rings.
 - h. Handle: Wheel type.

2.9 STAINLESS STEEL BALL VALVES

A. Description:

- 1. Standard: MSS SP-110.
- 2. Minimum CWP Rating: 1000 psig (6895 kPa).
- 3. Body Material: Stainless steel.
- 4. Body Design: Three-piece bolted body type.
- 5. End Connections: Socket welding.
- 6. Seats: PTFE or TFE.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- 7. Stem: Stainless steel.
- 8. Ball: Stainless steel, vented.
- 9. Port: Full.
- 10. Handle: Lever type.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of water piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install restraints on piping. Comply with requirements for restraint devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for removal of ceiling panel, and coordinate with other services occupying that space.
- F. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- G. Install piping to permit valve servicing.
- H. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure ratings unless otherwise indicated.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- L. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- M. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 JOINT CONSTRUCTION

- A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. CPVC Piping Solvent-Cemented Joints: Comply with ASTM F402 for handling solvent cements, primers, and cleaners; make joints according to ASTM D2846/D2846M Appendix.
- C. PP Piping Electro-Fusion Joints: Make according to ASTM F1290.
- D. PP Piping Heat-Fusion Joints: Make according to ASTM D2657.
- E. PVC Piping Solvent-Cemented Joints: Comply with ASTM F402 for handling solvent cements, primers, and cleaners; make joints according to ASTM D2672.
- F. PVDF Piping Heat-Fusion Joints: Make according to ASTM D2657.
- G. Stainless Steel Sanitary Tubing Joints: Make fully penetrated-wall, butt-welding joints without use of filler metal. Comply with AWS D1.6/D1.6M for welding procedures and processes. Polish exterior of welds to match tubing.
- H. Join dissimilar pipe materials with transition fittings compatible with pipe materials being joined.

3.3 INSTALLATION OF VALVES

- A. Install sectional valves close to mains on each branch and riser serving equipment.
- B. Install shutoff valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves of same size as the pipe or tube in which they are installed unless otherwise indicated.
- E. Install plastic valves of the same material as the plastic pipe in which they are installed.
- F. Install stainless steel valves in stainless steel tubing.
- G. Install valves in horizontal piping with stem at or above center of pipe.
- H. Install valves in position to allow full movement of stem and lever handle.
- I. Install swing-check valves in horizontal position with the hinge pin level.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in non-corrosive environments.
 2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in non-corrosive environments.
 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
 5. Clamps for Vertical Piping: MSS Type 8 or Type 42.
 6. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1 adjustable clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43 adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49 spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs, 100 Feet (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.
- 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 minimum 3/8 inch (10 mm).
- E. Install padded hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
- F. Install padded supports for vertical CPVC piping NPS 2-1/2 (DN 65) and larger every 120 inches (3000 mm) and mid-story for NPS 2 (DN 50) and smaller.
- G. Install padded hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 (DN 25) and Smaller: 32 inches (813 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
- H. Install padded supports for vertical PP piping NPS 2-1/2 (DN 65) and larger every 120 inches (3000 mm) and mid-story for NPS 2 (DN 50) and smaller.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- I. Install padded hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
- J. Install padded supports for vertical PVC piping NPS 2-1/2 (DN 65) and larger every 120 inches (3000 mm) and mid-story for NPS 2 (DN 50) and smaller.
- K. Install padded hangers for PVDF piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 (DN 25) and Smaller: 30 inches (750 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/4 (DN 32): 33 inches (840 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
- L. Install padded supports for vertical PVDF piping NPS 2-1/2 (DN 65) and larger every 120 inches (3000 mm) and mid-story for NPS 2 (DN 50) and smaller.
- M. Install hangers for stainless steel tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - 4. NPS 3 (DN 80): 10 feet (3 m) with 1/2-inch (13-mm) rod.
- N. Install supports for vertical stainless-steel tubing every 10 feet (3 m).
- O. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- C. Connect deionized-water, distilled-water, and reverse-osmosis-water piping to equipment and service outlets with unions or flanges.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

3.6 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections:
 - 1. Test new piping, and parts of existing piping that have been altered, extended, or repaired, for leaks and defects.
 - 2. Schedule tests and their inspections by authorities having jurisdiction and Owner, with at least 24 hours' advance notice.
 - 3. Do not cover piping or put into service before inspection and approval by the authorities having jurisdiction and Owner.
 - 4. Test completed piping according to authorities having jurisdiction and Owner. If authorities having jurisdiction do and/or Owner does not have published procedures, perform tests as follows:
 - a. Hydrostatic Tests: Test piping at pressure of not less than 1-1/2 times the maximum system operating pressure, but not less than 100 psig (690 kPa). Hold test for two hours; pressure shall remain constant without pumping. Inspect system to determine visible leaks or significant pressure variations.
 - 1) Exception: Do not subject glass piping to pressure above manufacturer's pressure rating for size.
 - 5. If piping does not pass the test, replace leaking joints with new materials and retest until no leaks exist.
 - 6. Submit separate reports for each test.
- F. Processed water system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

3.8 CLEANING OF PIPING SERVING LABORATORIES

- A. Use procedures prescribed by authorities having jurisdiction and Owner or, if not prescribed, use procedures described below:
 - 1. Before using, purge new piping and parts of existing piping that have been altered, extended, or repaired.
 - 2. Remove flow indicators and flow-measuring devices before flushing. Replace after cleaning is completed.
 - 3. Provide storage tank(s), heat exchanger(s) and pumping system(s) required for cleaning.
 - 4. Clean piping by pumping at a sufficient velocity and quantity to dislodge sediment or dirt with sodium hypochlorite and deionized, distilled, and reverse-osmosis water mixture throughout the system.
 - 5. Open all taps until cleaning solution is detected, then close taps. Retain solution in the system at least four hours.
- B. At the end of the retention period, open all faucets and taps to thoroughly flush with clean reagent, deionized, distilled, and reverse-osmosis water until solution is drained from the system.

3.9 PIPING APPLICATION

- A. Transition and special fittings with pressure ratings at least equal to piping, and of same or compatible material, may be used in applications below.
- B. Pipe fittings shall be the same material as the piping to which it is connected.
- C. Reagent-Water Piping: Use any of the following piping materials for each pipe size range:
 - 1. Pipe Sizes NPS 3 (DN 80) and Smaller:
 - a. Schedule 40, CPVC pipe and fittings and solvent-cemented joints.
 - b. Schedule 80, CPVC pipe and fittings and solvent-cemented joints.
 - c. PP pipe and fittings and heat-fusion joints.
 - d. PP pipe and fittings and electro-fusion joints.
 - e. Schedule 40, PVC pipe and fittings and solvent-cemented joints.
 - f. Schedule 80, PVC pipe and fittings and solvent-cemented joints.
 - g. PVDF pipe and fittings and heat-fusion joints.
 - h. Stainless steel sanitary tubing and welded joints.
- D. Deionized-Water Piping: Use any of the following piping materials for each pipe size range:
 - 1. NPS 3 (DN 80) and Smaller:
 - a. PP pipe and fittings and heat-fusion joints.
 - b. PP pipe and fittings and electro-fusion joints.
 - c. PVDF pipe and fittings and heat-fusion joints.
 - d. Stainless steel sanitary tubing and welded joints.
- E. Distilled-Water Piping: Use any of the following piping materials for each pipe size range:

1. NPS 3 (DN 80) and Smaller:
 - a. PP pipe and fittings and heat-fusion joints.
 - b. PP pipe and fittings and electro-fusion joints.
 - c. PVDF pipe and fittings and heat-fusion joints.
 - d. Stainless steel sanitary tubing and welded joints.

F. Reverse-Osmosis-Water Piping: Use any of the following piping materials for each pipe size range:

1. NPS 3 (DN 80) and Smaller:
 - a. PP pipe and fittings and heat-fusion joints.
 - b. PP pipe and fittings and electro-fusion joints.
 - c. PVDF pipe and fittings and heat-fusion joints.
 - d. Stainless steel sanitary tubing and welded joints.

3.10 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Valves shall be the same material as the piping to which they are connected.
 2. Shutoff Duty: Install ball valves in piping NPS 2 (DN 50) and smaller. Install butterfly or diaphragm valves for NPS 3 (DN 80) piping.
 3. Throttling Duty: Install ball valves in piping NPS 2 (DN 50) and smaller. Install diaphragm valves for NPS 3 (DN 80) piping.

END OF SECTION 226700

SECTION 226719 - PROCESSED WATER EQUIPMENT FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes reagent-water, deionized-water, distilled-water, and reverse-osmosis-water equipment and processed water faucets. Equipment and associated control and accessories shall be capable of producing reagent grade water applicable to the Type required at final service.
 - 1. Multimedia filter.
 - 2. Carbon filter.
 - 3. Water softeners.
 - 4. De-chlorination filter.
 - 5. Deionized (DI) mixed beds.
 - 6. RO systems.
 - 7. Recirculating pump.
 - 8. Purified-water storage tank
 - 9. Point-of-use portable polishers.
 - 10. Ultra-violet sterilization unit.
 - 11. Recirculating pure-water faucet.
- B. Related Requirements:
 - 1. Section 226700 "Processed Water Systems for Laboratory and Healthcare Facilities" for piping, fittings and valves.

1.3 DEFINITIONS

- A. RO: Reverse osmosis.

1.4 ACTION SUBMITTALS

- A. Product Data for each type of product, including the following.
 - 1. Pump curves.
 - 2. Equipment dimensions and weight data.
 - 3. Electrical wiring data.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

4. Control panel layout.
5. Vibration data.

B. Shop Drawings:

1. Provide a flow schematic of the proposed system, showing:
 - a. Equipment and accessories.
 - b. Piping and directional flows and sizes.
 - c. Flow rates.
 - d. Connection to domestic water.
 - e. Components.
 - f. Interconnection piping.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Operation and Maintenance Data: For all equipment in this section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer shall have the qualifications for supplying and servicing process water equipment, including engineering services.
- B. The process water quality shall be in accordance with ASTM D1193.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain processed water equipment from single source.
- B. Design based on Mar Cor Purification custom packaged DI skid. Package to include the following.
 1. Carbon Filtration
 2. Storage Tank
 3. Level Controller
 4. Recirculation Pump
 5. DI Exchange Tanks
 6. Ultra-Violet System
 7. Resistivity Monitor

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2.2 PERFORMANCE REQUIREMENTS

- A. Design equipment shall be based on the city of Wilmington, NC make-up water conditions obtained from the city water supply quality report.
 - 1. Reagent-Water Piping: 100 psig (690 kPa) unless otherwise indicated.
 - 2. Deionized-Water Piping: 150 psig (1035 kPa) unless otherwise indicated.
 - 3. Distilled-Water Piping: 150 psig (1035 kPa) unless otherwise indicated.
 - 4. RO Water Piping: 150 psig (1035 kPa) unless otherwise indicated.

2.3 MULTIMEDIA FILTRATION

- A. Filter Tank:
 - 1. Material: Fiberglass with a polyethylene liner and inner shell constructed of HDPE.
 - 2. Rated Working Pressure: 150 psig (1034 kPa) psig at 120 deg F (49 deg C) temperature.
- B. Distributor Assembly:
 - 1. Hub and Lateral Distribution System:
 - a. For tanks 21 inches (5333 mm) in diameter and larger.
 - b. Material: ABS or PVC.
 - 2. Single Non-Clogging Segmented Distributor:
 - a. For tanks 18 inches (457 mm) in diameter and smaller.
 - b. Material: ABS.
- C. Operating Valves:
 - 1. Fully Automatic Multiport Control Valve:
 - a. Motor-driven single-piston valve with a piston timer to control regeneration program.
 - b. Fully adjustable.
 - 2. Diaphragm Valves: Permit separate water source for backwashing.
- D. Regeneration Initiation Control:
 - 1. Provide a seven-day time clock to allow the system to regenerate at any time of the day or night and on any day of the week.
 - 2. Provide a differential pressure switch to initiate backwash based on measurement of increased pressure loss across the system.
- E. Filter Media:
 - 1. Top Layer: 1.0- to 1.2-mm anthracite.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

2. Second Layer: 0.4- to 0.5-mm flint sand.
3. Third Layer: 0.35- to 0.45-mm garnet.
4. All Layers: Resting on coarse gravel under-bedding.

2.4 CARBON FILTER

A. Filter Tank:

1. Welded, industrial-grade, cold-rolled carbon steel with dished heads constructed and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels. Tank shall have the maximum working pressure of not less than 150 psig (1034 kPa).
2. Filter Media:
 - a. Two layers of graduated supporting gravel.
 - b. One layer of 2 cu. ft. (56 L) of activated carbon.
 - c. Bottom layer of coarse gravel under-bedding.
3. The tank shall be provided with O-Ring seals at the openings, inlets, and outlets.
4. Tank shall have an epoxy enamel finish.
5. Provide seven-day time clock to allow the system to regenerate at any time of the day or night and on any day of the week.

2.5 WATER SOFTENERS

A. Standards: Comply with NSF 44.

B. Softener Tank: Welded, industrial-grade, cold-rolled carbon steel or Fiberglass-reinforced polyester (FRP).

1. 150-psig (1034-kPa) operating pressure and ASME stamped.
2. Design at a temperature of 120 deg. F.
3. Tank to be lined with 20-mil-thick vinyl bag.
4. Mineral Bed: Non-phenolic polystyrene resin with a minimum exchange capacity of 30,000 grains per cubic foot when regenerated with 15 lbs (6.8 kg) of salt per cubic foot (cu.M.). Mineral shall be solid and particle the proper size, not more than 4 percent through a No. 40 mesh wet screening and shall not contain any foreign shapes that will interfere with the normal operation of the softener.

C. Brine Tank: Shall be molded rigid polyethylene with cover. Tanks shall be furnished with a metering system, valves, and controls.

2.6 DECHLORINATION FILTER

A. Filter: Two independent, activated carbon filters in parallel. Resultant residual chlorine concentration shall be less than 0.1 ppm.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- B. Filter Vessel: Fiberglass-reinforced molded-thermoplastic inner shell with dished heads, equipped with reinforced openings for piping connections.
 - 1. Hand hole at the top and bottom.
 - 2. Vessel to be rated at 150-psig (1034-kPa) working pressure in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels.
- C. Provide controls compatible with the facility control system. Provide connection for trouble alarm.
- D. Provide pressure gauges with simple cocks on inlet and outlet of each tank.

2.7 DEIONIZED (DI) MIXED BEDS

- A. Tank:
 - 1. Material: Reinforced fiberglass with vinyl ester lining for removing dissolved ionized solids.
 - 2. Minimum Water Resistivity: 10 megohm - cm at 25 deg C.
 - 3. Pressure Ratings: Operating pressure of not less than 150 psig (1034 kPa) and test pressure not less than 185 psig (1275 kPa).
- B. Resin: Suitable for using in mixed-bed deionizer application and for intended application.

2.8 REVERSE OSMOSIS (RO) SYSTEMS

- A. Pressurized Membrane System: High-pressure pump forces water through the membrane(s) to remove 99 percent of organic solids, bacteria, contaminants, and particles and 97 percent of dissolved solids.
- B. Pre-filtration: Polypropylene depth filters, capable of removing 90 percent of particles greater than 5-micron.
 - 1. Housing:
 - a. Type 304 or Type 316 stainless steel.
 - b. Include vent and drain plugs with EPDM o-rings.
 - c. Include Type 304 or Type 316 pressure gauge at the inlet and outlet.
- C. Membrane modules with thin-film composite type membranes and membrane vessels to allow a maximum flux for the following:
 - 1. First Stage: 18 gallons per square foot per day (733 liters per square meter per day) of membrane surface area at 17 percent recovery.
 - 2. Second Stage: 30 gallons per square foot (114 liters per square meter per day) per day of membrane surface area at 35 percent recovery.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

D. Panel-Mounted Controls and Instrumentation on a Common Frame:

1. Material: Stainless steel or Epoxy-coated aluminum.
2. Features:
 - a. Flow meters
 - b. Type 304 or Type 316 stainless steel pressure gauges for pump discharge and regulated pump pressure.
 - c. Control valves.
 - d. Pump starter with indicated light.
 - e. Feedwater pressure switch with time delay for low-pressure shutdown.
 - f. Time controller for automatic fast flush.
 - g. Monitor/controller with selector switch for feed to monitor conductivity.
 - h. Trouble alarm with ability to connect to the building management system.

2.9 PURIFIED-WATER STORAGE TANK

- A. Material: Fabricated of molded polyethylene with a cone bottom and extra heavy wall construction. Provide with four lifting lugs of Type 304 or Type 316 stainless steel.
- B. Mounting: Steel stand assembly with hold-down lugs of Type 304 or Type 316 stainless steel.

2.10 RECIRCULATING PUMP

- A. Type: Vertical or Horizontal.
- B. Pump Material: Type 304 or Type 316 stainless steel.
- C. Impeller Material: Stainless steel.
- D. Seals: Mechanical.
- E. Gaskets: Teflon.
- F. Size and capacity as shown on Drawings.

2.11 POINT-OF-USE PORTABLE POLISHERS

- A. The system shall be capable of operating from ordinary tap or pretreated water.
- B. The unit shall produce purified water that complies with ASTM International, College of American Pathologists, and Clinical Laboratory Standards Institute specifications and USP29-NF24 for grade water Type required by end use equipment.
- C. Output Flow Rate: 0.44 gpm (2 L/m).
- D. Accessories: Inlet shut-off valve.

2.12 ULTRA-VIOLET STERILIZATION UNIT

- A. Inline Sterilizer Light: Provide to reduce the bacteria.
- B. Ultra-Violet Lamps: Ultra-violet lamp(s) designed to operate at 115 V, single phase, 60 Hz.
 - 1. Housing: Type 304, electro-polished and passivated stainless-steel, complying with MIL-S-5002.
- C. Provide a sensor that will be able to indicate level of UV radiation being produced.

2.13 RECIRCULATING PURE-WATER FAUCET

- A. Faucet: **(refer to Lab drawings and specs for information)**
 - 1. Deck-mounted recirculating type to eliminate dead legs in the purified-water system.
 - 2. Plastic lined.
 - 3. Include diaphragm valve with a brass valve stem and bonnet; on-off control.
 - 4. Compatible with grade of water delivered.

2.14 NON-RECIRCULATING PURE-WATER FAUCET

- A. Faucet: **(refer to Lab drawings and specs for information)**
 - 1. Deck-mounted non-recirculating type.
 - 2. Brass casting and inert polypropylene-lined interior.
 - 3. Include diaphragm valve with a brass valve stem and bonnet; on-off control.

2.15 SOURCE QUALITY CONTROL

- A. Manufacturer to perform a factory test of components, piping, and skid assemblies prior to shipment and furnish certification that the testing has been performed and the certification meets specified design requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Locations and Arrangements: Drawings and details indicate general location and arrangement of water piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install restraints on equipment. Comply with requirements for restraint devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

- C. Install equipment in accordance with all codes, standards, and manufacturers recommendations.
- D. Provide documentation that the equipment has been installed in accordance with manufacturers requirements.
- E. Provide a startup of the equipment and a per-check of all associated piping, valves, control devices and control panels.
- F. After completion of the installation, provide up to eight hours of instructional time with the Owner's personnel.
- G. Mount equipment and/or skid(s) on concrete pads.
- H. Connect, calibrate, balance, and adjust equipment, devices, and instrumentation to perform functions as specified.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of equipment, piping, fittings, and specialties.
- B. Where installing equipment, allow space for service and maintenance.
- C. Connect deionized-water, distilled-water, and RO water piping to equipment and service outlets with unions or flanges.

3.3 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections:
 - 1. After installation, Installer shall test equipment for performance, leaks, and defects.
 - 2. The Installer shall notify the authorities having jurisdiction, Owner, Architect, and engineer, with at least 24 hours' advance notice.

DOBO HALL RENOVATION,
PACKAGE B – DEMOLITION
UNC WILMINGTON
Architect's Project No: 580999

3. Do not cover equipment or put into service before inspection and approval by the authorities having jurisdiction, Owner, Architect, and engineer.
4. Submit separate reports for each test.

F. Processed-water system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.5 SANITIZING OF EQUIPMENT SERVING LABORATORIES

A. Use procedures prescribed by authorities having jurisdiction and Owner or, if not prescribed, use procedures described below:

1. Remove flow indicators and flow-measuring devices before flushing. Replace after cleaning is completed.
2. Clean equipment by pumping at a sufficient velocity and quantity to dislodge sediment or dirt with sodium hypochlorite and a deionized-, distilled-, and RO- water mixture throughout the system.
3. Open all taps until solution is detected, then close taps. Retain solution in the system at least four hours.

END OF SECTION 226719

SECTION 230130 - EXISTING HVAC AIR DISTRIBUTION SYSTEM CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cleaning existing HVAC air-distribution equipment, ducts, plenums, and system components.
- B. Related Requirements:
 - 1. Section 233113 "Metal Ducts" for cleaning newly installed metal ducts.
 - 2. Section 014520 "Testing, Adjusting, Balancing for HVAC" for system flow documentation before cleaning and balancing and following cleaning and restoration.
 - 3. Section 233300 "Air Duct Accessories" for restoration of opened ducts and plenums with access doors.

1.3 DEFINITIONS

- A. ACAC: American Council for Accredited Certification.
- B. AIHA-LAP: American Industrial Hygiene Association Lab Accreditation Program
- C. ASCS: Air systems cleaning specialist.
- D. CESB: Council of Engineering and Scientific Specialty Boards.
- E. CMI: Certified Microbial Investigator.
- F. CMC: Certified Microbial Consultant.
- G. CMR: Certified Microbial Remediator.
- H. CMRS: Certified Microbial Remediation Supervisor.
- I. EMLAP: Environmental Microbiology Laboratory Accreditation Program.
- J. IEP: Indoor Environmental Professional.
- K. IICRC: Institute of Inspection, Cleaning, and Restoration Certification.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

L. NADCA: National Air Duct Cleaners Association.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Cleaning agents
2. Antimicrobial surface treatments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For an ASCS.
2. For an IEP.
3. For a CMR and a CMRS.

B. Field Quality-Control Reports:

1. Project's existing conditions.
2. Evaluations and recommendations, including cleanliness verification.
3. Strategies and procedures plan.

1.6 CLOSEOUT SUBMITTALS

A. Post-Project report.

1.7 QUALITY ASSURANCE

A. ASCS Qualifications: A certified member of NADCA.

1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
2. Supervisor Qualifications: Certified as an ASCS by NADCA.

B. IEP Qualifications: CMI who is certified by ACAC and accredited by CESB.

C. IEP Qualifications: CMC who is certified by ACAC and accredited by CESB.

D. CMR Qualifications: Certified by ACAC and accredited by CESB.

E. CMRS Qualifications: Certified by ACAC and accredited by CESB.

F. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.

G. Cleaning Conference: Conduct conference at Project site.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Review methods and procedures related to HVAC air-distribution system cleaning, including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS

2.1 HVAC CLEANING AGENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Apex Engineering Products Corporation.
 2. BBJ Environmental Solutions.
 3. Goodway Technologies Corporation.
 4. Nu-Calgon.
 5. QuestVapco Corporation.
- B. Description:
 1. Formulated for each specific soiled coil condition that needs remedy.
 2. Will not corrode or tarnish aluminum, copper, or other metals.

2.2 ANTIMICROBIAL SURFACE TREATMENT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Bio-Cide International, Inc.
 2. Contec, Inc.
 3. Ecolab, Inc.
- B. Description: Specific product selected shall be as recommended by the IEP based on the specific antimicrobial needs of the specific Project conditions.
 1. Formulated to kill and inhibit growth of microorganisms.
 2. EPA-registered for use in HVAC systems and for the specific application in which it will be used.
 3. Have no residual action after drying, with zero VOC off-gassing.
 4. OSHA compliant.
 5. Treatment shall dry clear to allow continued visual observation of the treated surface.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspect HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Evaluation and Recommendation" according to NADCA ACR.
- C. Cleaning Plan: Prepare a written plan for air-distribution system cleaning that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule, including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
 - 6. Exhaust equipment setup locations.
- D. Existing Conditions Report: Prepare a written report that documents existing conditions of the systems and equipment. Include documentation of existing conditions, including inspection results, photo images, laboratory results, and interpretations of the laboratory results by an IEP.
 - 1. Prepare written report listing conditions detrimental to performance of the Work.
- E. Proceed with work only after conditions detrimental to performance of the Work have been corrected.
- F. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- G. Comply with NADCA ACR, "Guidelines for Constructing Service Openings in HVAC Systems" Section.
- H. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning.

3.2 CLEANING

- A. Comply with NADCA ACR, including items identified as "recommended," "advised," and "suggested."
- B. Perform electrical lockout and tagout according to Owner's standards or authorities having jurisdiction.
- C. Remove non-adhered substances and deposits from within the HVAC system.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- D. Complete cleaning in accordance with Owner-Contractor agreed-upon scope of work.
- E. Systems and Components to Be Cleaned: All air-moving and -distribution equipment.
- F. Systems and Components to Be Cleaned:
 - 1. Ductwork:
 - a. Supply-air ducts.
 - b. Transfer ducts.
- G. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Particulate Collection:
 - 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 - 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,
- I. Control odors and mist vapors during the cleaning and restoration process.
- J. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- K. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- L. Clean all air-distribution devices, registers, grilles, and diffusers.
- M. Clean non-adhered substance deposits according to NADCA ACR and the following:
 - 1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
 - 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
 - 3. Clean evaporator coils, reheat coils, and other airstream components.
- N. Air-Distribution Systems:
 - 1. Create service openings in the HVAC system as necessary to accommodate cleaning.
 - 2. Mechanically clean air-distribution systems specified to remove all visible contaminants, so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- O. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- P. Mechanical Cleaning Methodology:
 - 1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials, such as duct and plenum liners.
 - 2. Cleaning Mineral-Fiber Insulation Components:
 - a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR.
 - b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).
 - c. Fibrous materials that become wet shall be discarded and replaced.
- Q. Application of Antimicrobial Treatment:
 - 1. Apply antimicrobial agents and coatings if active fungal growth is determined by the IEP to be at Condition 2 or Condition 3 status according to IICRC S520, as analyzed by a laboratory accredited by AIHA-LAP with an EMLAP certificate, and with results interpreted by an IEP. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
 - 2. Apply antimicrobial treatments and coatings after the system is rendered clean.
 - 3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
 - 4. Microbial remediation shall be performed by a qualified CMR and CMRS.

3.3 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR, "Verification of HVAC System Cleanliness" Section.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- C. Surface-Cleaning Verification: Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Additional Verification:
 - 1. Perform surface comparison testing or NADCA vacuum test.
 - 2. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.
- E. Prepare a written cleanliness verification report. At a minimum, include the following:
 - 1. Written documentation of the success of the cleaning.
 - 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 - 3. Surface comparison test results if required.
 - 4. Gravimetric analysis (nonporous surfaces only).
 - 5. System areas found to be damaged.
- F. Photographic Documentation: Comply with requirements in Section 013233 "Photographic Documentation."

3.4 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in Section 233113 "Metal Ducts."
- C. Reseal fibrous-glass ducts. Comply with requirements in Section 233116 "Nonmetal Ducts."
- D. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."
- E. Replace damaged insulation according to Section 230713 "Duct Insulation."
- F. Ensure that closures do not hinder or alter airflow.
- G. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.
- H. Restore manual volume dampers and air-directional mechanical devices inside the system to their marked position on completion of cleaning.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- I. Measure air flows through air-distribution system.
- J. Measure static-pressure differential across each coil.

3.5 PROJECT CLOSEOUT

A. Post-Project Report:

- 1. Post-cleaning laboratory results if any.
- 2. Post-cleaning photo images.
- 3. Post-cleaning verification summary.

B. Drawings:

- 1. Deviations of existing system from Owner's record drawings.
- 2. Location of service openings.

END OF SECTION 230130

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.
- G. NCSBC: North Carolina State Building Code

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1.4 QUALITY ASSURANCE

- A. Equipment and appliances comprising portions of the mechanical systems regulated by the NCSBC shall be listed and labeled in accordance with the current edition of the NCSBC.
- B. Equipment and appliances comprising portions of the mechanical systems regulated by the NCSBC shall be installed in accordance with the listing, manufacturer's installation instructions, and the NCSBC. Manufacturer's installation instructions shall be available on the job site for use and inspection.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- D. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1.7 INTENT OF CONTRACT DOCUMENTS

- A. Mechanical and HVAC drawings are diagrammatic, indicating general locations and arrangements of pipe, duct, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.
- B. Coordinate work in order to achieve proper operation and to provide a maintainable installed condition.
- C. Notify the Architect's representative immediately of conditions which do not comply or will not produce this result.
- D. Indicated configurations were used to size pipes, pumps, expansion tanks and other devices. Install piping, duct, and equipment generally as indicated. Minor deviations are permitted in the course of necessary coordination. Major changes shall be submitted for approval by the Architect's representative. Additional fittings and offsets not indicated are expected, anticipated by the design, and shall be provided. If more than 5% of the indicated number of fittings are required or if one change in direction is within six inches of another change in direction and this "Z" shape is not indicated notify the Architect's representative immediately. Provide necessary additional fittings and offsets. Changes in pipe size shall be made only with written approval from the Architect's representative.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to Section "Hydronic Piping" for additional pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping sections for joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions inside & outside pipe and:
 - 1. ASME B16.21, non-metallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated, and full-face or ring type, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free (95% Tin, 5% Antimony) alloy. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg-5, silver alloy for refrigerant piping, unless otherwise indicated.
- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MECHANICAL GROOVED JOINT COUPLINGS

- A. Manufacturer: Victaulic
- B. Description: Pipe joint consisting of a grooved pipe, EPDM gasket, steel housing, two bolts and two nuts.
- C. Gasket Material: Grade "E" EPDM suitable for use up to 250°F.
- D. Housing: Carbon steel

2.4 DIELECTRIC FITTINGS

- A. Where piping of dissimilar metals is joined together use yellow brass unions or as below.
- B. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 - E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
- 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Underdeck Clamp: Clamping ring with set screws.

- E. Molded PE: Reusable, PE, tapered cup-shaped and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 [HVAC DEMOLITION]

- A. Refer to Sections "Cutting and Patching" and "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Equipment to Be Removed: Remove equipment and associated piping back to main unless otherwise indicated. Cap services.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services. Remove, clean, and store equipment. When appropriate, reinstall, reconnect, and make equipment operational.
 5. Equipment to Be Removed and Salvaged: Remove equipment and associated piping back to main unless otherwise indicated. Cap services. Remove equipment, clean, and store as directed (May be off-site). Make available to owner at time of the owner's choosing.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.]

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following and Division 23 Sections specifying piping systems.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated.
- D. Install piping above accessible ceilings allowing sufficient space for ceiling panel removal.
- E. Install piping to permit valve operation & servicing.
- F. Install condensate drain piping at 1% slope.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections unless otherwise indicated.
- I. Install piping leaving room for installation of insulation.
- J. Install system components with pressure rating equal to or greater than system operating pressure.
- K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 1. Exposed, Interior Installations/Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Exposed, Interior Installations/Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish and set-screw.
 3. Exposed, Interior Installations/Insulated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 4. Exposed, Interior Installations/Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with finish to match surrounding surfaces.
 5. Exposed, Interior Installations/Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with finish to match surrounding surfaces.
 6. Exposed, Interior Installations/Piping in Unfinished Service Spaces: None, provide sealant.
 7. Exposed, Interior Installations/Piping in Equipment Rooms: None, provide sealant.
 8. Exposed, Interior Installations/Piping at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces: None - provide sealant and sleeve extending 2" above floor to prevent liquid leaking to floor below.
- L. Provide seal around piping penetrations of full height interior walls, both rated and non-rated, that occur above ceilings. Refer to Section 079200 Joint Sealants.
- M. Sleeves are not required for core-drilled holes.
1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.
- O. Install sleeves for pipes passing through walls, floors, or roofs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment rooms, fan rooms or other similar wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring.
 2. Install sleeves as walls and slabs are constructed.
 - a. PVC Pipe Sleeves: Permitted for pipes smaller than 6" except aboveground, exterior-walls.
 - b. Steel Sheet Sleeves: Permitted for pipes 6" and larger, penetrating gypsum-board partitions except aboveground, exterior-walls.
 - c. Seal space outside sleeve fittings with grout and sealant.
 3. Except for penetrations where mechanical sleeve seals are used, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Section "Joint Sealants".
- P. Aboveground Exterior Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
4. Sleeves from an approved sleeve seal manufacturer shall be acceptable.

- Q. Underground Exterior Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.
- R. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply water-flushable flux, unless otherwise indicated, to tube end. Construct joints using lead-free solder alloy.
- E. Brazed Joints: Construct joints using copper-phosphorus brazing filler metal.
- F. Threaded Joints: Thread pipe with tapered pipe threads. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless otherwise indicated.

- G. Welded Joints: Construct joints using qualified processes and welding operators.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Mechanical Joints: Prepare pipe ends and fittings, apply coupling, and join according to joint manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 1. Install unions, in piping 2" and smaller, one adjacent to each valve and at final connections to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2" and larger, adjacent to final connections to each piece of equipment.
 3. Install dielectric unions or flanges for connections of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to service side of equipment.
- D. Install equipment to allow space for other systems.

3.6 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 HOUSEKEEPING PADS AND EQUIPMENT PADS

- A. Housekeeping pads and equipment pads: Anchor equipment to concrete according to equipment manufacturer's written instructions and according to seismic codes at project location.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Construct concrete pads in accordance with drawing details.
2. Details may be found on structural drawings. If details are not provided comply with the following:
 - a. Housekeeping pads inside the building shall be 6" thick and 6" larger all around than supported equipment. Provide #4 rebar at 12" on center each way at mid-depth of slab. Provide a 3/4" chamfer on all edges.
 - b. Equipment pads outside the building shall be 8" thick with a 12" deep and 20" wide turndown (footing) all around the outside edge of the pad. Provide #5 rebar at 16" on center each way at mid-depth of slab. Pad shall be 6" larger all around than supported equipment.
 - c. Install epoxy-coated anchor bolts. For equipment on housekeeping pads bolts shall extend through housekeeping pad, and anchor into structural concrete floor.
 - d. Place and secure anchor bolts using supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions for placement.
 - e. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - f. Install anchor bolts according to anchor bolt manufacturer's written instructions.
 - g. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete".

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.9 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.

H. Cure placed grout.

3.10 EXCAVATION AND BACKFILL

- A. Excavation and backfill shall be as indicated in Division 1 specifications and on the drawings. If excavation and backfill is not otherwise indicated the following shall apply:
1. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below frost line.
 2. Excavate trenches to uniform widths to provide twelve inches clear on each side of pipe. Excavate trench walls vertically from trench bottom.
 3. Trench Bottoms: Excavate trench bottoms to provide flat surface. Place and compact six inches of sand. Excavate and shape sand to provide uniform bearing and support of pipes. Shape sand to provide continuous support for bells, joints, fittings, and barrels of pipes. Sand shall be free of projecting stones and sharp objects.
 4. Backfill and hand tamp to 95% proctor to six inches above the top of the pipe.
 5. Backfill and machine tamp the remainder of the trench to 95% proctor in twelve inch lifts.

END OF SECTION 230500

SECTION 230513 – MOTORS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

- A. Manufacturer's catalog and efficiency data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.4 COORDINATION

- A. All motors are required to be equipped with overload protection located near the motor.
 - 1. Overload protection shall:
 - a. Be located between the circuit breaker or fuse provided under Division 26 and the motor windings.
 - b. Meet one of the options specified in the following paragraph.
 - 2. Overload protection may be:
 - a. Located in the motor installed by the motor manufacturer. (preferred)
 - b. A separate device located near the motor.
 - c. Located in, or with, a disconnect switch provided by the equipment manufacturer. Provision of this switch shall not modify, change, or eliminate any Division 26 requirement. This means some equipment shall be provided or specified with two disconnecting means.
- B. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
 - 1. Compatible with controller
 - 2. Matched to torque and horsepower requirements of the load.
 - 3. Matched to ratings and characteristics of supply circuit and required control sequence.
- C. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
- D. Belt tension must be wrench and socket adjustable.
- E. Belt tensioning device must accommodate adjustable sheaves.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

- A. Motor requirements apply except as follows:
1. Ratings, performance, or characteristics for a motor are specified in another Section or are scheduled on the drawings.
 2. Motor manufacturer requires ratings, performance, or characteristics, other than those specified to meet indicated performance.

2.2 MOTOR CHARACTERISTICS

- A. Frequency Rating: 60 Hz.
- B. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- C. Duty: Continuous at 105 deg F and 3300 feet above sea level.
- D. Capacity and Torque sufficient to:
1. Start, accelerate, and operate connected load.
 2. Maintain designated speeds.
 3. Operate at installed altitude and environment.
 4. Operate with indicated operating sequence.
 5. Operate without exceeding nameplate ratings.
 6. Operate without utilizing service factor.
- E. Enclosure: Open drip-proof unless otherwise indicated.
- F. Minimum Service Factor: 1.15 unless otherwise indicated.
- G. Lift eye in the frame of the motor for all motors 15 hp and larger.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. NEMA Premium efficiency motors shall meet the following full load efficiency:

HP	ODP			TEFC		
	6 Pole	4 Pole	2 Pole	6 Pole	4 Pole	2 Pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0

- C. Efficiency: NEMA Premium
- D. Stator: Copper windings, unless otherwise indicated.
- E. Rotor: Squirrel cage, unless otherwise indicated.
- F. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating, unless otherwise indicated.
- H. Insulation: Class F, unless otherwise indicated.
- I. Code Letter Designation: NEMA starting Code F or G.
- J. Enclosure: Cast iron.
- K. Finish: Gray enamel.
- L. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- M. Motors Used with Variable Speed Drives: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Premium Efficiency Motors: Class B temperature rise, Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise, Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally-protected motors.
 - 5. Shaft Grounding: Provide AEGIS bearing protection ring or approved equal.
 - a. All motors operated on variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge electrical shaft currents within the motor and/or its bearings.
 - b. Motors up to 100 HP shall be provided with a minimum of one shaft grounding ring installed either on the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- c. Grounding rings shall be provided and installed by the motor manufacturer in accordance with the shaft grounding ring manufacturer's recommendations.
- N. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
 - 1. Measure winding resistance.
 - 2. Read no-load current and speed at rated voltage and frequency.
 - 3. Measure locked rotor current at rated frequency.
 - 4. Perform high-potential test.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Perform the following:
 - 1. Run each motor with its controller at load.
 - 2. Demonstrate correct rotation, alignment, and speed.
 - 3. Test interlocks and control features for proper operation.
 - 4. Verify that current in each phase is within nameplate rating.
 - 5. Verify RPM is in accordance with nameplate.
 - 6. Where a generator is provided, run each motor on the generator with its controller and load. Demonstrate correct rotation, alignment, and speed.

3.2 ADJUSTING

- A. Align motors, bases, and shafts.

3.3 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 230513

SECTION 230514 – VARIABLE SPEED DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. Factory Installed Variable Speed Drive: A drive installed by motorized-equipment manufacturer as a component of equipment utilized to control the speed of a motor.
- B. Field-Installed Variable Speed Drive: A drive installed in the field by the contractor to control the speed of a motor not equipped with a factory installed drive.
- C. VSD: Variable Speed Drive

1.3 SUBMITTALS

- A. Submittals shall include the following information:
 - 1. Outline dimensions
 - 2. Conduit entry locations
 - 3. Weight.
- B. Customer connection and power wiring diagrams.
- C. Technical product description including but not limited to a complete list of options.
- D. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD). Analysis shall include all HVAC loads and all equipment with VFDs (chillers, rooftop units, cooling tower fans, etc.).
- E. The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. All VFDs shall include a minimum of 5% impedance reactors.

1.4 QUALITY ASSURANCE

- A. VSDs and options shall be UL listed as a complete assembly.
- B. The base VSD shall be UL listed for 100 KAIC without the need for input fuses.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- C. The VSD shall be tested by the manufacturer.
- D. All optional features shall be functionally tested at the factory for proper operation.
- E. 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. Comply with UL 508C.
- F. Referenced standards:
 - 1. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
 - 2. UL508C
 - 3. ICS 7.0, AC Adjustable Speed Drives
 - 4. IEC 16800 Parts 1, 2 and 3NEC 430.120, Adjustable-Speed Drive Systems
 - 5. IBC 2012 Seismic – referencing ASC 7-05 and ICC AC-156
- G. All VSDs installed on this project shall be from the same manufacturer.
- H. The VSD enclosure shall be seismically certified and labeled in accordance with the IBC 2012 International Building Code:
 - 1. VSD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.
 - 2. A Seismic importance factor of 1.5 shall be used and shall be based upon actual shake test data as defined by ICC AC-156. Seismic ratings based upon calculations alone are not acceptable.
 - 3. Certification of Seismic rating must be based on testing done in all three axis of motion by a certified lab.
- I. Installations in life safety applications including but not limited to smoke removal and make up air to smoke removal systems shall be included in the seismic approval.

1.5 WARRANTY

- A. The VSD shall be warranted by the manufacturer for a period of 2 Years from Date of Substantial Completion. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VSD manufacturer.

1.6 COORDINATION

- A. Coordinate features of VSDs with motors, installed units, and accessory devices. Provide VSDs that meet the requirements indicated in this and other equipment specific specification sections.
- B. Confirm that motors controlled by VSDs, provided under this section are designed and labeled for use with variable speed drives, and suitable for use throughout speed range without overheating.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- C. Coordinate VSD support with requirements for maintenance and replacement; and installation of accessories.

PART 2 - PRODUCTS

2.1 FACTORY INSTALLED VARIABLE SPEED DRIVES

- A. The VSD shall be enclosed in a UL Listed enclosure.
- B. Refer to equipment specific specification sections.
- C. Where equipment specific specification sections do not indicate variable speed drive requirements comply with 2.2 below.

2.2 FIELD-INSTALLED VARIABLE SPEED DRIVES

- A. Manufacturers

- 1. Basis of Design – Honeywell.
 - 2. ABB.
 - 3. Cuttler Hammer (Eaton).
 - 4. Danfoss-Graham.
 - 5. Square D (Schneider Electric).

- B. General

- 1. Furnish complete variable speed drives (VSDs) as indicated.
 - 2. Drawing schedules, sequences of control, control diagrams, details, or other specification sections may indicate variable speed requirements.
 - 3. All standard and optional features shall be included within the VSD enclosure, unless indicated otherwise. Each VSD shall be housed in a NEMA 1 enclosure, or other NEMA type according to installation and operating conditions.
 - 4. Provide NEMA 3R weatherproof enclosures for drives mounted outside.
 - 5. The UL listing shall allow mounting in a plenum or other air handling compartment. If a NEMA 12 enclosure is required for the plenum rating, the manufacturer shall supply a NEMA 12 rated VSD.
 - 6. Provide a separately housed manual 3 contactor bypass consisting of a door interlocked main fused disconnect pad lockable in the off position, a built-in motor starter, and a four position DRIVE/OFF/LINE/TEST switch controlling three contactors. In the OFF position, the motor and drive are disconnected. In the LINE position, the motor is operated at full speed from the AC line power and the power is disconnected from the drive, so that service may be performed. In the TEST position, the motor is operated at full speed from the AC line power. This allows the drive to be given an operational test while continuing to run the motor at full speed in bypass. A normally closed dry contact shall be interlocked with the drive's safety trip circuitry to stop the motor whether in DRIVE or BYPASS mode in case of an external safety fault. The use of microprocessor-

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

based bypass control shall not be allowed. A bypass is not required on VFD's for fan arrays in air handling units.

- C. The VSD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current. Operation shall be suitable for centrifugal pump and fan control and shall eliminate the need for motor de-rating.
- D. With the motor's rated voltage applied to the VSD input, the VSD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VSDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.
- E. The VSD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.
- F. The VSD and options shall be tested to ANSI/UL Standard 508. The complete VSD, including all specified options, shall be assembled by the manufacturer and shall be UL-508 certified for the building and drive assembly including options. Assembly of the options by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VSD and option panel, in the case where these are not contained in one panel.
- G. The VSD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VSDs without DC link reactors shall provide a minimum 3% impedance line reactor.
- H. The VSD's full load amp rating shall meet or exceed NEC Table 430-150. The VSD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.
- I. The VSD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without derating.
- J. An automatic energy optimization selection feature shall be provided standard in the VSD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.
- K. Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VSD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.
- L. An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- M. Galvanic and/or optical isolation shall be provided between the VSD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VSDs not including either galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.
- N. VSD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VSD efficiencies while reducing motor noise.
- O. Protective Features:
1. Disconnect with drive fusing.
 2. A minimum of Class 20 I²t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.
 3. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, overvoltage, undervoltage, VSD overtemperature and motor overtemperature. The VSD shall display all faults in plain English. Codes are not acceptable.
 4. Protect VSD from sustained power or phase loss. The VSD shall provide full rated output with an input voltage as low as 90% of the nominal. The VSD will continue to operate with reduced output with an input voltage as low as 164 V AC for 208/230 volt units, and 313 V AC for 460 volt units.
 5. The VSD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.
 6. VSD package shall include semi-conductor rated input fuses to protect power components.
 7. To prevent breakdown of the motor winding insulation, the VSD shall be designed to comply with IEC Part 34-17. Otherwise, the VSD manufacturer must ensure that inverter rated motors are supplied.
 8. VSD shall include a "signal loss detection" circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC, and shall be programmable to react as desired in such an instance.
 9. VSD shall function normally when the keypad is removed while the VSD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.
 10. VSD shall catch a rotating motor operating forward or reverse up to full speed.
 11. VSD shall be rated for 100,000 amp interrupting capacity (AIC).
 12. VSD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VSD will identify which of the output phases is low or lost.
 13. VSD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230 volt VSDs, and 539 V AC on 460 volt VSDs.
- P. Interface Features:
1. Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VSD and determine the speed reference.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. The VSD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VSD is in Auto/Remote mode.
3. The VSD shall provide potentiometer speed control. Electronic speed controls are not acceptable.
4. Lockable, alphanumeric backlit display keypad can be remotely mounted up to 10 feet away using standard 9-pin cable.
5. The keypads for all sizes of VSDs shall be identical and interchangeable.
6. To set up multiple VSDs, it shall be possible to upload all setup parameters to the VSD's keypad, place that keypad on all other VSDs in turn and download the setup parameters to each VSD. To facilitate setting up VSDs of various sizes, it shall be possible to download from the keypad only size independent parameters.
7. Display shall be programmable to display in 9 languages including English, Spanish and French.
8. The display shall have four lines, with 20 characters on three lines and eight large characters on one line.
9. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VSD when the keypad is removed.
10. A quick setup menu with factory preset typical HVAC parameters shall be provided on the VSD eliminating the need for macros.
11. The VSD shall include a standard RS-485 communications port.
12. As a minimum, the following points shall be controlled and/or accessible:
 - a. VSD Start/Stop
 - b. Speed reference
 - c. Fault diagnostics
 - d. Meter points
 - e. Motor power in HP
 - f. Motor power in kW
 - g. Motor kW-hr
 - h. Motor current
 - i. Motor voltage
 - j. Hours run
 - k. Feedback signal #1
 - l. Feedback signal #2
 - m. DC link voltage
 - n. Thermal load on motor
 - o. Thermal load on VSD
 - p. Heat sink temperature
13. Four additional Form C 230 volt programmable relays shall be available for factory or field installation within the VSD.
14. LonWorks communication shall be available for factory or field installation within the VSD.
15. Two set-point control interface (PID control) shall be standard in the unit. VSD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.
16. Floating point control interface shall be provided to increase/decrease speed in response to contact closures.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

17. Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. VSDs unable to show these four displays simultaneously shall provide panel meters.
18. Sleep mode shall be provided to automatically stop the VSD when its speed drops below set "sleep" level for a specified time. The VSD shall automatically restart when the speed command exceeds the set "wake" level.
19. The sleep mode shall be functional in both follower mode and PID mode.
20. Run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VSD does not start until dampers or other auxiliary equipment are in the proper state for VSD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VSD to start.
21. The following displays shall be accessible from the control panel in actual units: Reference Signal Value in actual units, Output Frequency in Hz or percent, Output Amps, Motor HP, Motor kW, kW-hr, Output Voltage, DC Bus Voltage, VSD Temperature in degrees, and Motor Speed in engineering units per application (in GPM, CFM, etc.). VSD will read out the selected engineering unit either in a linear, square or cubed relationship to output frequency as appropriate to the unit chosen.
22. The display shall be programmed to read in inches of water column (in-wg) for an air handler application, pressure per square inch (psi) for a pump application, and temperature (°F) for a cooling tower application.
23. VSD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.
24. If the temperature of the VSD's heat sink rises to 80°C, the VSD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VSD shall automatically reduce its output frequency to the motor. As the VSD's heat sink temperature returns to normal, the VSD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.
25. The VSD shall have temperature controlled cooling fans for quiet operation and minimized losses.
26. The VSD shall store in memory the last 10 faults and related operational data.
27. Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
28. Two programmable relay outputs, one Form C 240 V AC, one Form A 30 V AC, shall be provided for remote indication of VSD status.
29. Three programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include two voltage (0 to 10 V DC, 2 to 10 V DC) and one current (0 to 20 mA, 4 to 20 mA) input.
30. Two programmable 0 to 20 mA analog outputs shall be provided for indication of VSD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24 V DC status indication.
31. Under fire mode conditions, the VSD shall be able to be programmed to automatically default to a preset speed.

Q. Adjustments

1. VSD shall have an adjustable carrier frequency in steps of not less than 0.1 kHz to allow tuning the VSD to the motor.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Sixteen preset speeds shall be provided.
3. Four acceleration and four deceleration ramps shall be provided. Acceleration and deceleration times shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.
4. Four current limit settings shall be provided.
5. If the VSD trips on one of the following conditions, the VSD shall be programmable for automatic or manual reset: undervoltage, overvoltage, current limit and inverter overload.
6. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.
7. An automatic "on delay" may be selected from 0 to 120 seconds.

R. Service Conditions

1. Ambient temperature, -10 to 40°C (14 to 104°F).
2. 0 to 95% relative humidity, non-condensing.
3. Elevation to 3,300 feet without derating.
4. AC line voltage variation, -10 to +10% of nominal with full output.
5. No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Examination

1. Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VSD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. Separate conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.
2. The VSD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VSD shall not be operated while the unit is covered.

B. Start-up Service

1. The manufacturer shall provide start-up commissioning of the VSD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VSD, its options and its interface wiring to the building automation system.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- 3.2 CLEANING: After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION 230514

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

- A. Available Manufacturers:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Wade
 - 3. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2.3 SLEEVE-SEAL SYSTEMS

A. Available Manufacturers:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Link Seal
4. Metraflex Company (The).
5. Pipeline Seal and Insulator, Inc.
6. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM or Nitrile rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
- 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4" clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants.
- E. Fire Ratings: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide 1/4" clear space between sleeve and pipe or pipe insulation.
 - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
 - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire Rating: Maintain indicated fire rating at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building unless otherwise indicated. They are not required at sanitary and storm piping exits unless otherwise indicated.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade, below Grade, Concrete Slabs-on-Grade, and Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

END OF SECTION 230517

SECTION 230519 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 ABBREVIATIONS

- A. AFF Above Finished Floor.
- B. BAS Building Automation System

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 THERMOMETERS

- A. Available Manufacturers:
 - 1. Flo Fab Inc.
 - 2. Miljoco Corporation.
 - 3. Palmer Wahl Instrumentation Group.
 - 4. Tel-Tru Manufacturing Company.
 - 5. Trerice, H. O. Co.
 - 6. Weiss Instruments, Inc.
 - 7. Winters Instruments - U.S.
- B. Standard: ASME B40.200.
- C. Case: Cast aluminum
- D. Size: 9" nominal unless otherwise indicated.
- E. Case Form: Adjustable angle.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- F. Tube: Glass with magnifying lens and blue or red organic liquid. Mercury is not acceptable.
- G. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in 2° F increments.
- H. Window: Glass.
- I. Stem:
 - 1. Duct Installation: Aluminum ventilated.
 - 2. Pipe Installation: Brass.
- J. Thermowell Connector for Pipe Installation: 1-1/4" with ASME B1.1 threads.
- K. Accuracy: Plus or minus one scale division.
- L. Scale Range: Suitable for service.

2.2 DUCT THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

- A. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Manufactured by thermometer manufacturer, pressure-tight, socket-type fitting made for insertion into piping tee.
 - 3. Material:
 - a. Copper Tubing/Piping: Brass.
 - b. Steel Piping: Type 316 stainless steel
 - 4. Type: Stepped shank unless straight or tapered shank is recommended by manufacturer.
 - 5. Bore: Diameter required to match thermometer stem.
 - 6. Insertion Length: Length required to match thermometer stem and to reach center of pipe.
 - 7. Lagging Extension: Include for insulated piping and tubing.
 - 8. Heat transfer medium: As available and recommended by manufacturer.

2.4 PRESSURE GAUGES

- 1. Available Manufacturers:
 - a. Ernst Flow Industries.
 - b. Flo Fab Inc.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- e. Terice, H. O. Co.
 - f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - g. Weiss Instruments, Inc.
- 2. Application Standard: ASME B40.100.
 - 3. Case: Dry, field liquid fillable, satin finished, type 304 stainless steel, stem mounted, flangeless.
 - 4. Pressure-Element Assembly: Bronze tube.
 - 5. Pressure Connection: Brass, with 1/4" or 1/2" ASME B1.20.1 pipe threads and bottom-outlet unless back-outlet is indicated.
 - 6. Movement: Stainless steel.
 - 7. Dial Size: 4-1/2"
 - 8. Dial Face: Nonreflective aluminum with permanently etched black scale markings graduated in psi. Two PSI maximum per graduation.
 - 9. Pointer: Adjustable black metal.
 - 10. Window: Glass.
 - 11. Ring: 304 stainless steel.
 - 12. Accuracy: Grade 1A, plus or minus 1 percent of full scale.
 - 13. Units: PSI
 - 14. Scale range: Suitable for service.

2.5 GAUGE ATTACHMENTS

- A. Pulsation Dampener: ASME B40.100, brass; with 1/4" or 1/2", ASME B1.20.1 pipe threads and piston type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass for copper, and stainless steel for steel, pipe filled with water with 1/4" or 1/2" pipe threads to prevent live steam from entering gauge. Provide on all gauges serving steam systems.
- C. Valves: Brass needle for copper pipe, or stainless-steel needle for steel pipe, with 1/4" or 1/2", ASME B1.20.1 pipe threads.

2.6 TEMPERATURE/PRESSURE PLUG

- A. Available Manufacturers:
 - 1. Flow Design, Inc.
 - 2. Terice, H. O. Co.
 - 3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 4. Weiss Instruments, Inc.
- B. Description: Test fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- D. Thread Size: 1/2", ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psi at 200°F.
- F. Core Inserts: EPDM self-sealing rubber.

2.7 TEMPERATURE/PRESSURE PLUG KITS

- A. Available Manufacturers:
 - 1. Flow Design, Inc.
 - 2. Trerice, H. O. Co.
 - 3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 4. Weiss Instruments, Inc.
- B. Provide one temperature/pressure plug kit containing two thermometers, one pressure gauge, pressure gauge adapter, and carrying case. Thermometer sensing elements, pressure gauge, and gauge adapter probes shall be of a diameter to fit temperature/pressure plugs and of length to project into piping.
- C. Low Range Thermometer: Small, bimetallic insertion type with 1" to 2" diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125°F.
- D. High Range Thermometer: Small, bimetallic insertion type with 1" to 2" diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220°F.
- E. Pressure Gauge: Small, Bourdon-tube insertion type with 2" to 3" diameter dial and probe. Dial range shall be at least 0 to 200 PSI.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Thermowells:
 - 1. In all locations install so thermometer will be easily visible.
 - 2. In horizontal piping install with socket extending to center of pipe and in vertical position in piping tees.
 - 3. In vertical piping install with socket extending to center of pipe and in horizontal position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors.
- C. Install thermowells with lagging extension on insulated piping.
- D. Fill thermowells with heat-transfer medium as recommended by manufacturer.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- E. Install thermometers in thermowells and adjust vertical and tilted positions so they are within 15' (Measured from 6' above the floor) of an easily accessible location and the window is perpendicular to that location.
 - 1. Exception: Where installed in piping or ductwork located in excess of 20' AFF.
- F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- G. Install thermometers in the following locations:
 - 1. Where indicated
 - 2. Inlet and outlet of each hydronic zone.
 - 3. Inlet and outlet of each hydronic boiler.
 - 4. Inlet(s) and outlet(s) of each chiller.
 - 5. Inlet and outlet of each hydronic coil in air-handling units.
 - 6. Inlet(s) and outlet(s) of each hydronic heat exchanger.
 - 7. Inlet and outlet of each thermal-storage tank.
 - 8. Outside, return, and supply air ducts.
- H. Install pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.
- I. Install pressure gauges in the following locations:
 - 1. Inlet and outlet of each pressure-reducing valve.
 - 2. Inlet and outlet of each chiller.
 - 3. Inlet and outlet of each boiler.
 - 4. Inlet and outlet of each coil.
 - a. Exceptions (Install test plugs instead):
 - 1) Fan coil units.
 - 2) Variable volume terminal units.
 - 3) Blower coil units.
 - 5. Inlet of each thermal-storage tank.
 - 6. Suction and discharge of each pump.
- J. Install valve in piping for each pressure gauge.
- K. Install snubber in piping for each pressure gauge for fluids (except steam).
- L. Install siphon fitting in piping for each pressure gauge (for steam).
- M. Install test plugs in piping tees where indicated and at all pipe mounted BAS pressure and temperature sensors.

3.2 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow service, maintenance, and cleaning of meters, gauges, machines, and equipment.
- B. Connect flowmeter elements to meters.

- C. Connect flowmeter transmitters to meters.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

END OF SECTION 230519

SECTION 230523 – GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 3. MPTFE: Modified polytetrafluoroethylene plastic.
 - 4. NBR: Acrylonitrile-butadiene rubber.
 - 5. PTFE: Polytetrafluoroethylene plastic.
 - 6. RPTFE: Reinforced polytetrafluoroethylene plastic.
 - 7. SWP: Steam working pressure.
 - 8. TFE: Tetrafluoroethylene plastic.
 - 9. WOG: Water Oil Gas.

1.3 SUBMITTALS

- A. Product Data: For each type of valve proposed. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include proposed specialties and accessories.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
 - 1. Exceptions: Domestic hot- and cold-water valves unless referenced.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

4. Set butterfly valves closed or slightly open.
 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze & Brass: Shall be dezincification resistant. (Zinc content shall be less than 15%)
- C. Bronze Valves: 2" and smaller with threaded ends, unless otherwise indicated.
- D. Ferrous Valves: 2-1/2" and larger with flanged ends, unless otherwise indicated.
- E. Valve Pressure and Temperature Ratings: Not less than indicated for system pressure and temperature.
- F. Valve Sizes: Same as the larger of the upstream or downstream pipe, unless otherwise indicated.
- G. Valve Actuators:
1. As indicated in other Part 2 articles.
 2. Where indicated, provide a chain actuator.
 3. Chain Actuator: For attachment to valves of size and mounting height indicated.
 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
- H. Extended Valve Stems: Provide on insulated valves.
- I. Valve Flanges: Provide ASME B16.1 for cast-iron valves, ASME B16.5 for steel, and ASME B16.24 for bronze.
- J. Valve Grooved Ends: AWWA C606.
- K. Threaded: With threads according to ASME B1.20.1.
- L. Valve Bypass and Drain Connections: MSS SP-45.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2.2 COPPER-ALLOY BALL VALVES

- A. Two-Piece, Copper-Alloy Ball Valves (Full Port):
1. Conbraco Industries-Apollo 77C-140 Series with stainless steel ball & stem (Un-insulated piping)
 2. Conbraco Industries-Apollo 77C-140 Series with stainless steel ball & stem. Provide 2 ¼" stem extension (Insulated piping)
 3. Other Manufacturers:
 - a. Milwaukee
 - b. Watts
 - c. Nibco
 4. Handle Nut: Zinc plated steel or 300 series stainless steel.
 5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
 6. Threaded Pack Gland: Brass ASTM B-16 Alloy 360
 7. Packing: MPTFE or TFE
 8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 ¼" stem extension for Insulated piping.
 9. Thrust Washer: MPTFE or RPTFE
 10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
 11. Seats: MPTFE or Reinforced TFE
 12. Body: Bronze ASTM B-584 for solder or threaded connection.
 13. Body End Piece: Bronze ASTM B-584 for solder or threaded connection.
 14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
 15. Conform To: MSS SP-110

2.3 FERROUS-ALLOY BUTTERFLY VALVES

- A. General: Resilient seated butterfly valves rated for 250 psig shut-off and shall provide bi-directional bubble tight dead end service without a downstream flange. Valve shall be full lug, compatible with ANSI 125/150 flanges. Valves shall be in accordance with MSS-SP-67. The actuator mounting flange shall be ISO 5211. Valve design shall accommodate 2" of insulation.
- B. Manual butterfly valves 2"-20":
1. Manufacturer: Bray Series 31H-119 or XOMOX Tuflin High Performance Butterfly Valve series.
 2. Body: Cast iron ASTM A126 Class B.
 3. Provide full lug pattern.
 4. Double dead-end bi-directional zero leakage must exceed ANSI Class IV leakage standard.
 5. Disc: Nylon 11, 15 mil thick and thermally applied over ductile iron ASTM 536, Grade 65-45-12 or 316 stainless steel.
 6. Stem: Type 300 or 400 series stainless steel, one piece, and shall utilize an internal connection to the disc via a double D drive. Provide blow-out proof stem in accordance with API 609.
 7. Seat: EPDM peroxide cured, rated for -40°F to +250°F.
 8. Packing: Buna-N with acetal bushing.
 9. Valves 2-1/2" and smaller shall be provided with 10 position lever lock handles.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

10. Valves 3" and larger shall be provided with hand wheel, manual, weatherproof worm gear actuators.
11. All valves located more than seven feet above the floor shall include chain wheel weatherproof, worm gear actuators with security cable device. Size hand wheel gear operators with no more than 40 lbs rim pull at full valve pressure rating.
12. Valves shall be individually tested at the factory to 110% of rated pressure with zero leakage.

2.4 BRONZE CHECK VALVES

A. Bronze, Horizontal Swing Check Valves:

1. NIBCO Model 413
2. Other Manufacturers:
 - a. Milwaukee Valve Company.
 - b. Nibco, Inc.
 - c. Stockham – Crane Energy Flow Solutions
3. Bonnet: ASTM B-62 bronze.
4. Body: ASTM B-62 bronze.
5. Hinge Pin: ASTM B-140 alloy C31400 bronze, or B-134 alloy C23000 bronze.
6. Disc Hanger:
 - a. Sizes 1/4" thru 3/4": Type 304 stainless steel.
 - b. Sizes 1" and larger: ASTM B-62 bronze.
7. Hanger Nut: ASTM B-16 bronze.
8. Disc Holder: ASTM B-62 bronze.
9. Seat Disc:
 - a. Water and Other Heat Transfer Fluids: ASTM B-62 bronze.
 - b. Steam: TFE
10. Seat Disc Nut: ASTM B-16 or B-62 bronze.
11. Hinge Pin Plug: ASTM B-140 alloy C31600 bronze.
12. Seat Disc Washer (When Provided): ASTM B-98 alloy C65500 or B-103 bronze.
13. Rating: 125 psig SWP and 200 psig CWP.
14. Conform To: MSS SP-80

B. Bronze, Inline Spring Loaded Check Valves:

1. Conbraco Industries-Apollo 61-100 series
2. Other Manufacturers:
 - a. Milwaukee Valve Company.
 - b. Stockham – Crane Energy Flow Solutions.
 - c. Nibco, Inc.
3. Body: ASTM B-584 alloy C84400 bronze.
4. Retainer/Stem: ASTM B16 brass or ASTM A-582 alloy C30300 stainless steel.
5. Ball Check: RPTFE or
6. Disc Holder 316 Stainless steel
 - a. Disc:
 - 1) Water, Oil, Gas: Buna-N
 - 2) Steam: TFE
 - b. Seat Screw: ASTM A-276 alloy S43000 stainless steel.
 - c. Body End: ASTM B-584 alloy C84400 bronze.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- d. Rating: 125 psig SWP and 250 psig CWP.
- 7. Guide: ASTM B16 Brass
- 8. Spring: Type 316 stainless steel.
- 9. Rating: 125 psig SWP and 400 psig WOG.

2.5 IRON BODY CHECK VALVES

A. Iron Body, Horizontal Swing Check Valves:

- 1. NIBCO Model 918-B
- 2. Other Manufacturers:
 - a. Apollo Valves – Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. Stockham – Crane Energy Flow Solutions.
- 3. Body Bolt: ASTM A-307 steel.
- 4. Bonnet: ASTM A-126 class B cast iron.
- 5. Body Gasket: Synthetic Fibers.
- 6. Body Nut: ASTM A-307 steel
- 7. Side Plug: ASTM B-16 alloy C36000 Brass.
- 8. Hanger Pin: ASTM B-16 alloy C36000 Brass.
- 9. Hanger: ASTM B-584 alloy C84400 cast bronze.
- 10. Disc: ASTM B-584 alloy C84400 cast bronze or ASTM A-536 ductile iron w/bronze face ring.
- 11. Seat Ring: ASTM B-584 alloy C84400 cast bronze.
- 12. Disc Nut: ASTM B-16 alloy C36000.
- 13. Body: ASTM A-126 class B cast iron.
- 14. Disc Bolt: ASTM B-16 alloy C36000 Brass.
- 15. Disc Plate: ASTM A-126 class B cast iron.
- 16. Disc Cage: ASTM A-126 class B cast iron.
- 17. Rating: 125 psig SWP and 200 psig CWP.
- 18. Conform To: MSS SP-71 Type 1.

B. Grooved-End, Ductile-Iron Spring Assisted Check Valves: Victaulic Series 716 with EPDM disc seal.

C. Spring Actuated Silent Check Valves:

- 1. NIBCO Model F-910
- 2. Other Manufacturers:
 - a. Apollo Valves – Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. Stockham – Crane Energy Flow Solutions
- 3. Body: ASTM A48 class 35 cast iron.
- 4. Seat: ASTM B-584 alloy C83600 (B) bronze.
- 5. Disc: ASTM B-584 alloy C83600 bronze.
- 6. Spring: Type 302 ASTM A313 stainless steel.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

7. Bushing:
 - a. 6" and Smaller: ASTM B-16 brass
 - b. 8" and Larger: ASTM B-584 alloy C83600 bronze.
8. Set Screws: Type 304 ASTM A-276 stainless steel.
9. Rating: 200 psig CWP.
10. Conform To: MIL-V-18436F

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully-open to fully-closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where indicated.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball and butterfly valves 4" and larger and more than 96 inches above finished floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 1. Swing Check Valves: In horizontal position with hinge pin level.
 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 3. Lift Check Valves: With stem upright and plumb.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- G. Where applicable, install an isolation valve on supply and return piping at each branch from a vertical riser to each floor served. Locate floor isolation valves in an accessible location. Multiple sets on one floor may be required to provide accessibility.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final testing and balancing. Replace valves if persistent leaking occurs.

3.4 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Throttling Service: Ball or butterfly valves.
 - 3. Pump Discharge: Spring-loaded, lift-disc check valves and ball or butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Chilled-Water, Heating Hot Water, Condenser Water, and Glycol Loop Piping (Use the following types of valves):
 - 1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
 - 2. Valves, NPS 2-1/2" and 3":
 - a. Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
 - b. Wafer-Lug, grooved-end, or flanged butterfly valves.
 - 3. Valves, NPS 4" and Larger: Wafer-Lug, grooved-end, or flanged butterfly valves.
 - 4. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2" and Smaller: Bronze, Inline Spring Loaded Check Valves or triple duty valve.
 - 5. Horizontal Check Valves, NPS 2" and Smaller: Bronze, Horizontal Swing Check Valves.
 - 6. Vertical Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
 - 7. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves, Spring Actuated Silent Check Valves, or triple duty valve.
 - 8. Horizontal Check Valves, NPS 2-1/2" and Larger: Bronze, Horizontal Swing Check Valves.
 - 9. Vertical Check Valves, NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.
- B. Terminology as defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design Requirement: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer where using methods other than indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test medium.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment.

1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

- B. Trapeze Pipe Hanger Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

1. Assemble and provide according to manufacturer's written instructions. Center piping on channel to evenly distribute load.
2. Pipe sizes and numbers shall be in accordance with the following:

TRAPEZE PIPE HANGER TABLE								
PIPE SIZE	4"	3"	2 ½"	2"	1 ½"	1 ¼"	1"	TOTAL # of PIPES
NUMBER OF PIPES PERMITTED IN ONE CHANNEL SUPPORT	2	0	0	0	0	0	0	2
	0	2	2	0	0	0	0	4
	0	2	0	4	0	0	0	6
	0	2	0	0	6	0	0	8
	0	0	4	2	0	0	0	6
	0	0	4	0	2	2	0	8

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

	0	0	4	0	0	8	0	12
	0	0	0	6	2	2	2	12
	0	0	0	8	0	2	0	10
	0	0	0	0	14	0	0	14
	0	0	0	0	0	16	0	16
Notes: <ol style="list-style-type: none"> 1. Piping larger than 4" in diameter is not permitted in a channel support system. 2. Channel support systems shall be limited to eight (8) pipes per channel and two (2) channels (levels) per support system. 3. Smaller pipes can be substituted for larger pipes. For example two ¾" pipes may be installed in lieu of two 1" pipes, or 2" in lieu of 3", etc. 4. Spacing shall be in accordance with requirements for the smallest supported pipe. Refer to other specification sections for spacing requirements. If spacing requirements are not indicated comply with MSS SP-69. 								

C. Metal Framing Systems:

1. Available Manufacturers:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

2.4 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
1. Available Manufacturers:
 - a. Cooper B-Line – Dura-Blok
 - b. MAPA Products
 - c. Mifab, Inc. – C-Port
 - d. Miro Industries, Inc.
 - e. OMG, Inc.
 - f. PHP Systems/Design
 - g. Pipe Prop
 - h. Roof Top Blox
 - i. Rooftop Support Systems – Eberl Iron Works, Inc.
 2. Provide pipe supports for supporting gas, condensate, refrigeration lines, or hydronic piping on flat roof surfaces. Support shall rest on roof surface without penetrating the roof surface. Supports for condensate piping shall be adjustable vertically to ensure pipe slopes as required.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- C. Curb Mounted Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.5 EQUIPMENT SUPPORTS/RAILS

- A. Description: Welded, shop or field fabricated equipment support made from structural carbon-steel shapes unless indicated otherwise.
1. Available Manufacturers:
 - a. Curbs Plus, Inc. – CPES-X
 - b. Kees – Equipment Support Model SF
 - c. Pate Company – Equipment Support ES-2
 - d. Portals Plus – ER-2A
 - e. Roof Products and Systems – Equipment Rails ER-2B
 - f. Thybar Corporation – TEMS 3
 2. Construction:
 - a. Minimum 18 gauge, G90 galvanized steel. Fully mitered and welded corners. Integral base plate. 3” Cant style support. All welds prime painted after fabrication. Full-depth internal C-channel reinforcing on 12” centers and 6” spreader channels on alternating 12” centers. 18 Gauge counterflashing factory-installed with tek-screws and neoprene washers. Factory-installed 2’x4” pressure-treated wood nailer.
 - b. Minimum height of 12” above finished roof or as noted.

2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Non-staining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69, MSS SP-89, and Table above. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.
- E. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.
- F. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Provide hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Provide lateral bracing with pipe hangers and supports to prevent swaying.
- J. Provide building attachments within concrete slabs or attach to structural steel. Building attachments may not used on steel joists unless otherwise indicated. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2" and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and provide reinforcing bars through openings at top of inserts.
- K. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Provide thermal-hanger shield insert with clamp sized to match OD of insert.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
- 2. Provide MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
- 3. Provide MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
- 4. Shield Dimensions for Pipe: Not less than the following:
 - a. Pipe ¼" to 3-½": 12 inches long and 0.048 inch thick.
 - b. Pipe 4": 12 inches long and 0.06 inch thick.
 - c. Pipe 5" and 6": 18 inches long and 0.06 inch thick.
 - d. Pipe 8" to 14": 24 inches long and 0.075 inch thick.
- 5. Pipes 8" and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 ROOF EQUIPMENT SUPPORTS

- A. Equipment supports must span a minimum of two structural roof members.
- B. No load shall be applied to a cantilever exceeding 12" in length.
- C. Fasten base flange to roof steel or deck with stitch weld or mechanical fastener not exceeding 18" on center in accordance with NRCA specifications.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Provide materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touchup: Unless otherwise indicated clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Provide same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and immediately apply galvanizing-repair paint. Paint shall comply with ASTM A 780.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Provide hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Provide nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Provide copper-plated pipe hangers and copper attachments for copper piping and tubing.
- F. Provide padded hangers for piping that is subject to scratching.
- G. Provide thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated provide the following:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of stationary pipes 1/2" to 30".

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes 4" to 14", requiring up to 4" of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes ¾" to 14", requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes ½" to 14" if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes ½" to 4", to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes ¾" to 8".
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes ½" to 8".
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes ½" to 8".
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes ½" to 8".
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes ½" to 8".
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS ½" to 3".
12. U-Bolts (MSS Type 24): For support of heavy pipes ½" to 14".
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-½" to 14" if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1" to 14", from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2-½" to 14", from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes 2" to 14" if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2" to 14" if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2" to 14" if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated provide the following:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers ¾" to 14".

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers $\frac{3}{4}$ " to 14" if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated provide the following:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
6. Flat Plate, Double Nut, and Washer as Detailed on Structural Drawings: For attaching to bar joists. Method of attachment to bar joists must be approved by the structural engineer and joist manufacturer.

K. Building Attachments: Unless otherwise indicated provide the following:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Flat Plate, Double Nuts, and Washer as Detailed on Structural Drawings: For use under roof installations with bar-joist construction to attach to bottom chord of joist.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For steel I-beams. Only allowed for open web joists if load does not exceed 50 lbs.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Provide one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

16. For sloping structure, provide clamp with swivel such that required threaded rod is vertical. Bending of threaded rod is not acceptable.
- L. Saddles and Shields: Unless otherwise indicated provide the followings:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Spring Hangers and Supports: Unless otherwise indicated provide the following:
1. Restraint-Control Devices (MSS Type 47): To control pipe movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Provide powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where indicated in concrete construction.

END OF SECTION 230529

SECTION 230548 - VIBRATION CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning & Development for the State of California.
- D. ASCE: American Society of Civil Engineers

1.3 RESPONSIBILITIES:

- A. The manufacturer of vibration isolation systems and devices shall:
 - 1. Determine the sizes and locations of isolators and provide equipment isolation as indicated.
 - 2. Guarantee indicated isolation system deflections.
 - 3. Provide installation instructions and drawings.
 - 4. Certify correctness of installation upon completion.
- B. The Contractor shall cause all vibration isolation systems, including the isolators, and flexible connectors between the isolated equipment and associated piping, ducting, and electrical work to be designed by a manufacturer experienced in this type of work.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors.
- B. Coordination Drawings: For areas indicated at 1/4" = 1'0" and where sections are cut on contract drawings, indicate coordination of HVAC piping and equipment with other systems and equipment in the vicinity, include supports and restraints.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

C. Qualification Data: For testing agency.

D. Shop Drawings:

1. Vibration Isolation Base Details: Detail fabrication, including anchorages, attachments to structure, and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
2. Dimensioned Outline Drawings for Each Scheduled Piece of Equipment: Identify center of gravity.
3. Dimensioned Outline Drawings for Each Scheduled Piece of Equipment: Locate and describe mounting and anchorage provisions.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Available Manufacturers:

1. Amber/Booth Company, Inc.
2. B-Line Systems, Inc.
3. Kinetics Noise Control.
4. Mason Industries.
5. Vibration Mountings & Controls, Inc.
6. Vibro-Acoustics, Inc.

B. Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.
2. Durometer Rating: Minimum 30.
3. Number of Layers: 1 2 3 or 4.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Durometer Rating: Minimum 30.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 3. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Restrained Mounts: All-directional mountings with wind restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to ¼" thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to ¼" thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Housed Spring Mounts: Housed spring isolators.
1. Housing: Ductile-iron or steel housing to provide all-directional restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of ¼" travel up or down before contacting a resilient collar.
- H. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

- J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

- K. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- L. Pipe Riser Resilient Support : All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- M. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2-inch- thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

- A. Available Manufacturers:
- B. Manufacturers:
 - 1. Amber/Booth Company, Inc.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries.
 - 4. Vibration Mountings & Controls, Inc.
 - 5. Vibro-Acoustics, Inc.
- C. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1" clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- D. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 - 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 FACTORY FINISHES

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip-galvanize metal components for exterior use.
 - 3. Bake enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and wind control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Strength of Support and Wind Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to resist loads within loading limits.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Comply with requirements indicated in the Contract Documents, in codes and ordinances, by Authority Having Jurisdiction, and by Manufacturer, for installation of all devices.

3.4 FIELD QUALITY CONTROL

- A. Perform tests.
- B. Tests:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least two of each type and size of installed anchors and fasteners.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, fix and retest until satisfactory results are achieved then modify all installations of same type to match.

C. Prepare test reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 VIBRATION ISOLATION SCHEDULE

A. Piping and Conduit

1. All piping and conduit connected to pumps, air handling units, or other pieces of moving equipment which are isolated from the structure by spring type vibration isolators shall be isolated from these units by flexible pipe connectors and shall be suspended on isolation hangers to a point 20 feet away. Refer to Section "Hydronic Piping" for flexible pipe connectors.
2. Provide spring hangers with 1/2" deflection for suspended piping.
3. Provide spring isolators with 1/2" deflection for floor-mounted piping.

B. Ductwork

1. Flexible connectors shall be used for ductwork connections to air handling units. Refer to Section "Metal Duct Accessories." Ductwork shall be suspended with elastomeric hangers for a distance of 20 feet from air handling units.

C. Indoor Air Handling Units

1. Internally isolate all fans on spring or elastomeric mounts.

D. Pumps

1. Anchor and grout to 6" high concrete housekeeping pad. Refer to Section "Hydronic Pumps." No other isolation required.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

E. Boilers

1. Provide elastomeric neoprene isolator pad with 1/4" deflection located on 6" high concrete equipment pad.

F. Laboratory Exhaust Fans

1. Provide vibration isolation equipment base for each laboratory exhaust fan. Provide flexible connectors to ductwork.

G. Power Ventilators

1. Provide elastomeric hangers for units suspended from structure above ceiling.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.

- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 - 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. 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. Letter Color: White or black.
 - 3. Background Color: Black or white.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 - 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- D. Plastic Labels for Equipment:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

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 or black.
 3. Background Color: Black or white.
 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- E. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- F. Label Content: Include equipment's drawing designation (tag) with unique equipment number as scheduled.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White or black.
- C. Background Color: Black or white.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include equipment's drawing designation (tag) with unique equipment number as scheduled. Include caution and warning information plus emergency notification instructions.

2.3 STENCILS

A. Stencils for Piping:

1. Lettering Size: Size letters according to ASME A13.1 for piping.
2. Stencil Paint: Exterior, oil based enamel, in colors in contrast with the piping finish. Paint may be in pressurized spray-can form.

B. Stencils for Ducts:

1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
2. Stencil Paint: Exterior, oil based enamel, in colors in contrast with the duct finish. Paint may be in pressurized spray-can form.

C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
2. Stencil Paint: Exterior, oil based enamel, in colors in contrast with the equipment finish. Paint may be in pressurized spray-can form.

2.4 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Finished hardwood or extruded aluminum.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.6 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 1. Size: 3 by 5-1/4 inches minimum.
 2. Fasteners: Reinforced grommet and wire or string.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Safety-yellow background with black lettering.

2.7 ACOUSTICAL CEILING GRID MARKER

- A. General: Plastic tape a minimum of three one-thousandths of an inch thick (3.0 mils) with pressure-sensitive, permanent-type, self-adhesive back.
- B. Width: three quarters of an inch (3/4") or 22 millimeters.
- C. Letter Size: 1/4" minimum or 8 millimeters.
- D. Letter Color: Black
- E. Tape Color: White.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding:
 - 1. Chilled Water Supply and Return – Dark Blue
 - 2. Condenser / Tower Water Supply and Return – Light Blue
 - 3. Heating Hot Water Supply and Return – Orange
 - 4. Natural Gas – Yellow
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings, omit intermediately spaced labels.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

3.5 DUCT LABEL INSTALLATION

- A. Install duct markers with permanent adhesive on air ducts in colors complying with ASME A13.1.
- B. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Chilled Water: 1-1/2 inches, round.
 - b. Condenser Water: 1-1/2 inches, round.
 - c. Refrigerant: 1-1/2 inches, round.
 - d. Hot Water: 1-1/2 inches, round.
 - e. Gas: 1-1/2 inches, round.
 - 2. Valve-Tag Colors:
 - a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
 - b. Flammable Fluids: Black letters on a safety-yellow background.
 - c. Combustible Fluids: White letters on a safety-brown background.
 - d. Potable and Other Water: White letters on a safety-green background.
 - e. Compressed Air: White letters on a safety-blue background.
 - f. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

3.7 FIRE AND SMOKE DAMPERS

- A. Access points for fire, smoke and fire-smoke dampers shall be permanently identified on the exterior of the duct by a label or sign with letters not less than 1" in height reading: "FIRE/SMOKE DAMPER, SMOKE DAMPER, or FIRE DAMPER."

3.8 ACOUSTICAL CEILING GRID MARKER INSTALLATION

- A. Attach tape with indicated text to t-bar below item of equipment.
- B. Attach tape to grid.
- C. Prepare surface and attach tape in accordance with manufacturer' recommendations.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- D. Surfaces to receive tape shall be clean and free of scale, dirt, and grease.
- E. Center tape on support grid. Tape shall be visible from within space.
- F. Provide with lettering at equipment located above lay-in tile ceilings including but not limited to:
 - 1. Valves: Text = V
 - 2. Air Handling Units: Text = AHU
 - 3. Air Removal Devices: Text = ARD
 - 4. Strainers: Text = S
 - 5. Terminal Units (VAV boxes): Text = TU
 - 6. Fan Coil Units: Text = FCU
 - 7. Blower Coils: Text = BC
 - 8. Coils: Text = C
 - 9. Heat Pumps: Text = HP
 - 10. Cabinet Unit Heaters: Text = CUH
 - 11. Fans: Text = F
 - 12. Damper operators: Text = D

3.9 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.10 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.11 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.12 CLEANING

- A. Clean faces of mechanical identification devices and glass fronts of valve schedules.

END OF SECTION 230553

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. Outdoor duct and pipe: Duct conveying untreated outside air at ambient temperature and humidity.
- B. Outdoor pipe: Pipe located outside the building insulation envelope.
- C. Supply air duct: Duct conveying air on the discharge side of an air handling unit or fan which will be delivered to a space in a building through a diffuser or connection to the return duct of another unit. Ductwork on the discharge side of a 100% outside air unit is considered to be Supply air duct.
- D. Return air duct: Duct conveying air from a space or plenum that will return to an air handling unit or energy transfer device. The air may be returned to the supply air duct after being conditioned, or it may be exhausted after passing through an energy transfer device. Typical examples of an energy transfer devices are plate heat exchangers, runaround coils, heat pipes, and energy wheels.
- E. Exhaust air duct: Duct conveying air from a space or plenum that will be exhausted from the building without being passed through an energy transfer device.
- F. Plenum: An unoccupied space or void, on the conditioned side of the building insulation and vapor barrier, being used to return conditioned air to the inlet side of a return or exhaust fan either directly or via a duct connection. An example would be a space with air handling light fixtures or openings in the ceiling used to transport air through the ceiling and then to an open duct located above the ceiling in another location.
- G. Indirectly Conditioned Space: A space having no direct conditioning but, due to air movement induced by an exhaust, or return opening, is conditioned by makeup air from an adjacent space. An example would be a small toilet. Boiler rooms, fan rooms, and mechanical rooms do not qualify as indirectly conditioned spaces.
- H. Inside the Building Insulation Envelope: For the purposes of this section, boiler rooms, fan rooms, and mechanical rooms are considered to be OUTSIDE the building insulation envelope.

1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
 - 1. Detail application of removable insulation covers.
 - 2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3. Detail attachment and covering of heat tracing inside insulation.
4. Detail insulation application at pipe expansion joints for each type of insulation.
5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
6. Detail removable insulation at piping specialties, equipment connections, and access panels.
7. Detail application of field-applied jackets.
8. Detail application at linkages of control devices.
9. Detail field application for each equipment type.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with type, grade, and maximum use temperature.
- B. Ship Insulated Piping System Components on pallets and wood supports. Securely fasten and protect from damage. Store off the ground and cover with opaque waterproof tarp to protect materials from sunlight and rain.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation, duct Installer for duct insulation, and equipment Installer for equipment insulation.
- C. Maintain clearances required for maintenance.
- D. Coordinate installation and testing of heat tracing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers:
 1. Mineral-Fiber Insulation:
 - a. CertainTeed Corporation.
 - b. Johns Manville.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- c. Knauf Insulation.
 - d. Owens Corning.
- 2. Flexible Elastomeric Thermal Insulation:
 - a. Aeroflex USA, Inc.
 - b. Armacell, LLC.
 - c. K-Flex USA.
 - d. Rubatex Corp.
- 3. Polyolefin Insulation:
 - a. Armstrong World Industries, Inc.
 - b. IMCOA.
- 4. Closed-Cell Phenolic-Foam Insulation:
 - a. Kooltherm Insulation Products, Ltd.
- 5. Calcium Silicate Insulation:
 - a. Johns Manville.
 - b. Owens Corning.
- 6. Removable Insulation Covers:
 - a. Advance Thermal Corp.
- B. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Duct Liner: Refer to specification section "Metal Ducts"
- H. Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, with factory applied FSK Jacket. Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin to maximum service temperature of 250°F.. Faced insulation shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E84.
- I. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, & IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
- J. Mineral-Fiber Blanket with Factory Applied FSK Jacket: Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin with a multi-purpose foil-scrim kraft (FSK) jacket to maximum service temperature of 250°F. FSK shall meet the requirements of ASTM C 1136, Type II, when surface burning characteristics are determined in

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

accordance with ASTM E 84 with the foil surface of the material exposed to the flame as it is in the final composite. Composite (insulation, facing and adhesive) shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84. Insulation properties shall be as follows:

1. Thickness: 1-1/2"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 5.1
 - c. Minimum installed R value assuming 25% compression: 4.2
2. Thickness: 2"
 - a. Density: 1.0 pcf
 - b. Minimum uncompressed R value: 7.4
 - c. Minimum installed R value assuming 25% compression: 6.0
3. Alternate to 2" 1.0 pcf: Thickness: 2.2"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 7.4
 - c. Minimum installed R value assuming 25% compression: 6.0
4. Thickness: 3"
 - a. Density: 0.75 pcf
 - b. Minimum uncompressed R value: 10.2
 - c. Minimum installed R value assuming 25% compression: 8.3
- K. Medium Temperature Mineral-Fiber Blanket for Operating Temperatures from 250 to 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- L. High Temperature Mineral-Fiber Blanket for Temperatures above 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- M. Mineral-Fiber Pipe Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket.
 2. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
 3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
 4. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
 - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

5. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
 6. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 7. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
 8. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- N. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Adhesive: As recommended by insulation material manufacturer.
 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
- O. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Glass Cloth: Woven glass-fiber fabric, plain weave, minimum 8 ounces per square yard.
- C. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- D. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
1. Adhesive: As recommended by insulation material manufacturer.
 2. PVC Duct Jacket Color: White or gray.
 3. PVC Pipe Jacket Color: Color-code piping jackets based on materials contained within the piping system.
- E. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Factory cut and rolled to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.
1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
 2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.
- F. Standard PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 2. Adhesive: As recommended by insulation material manufacturer.

2.3 REMOVABLE INSULATION COVERS

- A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. For chilled water pumps, provide min 22-gauge stainless steel box around suction diffuser and pump housing with 2" thick close cell elastomeric insulation liner adhered to inside of box. The box shall be designed to be in two (2) halves with latching clips/ latches for easy removal and re-installation. Where the two halves come together, there should be gasketing material for tight seal and along base. Alternative acceptable approaches are the use of pump insulation covers manufactured by Fit Tight Covers design for removable pump insulation covers.

2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..
 - 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
 - 2. Galvanized Steel: 0.005 inch thick.
 - 3. Aluminum: 0.007 inch thick.
 - 4. Brass: 0.010 inch thick.
 - 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 - 1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, plenum and breeching with adhesive. Pin length sufficient for insulation thickness indicated.
 - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, pipes, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.
- F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.5 VAPOR RETARDERS

- A. Mastics: Materials that are compatible with insulation materials, jackets, and substrates.

2.6 REMOVABLE INSULATION COVERS

- A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

PART 3 - EXECUTION

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts, piping, and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- G. Keep insulation materials dry at all times. Insulation that becomes wet or is otherwise damaged beyond repair, shall be removed immediately and replaced. Replacement material and installation shall be in accordance with these specifications.
- H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- I. Apply insulation with the minimum number of joints practical.
- J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- K. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
 - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
 - M. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
 - N. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Joints and Seams: Cover with tape and vapor retarder to maintain vapor seal.
 - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges, pipe joints, and fittings.
 - O. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
 - P. Install vapor-retarder mastic on ducts, pipes, plenums, and equipment.
 - 1. Ducts, pipes, plenums, and equipment with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape and mastic to maintain vapor-retarder seal.
 - 2. Ducts, pipes, plenums, and equipment without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
 - Q. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - 1. Seal penetrations with vapor-retarder mastic.
 - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - 3. Seal insulation to roof flashing with vapor-retarder mastic.
 - R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
 - S. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
 - T. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
 - 1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.
- 3.4 MINERAL-FIBER INSULATION APPLICATION
- A. Blanket Applications for Ducts, Pipes, and Plenums: Secure blanket insulation with adhesive, and anchor pins with speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, pipe, and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts & pipes and to all surfaces of fittings and transitions. Adhesive may be omitted from the top of horizontal rectangular ducts.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not compress insulation to less than 75% of its original thickness during installation.
 4. Install anchor pins and speed washers on sides, top, and bottom of horizontal pipes.
 5. Impale insulation over anchors and attach speed washers.
 6. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
 7. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 8. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
 9. Apply insulation on rectangular duct elbows, pipe fittings, and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows, and pipe elbows, with individually mitered gores cut to fit the elbow.
 10. Insulate duct and pipe stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- wide strips of the same material as insulation. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
 11. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
- B. Board Applications for Ducts, Plenums, & Equipment: Secure board insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, plenum, & equipment surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings, transitions, and equipment. Adhesive may be omitted from top surface of horizontal rectangular ducts.
 3. Space anchor pins as follows:
 - a. On duct & equipment sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct & equipment sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not compress insulation to less than 75% of its original thickness during installation.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

4. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct and equipment stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" wide strips of the insulating material. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to ducts, plenums, and equipment as follows:
 1. Follow the manufacturer's written instructions for applying insulation.
 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the duct, plenum, and equipment surface.

3.6 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
 1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch-thick coats of jacket manufacturer's recommended adhesive.
 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.7 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Paints" and section "Identification for HVAC Piping And Equipment"
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color shall be as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.8 DIFFUSER APPLICATIONS

- A. Insulate exposed metal surfaces on top of all supply diffusers. Where diffusers are mounted in a metal pan insulate the top of the metal pan.
 1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 2. Thickness: 1 inch.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3. Vapor Retarder Required: Yes.

3.9 APPLICATIONS

- A. Insulation materials and thickness are specified at the end of this Section.
- B. Insulate all ductwork, pipe and equipment:
1. Insulate ductwork in accordance with the application schedule(s) below.
 2. Exceptions: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - a. Vibration-control devices.
 - b. Testing agency labels and stamps.
 - c. Nameplates and data plates.
 - d. Manholes.
 - e. Handholes.
 - f. Cleanouts.
 - g. Plastic condensate drain piping.
 - h. Pipe-mounted condensate sensors.
 - i. Return ductwork inside the building insulation envelope.
 - j. Indoor exposed return air ductwork.
 - k. Exhaust ductwork.
 - 1) Exception: Duct beginning 18" upstream of backdraft damper and continuing to building envelope insulation.
 - l. Metal ducts with duct liner.
 - m. Factory-insulated flexible ducts.
 - n. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
 - o. Flexible connectors.
 - p. Access panels and doors in air-distribution systems.

3.10 INDOOR APPLICATION SCHEDULE

- A. Equipment: Chilled-water air separators and compression tanks.
1. Operating Temperature: 35 to 75 deg F.
 2. Insulation Material: Semi-Rigid Mineral-Fiber Board
 3. Insulation Thickness: 2"
 4. Field-Applied Jacket: Glass cloth.
 5. Vapor Retarder Required: Yes.
 6. Finish: Painted.
- B. Equipment: Chilled-water pumps
1. Operating Temperature: 35 to 75 deg F.
 2. Insulation Material: Removable insulation cover
 3. Vapor Retarder Required: Yes.
- C. Service: Condensate drain piping except plastic.
1. Insulation Material: Mineral fiber preformed pipe insulation.
 2. Insulation Thickness: 1"
 3. Vapor Retarder Required: Yes.
 4. Finish: Finished Spaces = Painted, concealed = none.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- D. Service: Chilled water supply and return.
1. Insulation Material: Mineral fiber preformed pipe insulation.
 2. Insulation Thickness:
 - a. Pipe sizes up to 1½" diameter: 1-1/2 inches.
 - b. Pipe sizes larger than 1½" diameter: 1-1/2 inches.
 - c. In mechanical rooms and unconditioned spaces increase insulation thickness by 1".
 3. Vapor Retarder Required: Yes
 4. Finish: Finished Spaces = Painted, Mechanical Rooms = Painted, concealed = none.
- E. Service: Heating hot-water supply and return.
1. Insulation Material: Mineral fiber preformed pipe insulation.
 2. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Steel, Copper, & PVC Pipe, Up to 1.5" diameter: 1-1/2 inches.
 - b. Steel, Copper, & PVC Pipe, 2" diameter & up: 2 inches.
 3. Vapor Retarder Required: No.
 4. Finish: Finished Spaces = Painted, Mechanical Rooms = Painted, concealed = none.
- F. Service: Glycol energy recovery water supply and return.
1. Insulation Material: Mineral fiber preformed pipe insulation.
 2. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Steel, Copper, & PVC Pipe, Up to 1.5" diameter: 1-1/2 inches.
 - b. Steel, Copper, & PVC Pipe, 2" diameter & up: 2 inches.
 3. Vapor Retarder Required: No.
 4. Finish: Finished Spaces = Painted, Mechanical Rooms = Painted, concealed = none.
- G. Refrigerant Suction and Hot-Gas Piping/Tubing:
1. Insulation Material and Thickness:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- H. Service: Unless otherwise indicated provide the following:
1. Concealed Ducts and Plenums:
 - a. Material: Mineral-Fiber Blanket.
 - b. Thickness: 2 inches.
 - c. Vapor Retarder Required: Yes.
 2. Ducts and Plenums in Finished Spaces:
 - a. Material: Mineral-Fiber Board.
 - b. Thickness: 1-1/2 inches.
 - c. Field-Applied Jacket: Glass cloth.
 - d. Vapor Retarder Required: Yes.
 - e. Paint: Color as selected by architect. Refer to section "Painting".
- I. Service: Round and flat oval, supply-air ducts, concealed and within the building insulation envelope.
1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 2. Thickness: 1-1/2 inches.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- 3. Vapor Retarder Required: Yes.
 - J. Service: Round and flat oval, outside-air ducts, concealed and within the building insulation envelope.
 - 1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 - 2. Thickness: 1-1/2 inches.
 - 3. Vapor Retarder Required: Yes.
 - K. Service: Rectangular, supply-air ducts, concealed and within the building insulation envelope.
 - 1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 - 2. Thickness: 1-1/2 inches.
 - 3. Vapor Retarder Required: Yes.
 - L. Service: Rectangular, outside-air ducts, concealed and within the building insulation envelope.
 - 1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
 - 2. Thickness: 1-1/2 inches.
 - 3. Vapor Retarder Required: Yes.
 - M. Service: Round and flat oval, supply-air ducts, exposed.
 - 1. Refer to section "Metal Ducts"
 - N. Service: Round and flat oval, outside-air ducts, exposed.
 - 1. Refer to section "Metal Ducts"
 - O. Service: Rectangular, supply-air ducts, in Finished Spaces.
 - 1. Material: Mineral-Fiber Board Thermal Insulation, Unfaced
 - 2. Thickness: 1-1/2 inches.
 - 3. Field-Applied Jacket: Glass cloth.
 - 4. Vapor Retarder Required: Yes.
 - 5. Paint: Color as selected by architect. Refer to section "Painting".
 - P. Service: Rectangular, outside-air ducts, in Finished Spaces.
 - 1. Material: Mineral-Fiber Board Thermal Insulation, Unfaced
 - 2. Thickness: 2 inches
 - 3. Field-Applied Jacket: Glass cloth.
 - 4. Vapor Retarder Required: Yes.
 - 5. Paint: Color as selected by architect. Refer to section "Painting".
- 3.11 BOILER BREECHING AND CONNECTOR APPLICATION SCHEDULE
- A. Boiler breechings and connectors shall be listed, labeled, factory-built, and insulated as specified in section "Breechings, Chimneys, and Stacks".

END OF SECTION 230700

SECTION 230713 – FIRE RATED INSULATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. This section specifies material and equipment to provide a 2-hour fire-resistive rated duct enclosure for air distribution systems.
- B. Related Sections:
 - 1. Section 230700 "HVAC Insulation."
 - 2. Section 233113 "Metal Ducts".

1.3 CODES AND STANDARDS

- A. The following published specifications, standards, or tests apply to flexible, fire rated duct wrap systems in this section:
 - 1. International Organization for Standardization (ISO).
 - 2. North Carolina Mechanical Code.
 - 3. ASTM E-119 Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 4. ISO 6944 - 1985 Edition, Fire Resistance Tests for Ventilation Air Ducts.
 - 5. ASTM E-84, UL/ULC 723 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 6. ASTM E-814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 7. ASTM E-518 Standard Test Method for Thermal Resistance.
 - 8. ASTM C-411 Standard Test Method for Hot Surface Performance of High-Temperature Thermal Insulation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include a complete copy of the listing report as published by the NRTL.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Fire-Test Response Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- B. Store in a covered dry environment.

1.8 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.9 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

2.2 FIRE-RATED INSULATION SYSTEMS – VENTILATION DUCTS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating on an air distribution duct assembly by a nationally recognized testing laboratory acceptable to the authority having jurisdiction.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M.
 - b. CertainTeed Corporation.
 - c. Johns Manville; a Berkshire Hathaway company.
 - d. Nelson Firestop; a brand of Emerson Industrial Automation.
 - e. Thermal Ceramics.
 - f. Unifrax Corporation.
- B. Performance Requirements:
 - 1. For all General Exhaust and Supply ducts, Ventilation Air Duct Listings:
 - a. 2-hour fire resistive enclosure assembly tested per ISO 6944 – 1985 Edition.
 - b. Firestop system, tested per ASTM E-814, 2-hour F and T ratings.

2.3 FIRE-RATED INSULATION SYSTEMS – CHEMICAL FUME EXHAUST DUCTS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating on an chemical fume exhaust duct assembly by a nationally recognized testing laboratory acceptable to the authority having jurisdiction.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M.
 - b. CertainTeed Corporation.
 - c. Johns Manville; a Berkshire Hathaway company.
 - d. Nelson Firestop; a brand of Emerson Industrial Automation.
 - e. Thermal Ceramics.
 - f. Unifrax Corporation.
- B. Performance Requirements:
 - 1. For all Laboratory and Hazardous Exhaust Duct, Chemical Fume Exhaust Duct Listing:
 - a. UL 1978.
 - b. ASTM E 119 2 hour engulfment test.

2.4 SECUREMENTS

- A. Bands:
 - 1. As required to maintain the listing of the system and included in the listing and installation requirements.
- B. Insulation Pins and Hangers:
 - 1. As required to maintain the listing of the system and included in the listing and installation requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- C. Install multiple layers of insulation with longitudinal and end seams staggered in accordance with manufacturer's instructions to maintain fire rating listing.
- D. Keep insulation materials dry during application and finishing.
- E. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- F. Install insulation with least number of joints practical.

3.4 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. The fire-rated insulation system shall be installed in compliance with the listing. A complete copy of the listing report as published by the NRTL shall be provided for the use of the installers and the authority having jurisdiction.
- B. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- C. Insulate duct access panels and doors to achieve same fire rating as duct.
- D. Install firestopping at penetrations through fire-rated assemblies. Install in accordance with the listing. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.5 DUCT INSULATION SCHEDULE

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and general exhaust ducts indicated on the floor plans to have fire-rated wrap: Layers as required to achieve 2-hour fire rating ventilation duct listing.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Indoor, concealed laboratory and hazardous exhaust ducts indicated on the floor plans to have fire-rated wrap: Layers as required to achieve 2-hour fire rating in accordance with the chemical fume exhaust duct listing.

END OF SECTION 230713

SECTION 250000 – BUILDING MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Building Management System (BMS), utilizing direct digital controls.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Products Supplied but not installed under this section:
 - 1. Control valves.
 - 2. Flow switches.
 - 3. Wells, sockets and other inline hardware for water sensors (temperature, pressure, flow).
 - 4. Automatic control dampers, where not supplied with equipment.
 - 5. Airflow Measuring Stations.
 - 6. Terminal unit controllers and actuators, when installed by terminal unit manufacturer.
 - 7. Variable frequency drives. (This does not include VFDs integral to machinery such as chillers or air handling units).
 - 8. In-line meters (gas, water, power, BTU).
- B. Products Installed But Not Supplied Under this Section:
 - 1. Section 233614 "Laboratory Temperature and Airflow Controls System".
- C. Products Not Furnished or Installed but Integrated with the Work of this Section:
 - 1. Refrigerant monitors.
 - 2. Smoke detectors (through alarm relay contacts).
 - 3. Chiller Control Systems.
 - 4. Boiler Control Systems.
 - 5. Chemical Water Treatment.
 - 6. High Efficiency Energy Recovery System.
- D. Work Required Under Other Divisions Related to This Section:
 - 1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
 - 2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
 - 3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

1.3 SYSTEM DESCRIPTION

- A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over a LonTalk open protocol bus. All controllers on the LonTalk bus shall be LonMark certified.

1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara 4 Framework.
2. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and MODBUS.
3. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
4. All control devices, including configurable and fully programmable controllers, furnished with this Section shall be programmable directly from the Niagara 4 Workbench embedded toolset upon completion of this project. The use of configurable or programmable controllers that require additional software tools shall not be acceptable.
5. Any control vendor that shall provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
6. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus NiagaraAX or Niagara 4 Framework server.
7. A laptop computer including engineering/programming software to modify Operating System Server BMS programs and graphics shall be included.
8. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.
9. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*"and "accept.wb.in=*"and "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.
10. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.
11. All JACE's provided as part of this project shall be the appropriate JACE-8000 model licensed with all necessary drivers.

1.4 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

1. Actuator: Control device that opens or closes valve or damper in response to control signal.
2. AI: Analog Input.
3. AO: Analog Output.
4. Analog: Continuously variable state over stated range of values.
5. BAS: Building Automation System. (Used interchangeably with BMS)
6. BMS: Building Management System. (Used interchangeably with BAS)
7. DDC: Direct Digital Control.
8. Discrete: Binary or digital state.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

9. DI: Discrete Input.
10. DO: Discrete Output.
11. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
12. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
13. GUI: Graphical User Interface.
14. HVAC: Heating, Ventilating and Air Conditioning.
15. IDC: Interoperable Digital Controller.
16. ILC: Interoperable Lon Controller.
17. LAN: Local Area Network.
18. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
19. Motorized: Control device with actuator.
20. NAC: Network Area Controller.
21. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
22. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
23. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
24. Operator: Same as actuator.
25. PC: Personal Computer.
26. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
27. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
28. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
29. PICS: BACnet Product Interoperability Compliance Statement.
30. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
31. Point: Analog or discrete instrument with addressable database value.
32. WAN: Wide Area Network.

1.5 WARRANTY

- A. Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year beginning on the date of Substantial Completion.
- B. Services, materials, and equipment shall include but not be limited to:
 1. The adjustment, required testing, and repair of the system including all computer equipment, transmission lines, transmission equipment, sensors and control devices.
 2. On-line support services shall be provided as follows:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- a. The local BAS representative shall have the capability to monitor and control the facility's building automation system via a dialup connection.
- b. If the problem is not resolved by local support, the national office of the building automation system manufacturer, having the same dialup capability, shall also provide online support.

1.6 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Submit documentation of contractor qualifications, including those indicated in "Quality Assurance" if requested by the A-E.
- D. Five copies of shop drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.
- E. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.
- F. Upon completion of the work, provide five (5) complete sets of 'as-built' drawings and other project-specific documentation in 3-ring hard-backed binders and one electronic copy.
- G. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

1.7 QUALITY ASSURANCE

- A. The Control System Contractor shall have a full service DDC office within 50 miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. The Control System Contractor shall be staffed with a minimum of ten (10) Niagara 4 certified software engineers and/or technicians. The Control System Contractor shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.
- B. Single Source Responsibility of Supplier: The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation and

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

service of computerized building management systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 10 years. All control panels shall be assembled by the Control System Contractor in a UL-Certified 508A panel shop. Control panels shall be assembled such that all necessary I/O points are pre-wired to terminal blocks. Wire ducts shall be installed within the panel as needed to accommodate field wiring.

- C. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

1.8 SOFTWARE OWNERSHIP

- A. The Owner shall have full ownership and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.10 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

1.11 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Distech.
2. Honeywell
3. TAC I/A Series

B. Approved Installation Contractors:

1. CMS Controls.
2. Engineered Control Solutions.
3. Schneider Electric.

C. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.

D. The installed system shall provide secure strong password access to all features, functions and data contained in the overall BMS.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing the LonWorks technology communication protocol in one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.

C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 BAS SERVER HARDWARE

- A. Minimum Computer Configuration (Hardware Independent).
 - 1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
 - 2. Processor: Intel Xeon CPU E5-2640 x64 (or better), compatible with dual- and quad-core processors.
 - 3. Memory: 8 GB or more.
 - 4. Hard Drive: 80 GB minimum, more recommended depending on archiving requirements.
 - 5. Display: Video card and monitor capable of displaying 1024 x 768 pixel resolution or greater.
 - 6. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
 - 7. Connectivity: Full-time high-speed ISP connection recommended for remote site access (i.e. T1, ADSL, cable modem).
- B. Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.4 SYSTEM NETWORK CONTROLLER (SNC)

- A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
- B. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
- C. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 Fox, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.
- E. The SNC shall employ a device count capacity license model that supports expansion capabilities.
- F. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
 - 1. BACnet
 - 2. Lon
 - 3. MODBUS
 - 4. SNMP

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

5. KNX
- G. The SNC shall be capable of executing application control programs to provide:
1. Calendar functions.
 2. Scheduling.
 3. Trending.
 4. Alarm monitoring and routing.
 5. Time synchronization.
 6. Integration of LonWorks, BACnet, and MODBUS controller data.
 7. Network management functions for all SNC, PEC and ASC based devices.
- H. The SNC shall provide the following hardware features as a minimum:
1. Two 10/100 Mbps Ethernet ports.
 2. Two Isolated RS-485 ports with biasing switches.
 3. 1 GB RAM
 4. 4 GB Flash Total Storage / 2 GB User Storage
 5. Wi-Fi (Client or WAP)
 6. USB Flash Drive
 7. High Speed Field Bus Expansion
 8. -20-60°C Ambient Operating Temperature
 9. Integrated 24 VAC/DC Global Power Supply
 10. MicroSD Memory Card Employing Encrypted Safe Boot Technology
- I. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- J. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- K. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.
 - b. Return to normal.
 - c. To default.
 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email of complete alarm message to multiple recipients.
 - c. Pagers via paging services that initiate a page on receipt of email message.
 - d. Graphics with flashing alarm object(s).
 3. The following shall be recorded by the SNC for each alarm (at a minimum):
 - a. Time and date.
 - b. Equipment (air handler #, access way, etc.).
 - c. Acknowledge time, date, and user who issued acknowledgement.
- L. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.
- M. The SNC shall support the following security functions.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 2. Role-Based Access Control (RBAC) for managing user roles and permissions.
 3. Require users to use strong credentials.
 4. Data in Motion and Sensitive Data at Rest be encrypted.
 5. LDAP and Kerberos integration of access management.
- N. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
1. Metadata: Descriptive tags to define the structure of properties.
 2. Tagging: Process to apply metadata to components
 3. Tag Dictionary
- O. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AVAV, CVAV, VFD) shall have an associated template file for reuse on future project additions.
- P. The SNC shall be provided with a 1 Year Software Maintenance license. Labor to implement not included.

2.5 BUILDING AUTOMATION SYSTEM CONTROLLERS

- A. HVAC control shall be accomplished using LonMark based devices. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".
1. Programmable Equipment Controllers - a controller designed for more complex sequences of operations such as built up AHU's, central plant operations, electrical monitoring, and control and management for chillers, boilers and generators. The PECs are to allow for the flexibility of custom control programming to meet the needed sequences of operation. PEC's shall be selected based upon I/O requirements. Additional I/O may be added via expansion modules.
 - a. All PECs shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - c. PEC's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC or relay).
 2. Advanced Variable Air Volume Controller (AVAV) - a controller designed specifically for room-level VAV control - pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO2, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, series fan powered terminal unit, parallel

- fan powered terminal unit, supply and exhaust air volume terminals and constant volume dual-duct terminal unit.
- a. The AVAV shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The controller shall have an internal velocity pressure sensor.
 - c. The AVAV shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - d. AVAV's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC).
 - e. The controller shall provide an integrated actuator option.
3. Configurable VAV Controller (CVAV) - the configurable VAV controller platform shall be designed specifically for room-level VAV control – pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO2, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, series fan powered terminal unit, parallel fan powered terminal unit, supply and exhaust air volume terminals, and constant volume dual-duct terminal unit.
- a. The CVAV shall be application specific configuration and shall at all times maintain their certification. All control sequences within or programmed into the CVAV shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The controller shall have an internal velocity pressure sensor.
 - c. The CVAV shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - d. CVAV's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC).
 - e. The controller shall provide an integrated actuator option.
4. Configurable Constant Volume AHU Controller (CVAHU) - the configurable constant volume AHU controller shall be designed specifically for single zone unitary AHU control –temperature, humidity, complex CO2, occupancy, and emergency control. Equipment includes: unitary air handling units, fan coil units, blower coil units, unit ventilators, and heat pumps.
- a. The CVAHU controller shall be application specific configuration and shall at all times maintain their certification. All control sequences within or programmed into the CVAHU controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The CVAHU controller shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - c. CVAHU controllers shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC).

2.6 OTHER CONTROL SYSTEM HARDWARE

- A. Motorized control dampers that will not be integral to the equipment shall be furnished by the Control System Contractor. Control damper frames shall be constructed of galvanized steel, formed into changes and welded or riveted. Dampers shall be galvanized, with nylon bearings. Blade edge seals shall be vinyl. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-gauge minimum and 6 inches wide maximum and frame shall be of welded channel iron. Damper leakage shall not exceed 10 CFM per square foot, at 1.5 inches water gauge static pressure.
- B. Control damper actuators shall be furnished by the Control System Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to a control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators.
- C. Control Valves: Control valves shall be 2-way or 3-way pattern as shown and constructed for tight shutoff at the pump shut-off head or steam relief valve pressure. Control valves shall operate satisfactorily against system pressures and differentials. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (unless otherwise noted or scheduled on the drawings). Valves with sizes up to and including 2 inches (51 mm) shall be "screwed" configuration and 2-1/2 inches (63.5 mm) and larger valves shall be "flanged" configuration. All control valves, including terminal unit valves, less than 2 inches (51 mm) shall be globe valves. Electrically-actuated control valves shall include spring return type actuators sized for tight shut-off against system pressures (as specified above) and, when specified, shall be furnished with integral switches for indication of valve position (open-closed). Pneumatic actuators for valves, when utilized, shall be sized for tight shut-off against system pressures (as specified above).
- D. Control Valve Actuators: Actuators for VAV terminal unit heating coils shall be "drive-open; drive-closed" type. All actuators shall have inherent current limiting motor protection. Valve actuators shall be 24-volt, electronic type, modulating or two-position as required for the correct operating sequence. Actuators on valves needing 'fail-safe' operation shall have spring return to Normal position. Modulating valves shall be positive positioning in response to the signal. All valve actuators shall be UL listed. Honeywell is basis of design.
- E. All control valves 2-1/2 inches (63.5 mm) or larger shall have position indication. All hot water control valves shall be Normally-Open arrangement; all chilled water control valves shall be Normally-Closed arrangement.
- F. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room Temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F (-38 to 60 degrees C). The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees F (.024 degrees C) over the entire range.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- G. Duct-mounted and Outside Air Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of ± 0.2 degrees C. Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F (-38 to 71 degrees C). The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 feet (2438 mm) long sensor element. These devices shall have accuracy of 0.5 degrees F (0.024 degrees C) over the entire range.
- H. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degrees F (0 to 60 degrees C). Sensors shall be selected for wall, duct or outdoor type installation as appropriate. Honeywell is basis of design.
- I. Carbon Dioxide Sensors (CO₂): Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.), repeatable to plus or minus 20 PPM. Sensor range shall be 0 - 2000 PPM. Accuracy shall be plus or minus five percent (5%) or 75 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 - 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure.
- J. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.
- K. Differential Analog (duct) Static Pressure Transmitters Provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube.
- L. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips.
- M. Water Flow Switches: Provide a SPST type contact switch with bronze paddle blade, sized for the actual pipe size at the location. If installed outdoors, provide a NEMA-4 enclosure. Flow switch shall be UL listed.
- N. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BMS in a UL-Certified 508A panel shop. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.
- O. Pipe and Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with and accuracy of $\pm 1\%$ accuracy. Their range shall be -5 to 250 degrees F (-20 to 121 degrees C). Limited range sensors shall be acceptable provided they are capable of sensing the range

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included.

- P. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F (-9 to 13 degrees C), range, vapor-charged temperature sensor. Honeywell model L482A, or approved equivalent.
- Q. Variable Frequency Drives: The variable frequency drive (VFD) shall be designed specifically for use in Heating, Ventilation, and Air Conditioning (HVAC) applications in which speed control of the motor can be applied. The VFD, including all factory installed options, shall have UL & CSA approval. VFD's shall include communications capability with DDC BMS via built-in interface card (MODBUS or BACnet). Honeywell SmartVFD is basis of design.
- R. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a sub base and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.
- S. Emergency Stop Switches: Provide toggle-type switch with normally-closed contact. Switch shall be labeled "AIR HANDLER EMERGENCY SHUTOFF, NORMAL - OFF."
- T. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit shall be designed to operate in the pressure ranges involved.
- U. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation.
- V. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.
- W. Lon Bus Surge Protectors: A Lon Bus Surge Protector, DITEK model # DTK-2MHL24BWB or equivalent shall be installed on the lon bus when it leaves and enters a building.
- X. Ethernet Port Surge Protector: An Ethernet Surge protector shall be installed similar to the Honeywell 14507678-004 or comparable.
- Y. Airflow Monitoring Stations: Ebtron Brand Gold airflow monitoring stations shall be Lon. Controls Contractor shall verify installed duct sizes and airflows before ordering.
- Z. Gas Meters: Onicon brand F-5400 Series Thermal Mass Flow Meter, D-100 display with LonWorks TP/FT-10F Output. Controls Contractor shall verify installed pipe size, meter placement sizes and flows before ordering.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

AA. Domestic Water Meters:

1. Building meters: Neptune
 - a. 1.5 inches and below shall be positive displacement type with matching strainer.
 - b. 2 inches and above shall be compound type meter with matching strainer.
2. Irrigation meters: Neptune
 - a. Minimum 2" turbine meter with matching strainer
3. Meter Register: Neptune E-Coder register w/ the potted cable. (The R900i register is NOT compatible, since it does not feature a connection wire.)
4. Meter Gateway: Scadametrix Ethermeter <http://www.scadametrix.com/> The gateway device shall directly interrogate the meter register and shall calculate and relay the following parameters to the BMS: Totalized Volume, Instantaneous Flowrate

BB. BTU Meters: Onicon System-10 BTU meter, LonWorks communication, F-3500 Electromagnetic Flow Meter

CC. Electric Meter: Digital Electric Meter with Modbus communication. Unit shall display and communicate totalized kWh, voltage, amps, kW

DD. Liquid Flow Meters: Onicon F-3500 Electromagnetic Flow Meter, D-100 Display with LonWorks Communication.

2.7 BAS SERVER & WEB BROWSER GUI - SYSTEM OVERVIEW

- A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.
- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Windows operating systems.
- C. The BAS server software shall support at least the following server platforms (Windows 7, 8.1, Server 12). The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.
- D. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
 1. Trending.
 2. Scheduling.
 3. Electrical demand limiting.
 4. Duty Cycling.
 5. Downloading Memory to field devices.
 6. Real time 'live' Graphic Programs.
 7. Tree Navigation.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

8. Parameter change of properties.
 9. Set point adjustments.
 10. Alarm / event information.
 11. Configuration of operators.
 12. Execution of global commands.
 13. Add, delete, and modify graphics and displayed data.
- E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
1. Server Software, Database and Web Browser Graphical User Interface.
 2. 5 Year Software Maintenance license. Labor to implement not included.
 3. Embedded System Configuration Utilities for future modifications to the system and controllers.
 4. Embedded Graphical Programming Tools.
 5. Embedded Direct Digital Control software.
 6. Embedded Application Software.
- F. BAS Server Database: The BAS server software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.
- G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
 2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

2.8 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.
- B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.

- C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.
1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
 2. Groups View shall display Scheduled Groups and custom reports.
 3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
- D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
 2. Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards.
 3. Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
 4. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
 5. Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
 6. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
 7. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.
 8. Logic - Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
 9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
- E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24 bit True Color.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
 3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
 4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability. .
 5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
 - a. Each piece of equipment monitored or controlled including each terminal unit.
 - b. Each building.
 - c. Each floor and zone controlled.
- F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day ' Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the ' Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
1. Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
 - a. Types of schedule shall be Normal, Holiday or Override.
 - b. A specific date.
 - c. A range of dates.
 - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
 - e. Wildcard (example, allow combinations like second Tuesday of every month).
 2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
 3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an ' individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the ' tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the ' tenant group'.
 4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller,

- boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
 6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
- G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
 2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
 3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
 4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
 5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
 6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A ' network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
 7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the BAS Server database.
 8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
 9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
 - b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
 - c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
 - d. Write Property: The write property reporting action updates a property value in a hardware module.
 - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
 - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
- H. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
- 1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
 - 2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
 - 3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
 - 4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
 - 5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
 - 6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
 - 7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).
- I. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
 - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
 - b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.
 - c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

2.9 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.
- D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
 1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
10. Live Graphical Programs: The Graphic Programming software shall support a 'live' mode, where all input/output data, calculated data and set points shall be displayed in a 'live' real-time mode.

2.10 LONWORKS NETWORK MANAGEMENT

- A. Systems requiring the use of third-party LonWorks network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices and to view health and status counters within devices.
- D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.
- E. The network management database shall be resident in the Site Network Controller (SNC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times and within the control system shall not be accepted.

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

- A. Provide a designated project manager who will be responsible for the following:
 - 1. Construct and maintain project schedule
 - 2. On-site coordination with all applicable trades and subcontractors
 - 3. Authorized to accept and execute orders or instructions from owner/architect
 - 4. Attend project meetings as necessary to avoid conflicts and delays
 - 5. Make necessary field decisions relating to this scope of work
 - 6. Coordination/Single point of contact.

3.2 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that power supply is available to control units and operator workstation.
- D. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.3 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.4 GENERAL

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.
- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.5 WIRING

- A. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.
- C. Excess wire shall not be looped or coiled in the controller cabinet.
- D. Incorporate electrical noise suppression techniques in relay control circuits.
- E. There shall be no drilling on the controller cabinet after the controls are mounted inside.
- F. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.
- G. Use manufacturer-specified wire for all network connections.
- H. Use approved optical isolation and lightning protection when penetrating building envelope.
- I. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.6 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.
- B. The Control System Contractor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.7 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

- B. The Control System Contractor shall provide 48 total hours of comprehensive training in multiple sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These classes are to be spread out during the 1st year warranty period. The first class starting after final commissioning and the last class is to be in the last month of 1-year warranty period.

3.8 WARRANTY PERIOD SERVICES

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Contractor shall come with a 1 Year Software Maintenance license. All SNC and BAS Servers are included in this coverage.
- D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.
- E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.9 WARRANTY ACCESS

- A. The Owner shall grant to the Control System Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.10 OPERATION & MAINTENANCE MANUALS

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:
- B. As-built control drawings for all equipment.
- C. As-built Network Communications Diagram.
- D. General description and specifications for all components.
- E. Completed Performance Verification sheets.
- F. Completed Controller Checkout/Calibration Sheets.

3.11 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 230900

SECTION 230993 - SEQUENCES OF CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 ABBREVIATIONS

- A. BAS Building Automation System
- B. CFM Cubic Feet per Minute
- C. CRAC Computer Room Air Conditioner
- D. DDC Direct-digital controls
- E. °F Degrees Fahrenheit
- F. ECM Electrically-commutated motor
- G. RTU Rooftop unit
- H. VAV Variable-air volume
- I. VSD Variable Speed Drive
- J. NCSBC North Carolina State Building Code
- K. W Wire

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. Head End: Main temperature control computer system storing data accessible to the internet for WEB accessible systems and storing data accessible to the building system backbone for non-WEB accessible systems.
- C. Modulating: Able to electrically vary and stop in any position.
- D. Occupied Mode: Occupied or “design” operation.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- E. Outdoor air: Air outside the building or taken from outdoors and not previously circulated through the building.
 - F. Outdoor air measurement: Reporting of the volume of outdoor air taken into the building by RTU and reported to the building operator in CFM.
 - G. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations.
 - H. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
 - I. Record: Maintain in writing on paper and maintain an electronic copy (Portable Document Format (*.PDF) is acceptable). Make paper copy available for inspection upon request by Owner, Owner's representative, Architect, or Architect's representative. Email electronic copy to requested email address when request is made by the Owner, Owner's representative, Architect, or Architect's representative.
 - J. Set Point: An operating parameter adjustable at the head end by the operator.
 - K. Supply-Air Fan: Fan providing supply air to conditioned space.
 - L. Supply air: Air entering a space from air-conditioning, heating, or ventilating equipment.
 - M. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
 - N. Two-Position: Able to electrically move and stop in only two positions. Usually open or closed.
- 1.4 Submittals:
- A. Submit the following:
 - 1. Proposed control sequences.
 - 2. Freezestat manufacturer's data and wiring diagrams indicating all components required to execute the indicated sequence.
- 1.5 Trending:
- A. Unless otherwise indicated where trending is indicated the BAS shall measure or record each point value every 1.0 seconds and shall save results for a minimum of 30 days.
- 1.6 Coordination
- A. Refer to Section 019110 "General Commissioning Requirements" for Commissioning Plan requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (OPERATING SEQUENCES)

- 3.1 SET POINTS: Unless indicated otherwise all set points shall be adjustable from the head end.
- 3.2 TRENDING: Unless indicated otherwise all points shall have the ability to be recorded for trending every 5 minutes (adjustable).
- 3.3 OPTIMUM START/STOP:
- A. The BAS shall institute optimum start strategies for morning warm up and cool down functions. Equipment shall start early enough to restore occupied temperature set points 30 minutes prior to occupancy. Morning warm up and cool down must look at outside conditions and building historic thermal loading data at a minimum to determine optimum start/stop of the building to save energy and keep the building at set back temperatures as long as possible during unoccupied periods.
- 3.4 OUTSIDE AIR SENSORS:
- A. Graphics:
1. A system graphic similar to the control diagram on the drawings shall be developed and shall be readable from the BAS head end.
 2. Sensed points shall be displayed on the graphic and shall be readable from the BAS head end.
- B. Temperature: The BAS shall monitor outside air temperature as sensed by the outside air temperature sensor.
- C. Relative Humidity: The BAS shall monitor outside air relative humidity as sensed by the outside air humidity sensor.
- D. Web Bulb:
1. Web bulb temperature shall be calculated based on outside dry bulb temperature and relative humidity.
- 3.5 CENTRAL CHILLED WATER SYSTEM:
- A. Chilled Water System in Standalone Mode:
1. General:
 - a. The intent of this sequence of operation is to provide the most efficient operation of installed equipment. Goals are to maintain low condenser water supply

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- temperature, high chilled water supply temperature, operate the chiller in the most efficient part of their load profile, and to operate the chilled water pumps in the most efficient configuration.
- b. A system graphic representing all equipment included in the system.
2. Initial Set Points:
 - a. Pump lead lag time period: Two weeks.
 - b. Condenser water temperature: 95 degrees F.
 - c. Chilled water temperature: 40 degrees F.
 - d. Cooling tower fan(s) start: 5 degrees above condenser water temperature set point.
 - e. Cooling tower fan(s) stop time: 15 minutes.
 3. Chilled water pumps are duty/standby: The BAS shall alternate the two pumps in the duty/standby positions.
 4. Chilled water enable/disable: On a call for cooling by any piece of equipment, the chilled water sequence shall be enabled. If there is no call for cooling by any piece of equipment for more than 30 minutes, or the chilled water temperature falls to two degrees below set point and there is no call for cooling by any equipment, the BAS shall disable the chiller plant.
 5. System Startup: On a rise in outdoor air temperature to 2°F above the chilled water system deactivation temperature and on a call for cooling by any chilled water coil, the chilled water system shall be started. The cooling tower bypass valves shall modulate to maintain condenser water temperature at 10°F below set point (institute hard minimum of 60° F (adjustable) as recommended by the chiller manufacturer). The duty chilled water pump and condenser pumps shall be started, and the chiller shall be enabled. The chiller shall start and operate under its onboard controls. As the condenser water temperature increases above set point the bypass valves shall modulate open to the tower and closed to the bypass to maintain condenser water temperature at set point. Tower start shall be delayed until the bypass valves are 100% open to the tower and closed to the bypass at which time the lead tower shall be started and fan speed shall be modulated to maintain condenser water temperature at set point.
 6. Chiller Sequencing: The chiller shall operate under its own on-board controls and stage and vary compressor speeds as required to match the load. The BAS shall have provisions to sense failure of any chiller or pump. Failure of any piece of equipment shall result in immediate shut down of that equipment and associated equipment, indication of an alarm, and the start of the next available pump combination in the sequence. All failure alarms shall be reported to the head end and shall be manually reset.
 7. Chilled water temperature reset: The chilled water temperature shall be maintained such that a minimum of one chilled water valve is 85% open. If all chilled water valves are less than 85% open the chilled water temperature shall be reset up 1 degree F. every 10 minutes until one valve reaches 85% open. Maximum chilled water temperature shall be 10 degrees above chilled water temperature set point. If any valve reaches 95% open the chilled water temperature shall be reset down 1 degree F. every 10 minutes until no valve is more than 95 % open. Whenever there is a need for dehumidification the chilled water

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

temperature shall be returned to set point until dehumidification is no longer required. When humidity levels are returned to set point the chilled water temperature reset sequence shall resume and shall begin at the chilled water temperature set point.

8. Chilled water pump control: The BAS shall start and stop the chilled water pumps and modulate their speed as required by system demands. The system shall maintain differential pressure as transmitted by the leaving pressure differential transmitters. The 4-20mA DC signal shall be sent via a shielded twisted pair of wires run in ¾" conduit to the BAS. The BAS shall have field programmable independent set points, the value of which shall be the optimum differential pressure as designed for each remote location. Conduit shall be in accordance with Division 26 specification sections. Pumping energy efficiency shall be optimized.
9. Chiller Minimum Flow Control: The BAS shall monitor the chilled water supply flow meter and differential pressure across the evaporator supply/return at the chiller. The BAS shall modulate the chilled water minimum flow bypass valve as require to maintain the chiller minimum flow and differential pressure to the worst case as required by the chiller manufacturer.
10. Condenser Pump Sequencing: If a condenser pump fails to start, the backup condenser pump shall be started. Pumps shall be rotated by the BAS to equalize run time of the pumps.
11. System shutdown: On a fall in outdoor air temperature to the chilled water system deactivation temperature, the chilled water system shall be deactivated. The chillers shall be disabled and shall wait for confirmation that the chillers are off as reported by the current transmitter. After the chillers are confirmed off the chilled water pumps, condenser water pumps, and towers shall be disabled. The tower bypass valves shall be positioned to bypass the towers.
12. Temperatures for chiller supply/return, condenser supply/return, and building chilled water supply/return sensed by temperature sensors shall be indicated on the BAS head end graphics along with all available points available from the chiller control panel.
13. Differential pressure for condenser supply/return, and chilled water supply/return sensed by temperature sensors shall be indicated on the BAS head end graphics along with all available points available from the chiller control panel.
14. The BAS shall map control points from each chiller to the BAS and display them at the head end graphics for each chiller. Refer to Section 236416 "Centrifugal Water Chillers" for a list of required control points.

B. Central Plant Operation:

1. The chilled water system in Dobo shall have the ability to connect to the existing Wagner Chiller Plant central controls via a virtual plant controller. The virtual plant controller shall be capable of sending a signal to the Dobo controls and overriding the differential pressure discharge setpoint, and chilled water supply temperature. The central plant controller will be able to sequence the Dobo Hall Chilled Water system with the central plant Chill Tech Controller.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.6 BUILDING CHILLED WATER BRIDGE PUMPS

A. Initial Set points:

1. Chilled Water Supply Temperature: 42°F
2. Chilled Water Loop Differential Pressure: 15 psi (to be adjusted by TAB agent)

B. Chilled water temperature reset:

1. Chilled water temperature set point shall be re-set based on the following outside air temperatures.

Outside Air Temperature (°F)	Chilled Water Temperature (°F)
>=90	42
85	44
80	46
75	48
70	50
<=65	52

C. Monitoring Points:

1. Remote Chilled Water Plant Loop Return Temperature
2. Remote Chilled Water Plant Loop Supply Temperature
3. Building Chilled Water Return Temperature
4. Building Chilled Water Supply Temperature
5. Pump Speed
6. Pump Status
7. Pump VFD Alarm
8. Building Chilled Water Flow
9. Remote Chilled Water Plant Control Valve Position
10. Building Remote Differential Pressure

D. Remote Chilled Water Control Valve and Chilled Water Bridge Pumps (TCHWP-1A, 1B, 2A & 2B)

1. Pumps General: Chilled water pumps are variable speed and are in the duty/standby arrangement. The duty pump shall be alternated once a week or another approved method to equalize pump run time.
2. Pumps Control: The duty chilled water pump shall be enabled when there is a call for cooling. If the duty pump fails to start (as sensed by current sensing relay), the standby pump shall be enabled and alarm sent to head end indicated which pump failed to start. The duty pump shall ramp up in speed to maintain differential pressure set point (as determined through testing and balancing) for the sensor furthest from set point. Pump shall be disabled if there is no call for cooling for 30 minutes.
3. Remote Chiller Water Control Valve: The two-way control valve shall be modulated to maintain building chilled water supply water to set point.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

4. Pump Failure Alarm: Should either pump fail to start, as sensed by current sensing relay, an alarm shall be sent to the head end identifying the pump and stating that it has failed to start.
 5. Remote Measured Chilled Water Differential Pressure: The BAS shall utilize a differential measurement sensors and transmitters to obtain chilled water differential pressure. Refer to the chilled water pump control paragraph for additional information. Refer to floor plans for sensor location.
 6. Chilled Water Supply Temperature Reset: The BAS shall reset the chilled water supply temperature based on outside air temperature and the reset schedule indicated above. The maximum chilled water set point shall be 10 degrees above the design set point. Whenever there is a need for dehumidification, the chilled water temperature shall be reset to the minimum until relative humidity falls 5% below set point.
- E. Two-way Chilled Water Bypass Valve: The bypass valve shall be modulated open to maintain minimum flow through the pumps as measured by the building chilled water flow meter. Minimum flow shall be flow required by the pump manufacturer.

3.7 HEATING PLANT

- A. Initial Set points:
1. Heating Hot Water Loop Supply Temperature: 140°F
 2. Heating Hot Water Loop Differential Pressure: 15 psi (to be adjusted by TAB agent)
- B. Hot water temperature reset:
1. Hot water temperature set point shall be re-set based on the following outside air temperatures.

Outside Air Temperature (°F)	Hot Water Temperature (°F)
<=20	140
25	140
30	140
35	140
40	135
45	130
50	125
55	120
60	115
65	110
>=70	110

- C. Monitoring Points:
1. Heating Hot Water Loop Return Temperature
 2. Heating Hot Water Loop Supply Temperature
 3. Pump Speed

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

4. Pump Alarm
5. VFD Alarm
6. Boiler Alarm
7. Boiler Status
8. Building Heating Hot Water Flow
9. System Heating Hot Water Flow

D. Boiler (B-1, 2 & 3) and Hot Water Pumps (HWP-1 & HWP-2)

1. Pumps General: Hot water pumps are variable speed and are in the lead/lag arrangement. The lead pump shall be alternated once a week or another approved method to equalize pump run time. If the lead pump fails, the lag pump shall be energized and alarm issued to the head end.
2. Pumps Control: Hot water pumps include VFD's to vary speed based on the differential pressure sensor reading. An increase in differential pressure above set point shall reduce the pump speed; a decrease in differential pressure below set point shall increase the pump speed. If the lead pump fails to start (as sensed by current sensing relay), the lag pump shall be enabled and alarm sent to head end indicated which pump failed to start. Pumps shall be disabled if there is no call for heating for 30 minutes. If the lead pump runs at greater than 90% full speed (adjust based on pump curves) for 15 minutes, an additional pump stage will be added and an additional boiler isolation valve will be opened. Once in operation, both pumps will run at the same speed to meet the DP requirement. This sequence will continue until all three pumps are in operation. When the pumps in operation are running below 33% (adjust based on pump curves) for 5 minutes, the last staged pump will be de-energized and the remaining pumps will be ramped up to meet the DP requirement.
3. Boiler General: The boilers shall be enabled by the BAS when heating is required and modulated by the boiler plant control panel provided by the boiler manufacturer as required to maintain the heating hot water loop supply temperature at set-point. The BAS shall keep the lead boiler motorized isolation valve open at all times to prevent pump dead heading and close the lag boiler isolation valves when not operating. The BAS shall stage boilers to maximize boilers efficiency and alternate lead boiler once a week or another approved method to equalize run time. Boiler shall be disabled if pumps are not running.
4. Two-way Hot Water Bypass Valve: The bypass valve shall be modulated open to maintain minimum flow through the boilers and pumps as measured by the system level flow meter. Minimum flow shall be 100 GPM or as required by pump or boiler manufacturers.
5. The building level flow meter shall monitor flow to the building.
6. Pump Failure Alarm: Should either pump fail to start, as sensed by current sensing relay, an alarm shall be sent to the head end identifying the pump and stating that it has failed to start.
7. Boiler Alarm: Should the boiler fail an alarm shall be sent to the head end identifying the boiler, and indicating that it has malfunctioned.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- 3.8 VAV AHU WITH HIGH EFFICIENCY ENERGY RECOVERY COIL SERVING
TERMINAL UNITS AND LAB TERMINAL UNITS (AHU-1, 2, 3, & 4)
- A. DESCRIPTION: Custom 100% outside air variable volume air handling unit with 100% economizer capability, variable speed supply fan array, glycol heat recovery coil, emergency hot water pre-heating coil, chilled water cooling coil, and glycol re-heat coil serving multiple lab terminal units and terminal units. The AHU shall be controlled in parallel with the associated Lab Exhaust System to meet the ventilation requirements of the laboratory spaces. If the associated Lab Exhaust System fails, the associated AHU shall be disabled, and a high-level alarm shall be sent to the BAS.
 - B. Graphics: A system graphic similar to the proposed equipment layout shall be developed and shall be readable from the BAS head end.
 - C. Sensed points shall be displayed on the graphic and shall be readable from the BAS head end.
 - D. Damper positions shall be displayed on the graphic and shall be readable from the BAS head end.
 - E. Valve positions shall be displayed on the graphic and shall be readable from the BAS head end.
 - F. Fan operation shall be displayed on the graphic and shall be readable from the BAS head end.
 - G. In all modes of operation, commanded and reported position values for all control devices shall be displayed on the graphic and shall be readable from the BAS head end.
 - H. Initial Set Points:
 - 1. Occupied Mode:
 - a. Supply Fan Start/Stop Position: Start
 - b. Maximum Supply Fan Motor Speed: As required under section "Testing, Adjusting, and Balancing" to supply design maximum airflow with appropriate (not necessarily all) terminal unit dampers at maximum air flow.
 - c. Minimum Supply Fan Motor Speed: As required by unit manufacturer
 - d. Energy Recovery Pumps: Start
 - e. Outdoor Air Damper Position: Open
 - f. Minimum Unit Leaving Air Temperature: 55°F
 - g. Maximum Unit Leaving Air Temperature: 65°F
 - h. Maximum Unit Leaving Air Temperature During Morning Warm Up: 75°F
 - i. Energy Recovery Discharge Temperature Setpoint: Same as Unit Leaving Air Temperature.
 - j. High Space Relative Humidity: 55%
 - k. Low Space Relative Humidity (Humidification setpoint): 35% (adj)
 - l. Supply Fan High Positive Static Pressure Limit: 10.0" water column
 - m. Supply Fan High Negative Static Pressure Limit: -6.0" water column
 - n. Maximum terminal unit damper position: 95%
 - o. Minimum terminal unit damper position: 85%
 - p. Space Pressurization Setpoint: +0.05" WC

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- q. Fan Speed Reset (% of maximum set point): 5%
 - r. Fan Speed Adjustment Interval (minutes): 5
 - s. Economizer high limit temperature: 68°F
2. Unoccupied Mode (Maintenance manual override only):
- a. Supply Fan Start/Stop Position: Stop.
 - b. Outdoor Air Damper Position: Closed.
 - c. Discharge Air Damper Position: Closed.
 - d. Chilled Water Valve Position: Closed.
 - e. Hot Water Valve Position: Closed unless overridden by freeze protection.
- I. Start/Stop:
- 1. Start: The unit shall be started in stages as follows:
 - a. Stage 1: The discharge damper and outside air dampers shall be positioned fully open. Provide 30 Seconds for this to occur.
 - b. Stage 2: The supply fan shall be ramped up to operating speed and then speed shall modulate in accordance with applicable sequences.
 - c. Stage 3: Operation of the entire unit shall be turned over to applicable sequences.
 - 2. Stop: The unit shall be stopped in stages as follows:
 - a. Stage 1: Operation of the entire unit shall be taken from applicable sequences
 - b. Stage 2: The supply shall be ramped down over 15 seconds.
 - c. Stage 3: The supply fans shall be stopped.
 - d. Stage 4: The outdoor air dampers and discharge damper shall be positioned fully closed. Provide 30 Seconds for this to occur
 - e. Stage 5: Operation of the entire unit shall be turned over to applicable sequences.
 - 3. Emergency stop: Perform all stop stages at once.
 - 4. Occupied Mode Operation: During occupied hours the unit shall be started, the supply fans shall be running, the cooling and heating coils shall be active with their valves modulating in accordance with applicable sequences below, and dampers shall modulate in accordance with applicable sequences below.
 - 5. Unoccupied Mode: The AHUs are scheduled to run continuously to meet the ventilation requirements of the Lab and building. An unoccupied mode can be manually set into operation for maintenance purposes. In unoccupied mode, the BAS shall close the outside air damper and discharge dampers for the air tunnel that is in maintenance mode. The chilled water valve shall be closed.
- J. Operational Overrides:
- 1. Morning Warm up Operation (For non-lab spaces, refer to terminal sequences below):

The BAS shall optimize early start of the unit in warm-up mode. The unit shall be started early enough for spaces to reach their occupied space heating set points a minimum of 30 minutes prior to occupied time. Leaving air temperature shall be reset to its maximum morning warm up set point until occupied time when the BAS shall place the unit in occupied mode operation. During morning warm up terminal units shall be allowed to go from 100% maximum design airflow down to closed air valve position to prevent overheating interior zones.

2. Morning Cool down Operation (For non-lab spaces, refer to terminal sequences below): The BAS shall optimize the early start of the unit in cool-down mode. The unit shall be started early enough for spaces to reach their occupied space cooling set points a minimum of 30 minutes prior to the occupied time. Leaving air temperature shall be reset to its minimum set point until occupied time when the BAS shall place the unit in occupied mode operation. During morning cool down terminal units shall be allowed to go from 100% maximum design airflow down to closed air valve position to prevent overcooling zones.

K. Supply Fans Control:

1. Unoccupied Mode: During unoccupied mode operation, the BAS shall ramp the supply fans up to their minimum speed over a 30 second time period. Required minimum speed shall be determined by the equipment manufacturer and shall be instituted as the minimum fan speed. The lab spaces will be maintained to their night setback pressurization requirements. Non-lab terminal units shall be closed. Refer to terminal unit section below.
2. During occupied mode operation, the BAS shall ramp the supply fans up to their minimum speed over a 30 second time period. Required minimum speed shall be determined by the equipment manufacturer and shall be instituted as the minimum fan speed.
3. Supply Fan Motor Speed Control: The BAS shall continuously monitor the damper position of all terminal units connected to supply ductwork served by this unit. When any terminal unit damper opens beyond the maximum terminal unit damper position set point, the BAS shall reset the fan speed set point (downstream pressure set point) up by the fan speed reset set point. This shall occur at the fan speed adjustment interval set point until no damper is open beyond the maximum terminal unit damper position set point, or the VSDs are at their maximum fan speed set point. When all dampers are opened less than the minimum terminal unit damper position set point, the BAS shall reset the fan speed set point down by the fan speed reset set point. This shall occur at the fan speed adjustment interval set point until any terminal unit damper is open beyond the minimum terminal unit damper position set point, or the VSD is at its minimum setting. All VSDs in the fan array shall ramp together at the same speed.
4. Motor Speed Percentage: Fan motor speed shall be reported to the BAS as a percentage of full speed and it shall be indicated on the head end graphics.
5. Supply Fan High Static Pressure Limit: A static pressure sensor located in the supply fan discharge duct shall function as a safety input to the BAS. An increase in fan discharge static pressure above the high static limit set point shall cause the BAS to perform an emergency stop. An alarm shall be sent to the head end indicating the unit has been shut down due to excessive high static pressure.
6. Supply Fan High Negative Static Pressure Limit: A static pressure sensor located at the on the low pressure side (upstream) of the supply fan shall function as a safety input to the BAS. A decrease in negative static pressure below the supply fan high negative static pressure limit set point shall cause the BAS to perform an emergency stop. An alarm shall be sent to the head end indicating the unit has been shut down due to excessive negative static pressure.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

7. Drive Malfunction: Should one of the VSDs malfunction as indicated by the drive alarm circuit, an alarm shall be sent to the head end. The fan shall be disabled and the backdraft damper for that fan shall close. The rest of the fans in the fan array shall continue to operate with the sequences above.
8. Fan Failure Alarm: Should one of the supply fans fail (as sensed by its current sensing relay), the fan shall be stopped and backdraft damper for that fan shall close. An alarm shall be sent to the head end identifying the fan has failed. The rest of the fans in the fan array shall continue to operate with the sequences above.
9. Supply Fans Air Flow Measuring: Individual supply fan airflow shall be reported to the BAS and each AHU total CFM shall be reported to the BAS and it shall be indicated on the head end graphics.

L. High Efficiency Energy Recovery System (HEERS):

1. The HEERS shall operate independently to provide the desired air handler setpoints as communicated through the BMS. The BMS shall communicate the following points to the HEERS through a coordinated interface:
 - a. Operating Mode (heating, cooling, dehumidification/reheat, or economizer mode)
 - b. Supply air set temperatures for each supply air handler.
 - c. Air volumes in each supply and exhaust air handler.
 - d. Air temperature before and after each coil bank (2 data points in each supply air handler without reheat coil, 4 data points in each supply air handler with reheat coil, 2 data points in each exhaust air handler).
2. Demand-dependent regulation of the entire energy recovery system (reheat supply air temperature, circulation pumps, valves, heat exchangers, etc.), including controller hardware & software, display unit for energy efficiency, temperatures, volumetric flows
3. The control software shall be based on a simulation/optimization algorithm with:
 - a. Supply air set temperatures as set points or command signals (including reheat supply air set temperature in cooling mode)
 - b. Glycol/Water temperatures and volumes in the supply air heat exchangers as the actuating variables
 - c. Air volumes in the air handlers, outside air temperature, exhaust air temperatures and humidity as disturbance variables
4. The simulation algorithm continuously calculates the theoretical system performance (energy recovery efficiency) based on all control variables, the pump and heat exchanger performance curves, and different Glycol/Water volumes pumped through the system. The optimization algorithm then sets the actuating variables based on the simulated optimal system performance.
5. Controller Functions:
 - a. Primary function: heat (winter operation) or pre-cool/reheat (summer operation) supply air to supply air set temperature
 - b. Continuous measurement and recording of system operating parameters
 - c. Starting/shutting down pumps and regulating flow rate (pump speed) for optimal energy recovery

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- d. Minimizing pump power demand (flow rate increase only if additional pump power demand is smaller than marginal energy recovery)
 - e. When reaching/exceeding supply air temperature (set-point provided by Building Management System), the energy recovery system is turned down
 - f. Freeze protection at exhaust air heat exchangers, taking into account the exhaust air humidity
 - g. Pre-cool and reheat supply air to re-set temperature in summer operation
 - 6. The HEERS will operate its pumps, according to its own algorithms to maximize system efficiency and provide the desired leaving air temperature from the unit as signed by the BMS. The BMS contractor shall coordinate with the HEERS supplier to coordinate all inputs and outputs and adjust cooling coil control valve sequences to maximize system energy efficiency.
- M. Cooling Coil Control Valve:
- 1. The valve shall modulate to maintain unit leaving air temperature at set point. On a rise in unit discharge air temperature the valve will modulate towards open. On a fall in unit discharge air temperature the valve will modulate towards closed. When two control valves are used for one cooling coil, valve modulation should occur in parallel operation.
 - 2. Valve position shall be reported to the BAS and indicated on head end graphics.
 - 3. If the energy recovery coil leaving air temperature falls to the first freeze-stat set point, the building chilled water pump shall be enabled and the chilled water valve shall be fully open. The plant chilled water valve shall be closed.
- N. Emergency – Pre-Heating Coil Control Valve:
- 1. This pre-heating coil is the first stage of freeze protection. The heating coil valve is normally closed. On a fall in the energy recovery coil LAT below the first freeze-stat set point, the heating coil shall be commanded fully open by the first level freeze-stat.
 - 2. Valve position shall be reported to the BAS and indicated on head end graphics.
- O. Leaving Air Temperature Reset:
- 1. Leaving air temperature shall be sensed by a temperature sensor located in the unit discharge or supply air duct. The temperature and set point shall be reported to the BAS and displayed on the head end.
 - 2. At occupancy the leaving air temperature shall be set at the minimum unit leaving air temperature set point.
 - 3. On a decrease in supply fan motor speed below twenty five percent (25%) of the difference between the minimum fan motor speed set point and the maximum fan motor speed set point, the leaving air temperature set point shall be increased one degree (1°F) every five (5) minutes until the supply fan speed increases to the minimum fan motor speed set point plus forty percent (40%) of the difference between the minimum fan motor speed set point and the maximum fan motor speed set point. During this process, when the maximum unit leaving air temperature set point is reached, the fan speed shall continue to be reduced until the minimum fan motor speed set point is reached. At this time the unit will be at minimum cooling capacity (Minimum airflow and maximum

supply air temperature). Leaving air temperature set point shall remain constant when supply fan motor speed begins to increase. When supply fan motor speed increases to the minimum fan motor speed set point plus fifty percent (50%) of the difference between the minimum fan motor speed set point and the maximum fan motor speed set point, the leaving air temperature set point shall be reduced one degree (1°F) every five (5) minutes until either the leaving air temperature set point is reset down to the minimum unit leaving air temperature set point, or the supply fan motor speed set point decreases to the minimum fan motor speed set point plus thirty percent (30%) of the difference between the minimum fan motor speed set point and the maximum fan motor speed set point. During this process, when the minimum unit leaving air temperature set point is reached the leaving air temperature shall remain constant while fan speed continues to increase until the maximum fan motor speed set point is reached. At this time the unit will be at design cooling capacity (Design maximum airflow and design minimum supply air temperature).

P. Dehumidification Mode:

1. Exhaust air relative humidity shall be sensed by a relative humidity sensor located in the exhaust energy recovery unit. The exhaust relative humidity shall be reported to the BAS and displayed on the head end.
2. During occupied or unoccupied operation when the relative humidity rises above set point, the unit shall be placed in dehumidification mode. The BAS shall reset the leaving air temperature set point to minimum. The unit shall remain in dehumidification mode until the space relative humidity drops to 5% RH below set point at which time the BAS shall return to normal leaving air temperature reset control.
3. Economizer Mode shall be disabled during dehumidification mode except when the outside air temperature is less than 55°F.

Q. Economizer Mode: Whenever outside air temperature is less than the economizer high limit temperature set point (adjustable) and outside air temperature is less than the discharge air temperature and cooling is required, economizer operation shall be enabled.

1. Economizer operation shall be available twenty-four hours per day.
2. Economizer Mode shall be disabled during dehumidification mode, except when the outside air temperature is less than 55°F.

R. Outdoor Air Dampers:

1. Occupied Mode: The unit is 100% outside air unit. The dampers shall remain fully open whenever the supply fans are on.
2. Unoccupied Mode (Maintenance): The BAS shall close the damper.

S. Freeze Protection: When the air temperature (as sensed by a freezestat with an averaging bulb located upstream of the emergency pre-heating coil) drops below 40°F, the heating control valve shall modulate to fully open. This operation should be available during all modes of operation to prevent any coil from freezing. If the temperature continues to fall and the air temperature leaving the heating coil falls below 35°F (as sensed by a freezestat with an averaging bulb located upstream of the cooling coil) the fans shall stop and the outdoor air damper shall be closed and the discharge air damper shall close, the hot water valve shall be

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

fully opened. A high level alarm should be issued to the head end BAS graphics. The other air handling unit on the floor shall remain operational.

- T. System Safety: When the supply fan is stopped or airflow ceases for any reason other than a controlled stop (as sensed by a current sensing relay) the BAS shall perform an emergency stop. The other air tunnel shall remain operational.
- U. Supply Air Temperature: The BAS shall monitor supply air temperature downstream of the supply fan and shall display the temperature on the head end.
- V. Glycol Energy Recovery Coil Discharge Temperature: The BAS shall monitor the air temperature downstream of the heating coil and shall display the temperature on the head end.

3.9 LABORATORY EXHAUST SYSTEMS (LEF-1, 2, 3, 4)

- A. DESCRIPTION: The lab exhaust system consists of 2 parallel exhaust fans. Each exhaust fan is equipped with a variable speed fan and inlet isolation damper. The system is equipped with an outside air bypass damper to maintain fan discharge plume height at low system flows. Each exhaust system is equipped with a glycol runaround coil for recovering exhausted air. If the associated AHU fails, the associated Lab Exhaust System shall be disabled, and a high-level alarm shall be sent to the BAS.
- B. Graphics: A system graphic similar to the proposed equipment layout shall be developed and shall be readable from the BAS head end.
- C. Sensing points shall be displayed on the graphic and shall be readable from the BAS head end.
- D. Damper positions shall be displayed on the graphic and shall be readable from the BAS head end.
- E. Fan operation shall be displayed on the graphic and shall be readable from the BAS head end.
- F. In all modes of operation, commanded and reported position values for all control devices shall be displayed on the graphic and shall be readable from the BAS head end.
- G. Initial Set Points:
 - 1. Occupied Mode:
 - a. Exhaust Fan Start/Stop Position: Start
 - b. Maximum Exhaust Fan Motor Speed: As required under section "Testing, Adjusting, and Balancing" to exhaust design maximum airflow with appropriate (not necessarily all) terminal unit dampers at maximum air flow.
 - c. Minimum Supply Fan Motor Speed: As required by unit manufacturer.
 - d. Energy Recovery Pumps: Start
 - e. Outdoor Air Bypass Damper Position: 15% open.
 - f. Exhaust Fan High Positive Static Pressure Limit: 10.0" water column
 - g. Exhaust Fan High Negative Static Pressure Limit: -6.0" water column

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- h. Maximum terminal unit damper position: 95%
 - i. Minimum terminal unit damper position: 85%
 - j. Fan Speed Reset (% of maximum set point): 5%
 - k. Fan Speed Adjustment Interval (minutes): 1
 - 2. Unoccupied Mode (Maintenance manual override only):
 - a. Exhaust Fan Start/Stop Position: Stop.
 - b. Outdoor Air Bypass Damper Position: Closed.
 - c. Fan Inlet Isolation Air Damper Position: Closed.
- H. Start/Stop:
 - 1. Occupied Mode Operation: During occupied hours the unit shall be started, the exhaust fan(s) shall be running, and dampers shall modulate in accordance with applicable sequences below.
 - 2. Unoccupied Mode: The Exhaust Fan Systems are scheduled to run continuously to meet the ventilation requirements of the Lab and building. An unoccupied mode can be manually set into operation for maintenance purposes. In unoccupied mode, the BAS shall close the bypass outside air damper and fan isolation dampers.
- I. Exhaust Fan Control:
 - 1. A minimum of one exhaust fan shall be in operation at all times.
 - 2. The exhaust fans will be staged on as required to meet the exhaust requirements of the building. On an increase in exhaust requirement, as indicated by the fan being at 100% for 3 minutes, another fan shall be staged on. On a drop in exhaust requirement, as indicated by the fans being at or below 45% for 3 minutes, the reverse shall occur.
 - 3. The run order of the fans shall be rotated weekly to equalize fan run time.
 - 4. The fans will be started and stopped in a manner that will prevent fluctuations in duct static pressure during transition.
 - 5. On a call for a fan to run, the fan will be started and set to the minimum speed by its associated VFD. Once the fan is proven to be in operation, the fan isolation damper will be ramped open gradually. Once the isolation damper is 15% open, the VFD will be allowed to ramp the automatic speed setting, and the bypass damper will be set as indicated above.
 - 6. On shutdown, the isolation damper is commanded to be fully closed. Once the isolation damper position indicates that the damper is closed, the exhaust fan will be stopped.
- J. Exhaust Pressure Control:
 - 1. When in operation, each exhaust fan will be modulated to maintain the exhaust duct static pressures at set point, as indicated by the exhaust duct pressure sensors located in the exhaust ducts. The fans shall control to meet the static pressure setpoint of the worst case sensor. All fans in operation shall run at the same speed. Refer to Exhaust Fan Control for fan staging.
 - 2. On a drop in exhaust duct static pressure, the fan speeds shall be increased. On an increase in duct static pressure the fan speeds shall be decreased. Once the fans speeds

have modulated to minimum (45%), a further drop in exhaust requirement will modulate the outside air bypass damper open to maintain the exhaust static set point.

K. Exhaust Velocity Control:

1. The exhaust velocity is maintained at a minimum of 3000 fpm for each fan in operation by varying the fan speed and opening the outside air bypass damper. The exhaust velocity is determined by the factory supplied algorithm.

L. Exhaust Air Flow Measuring: Exhaust airflow shall be measured in each exhaust duct entering the ERU and reported to the BAS in total CFM for each ERU and it shall be indicated on the head end graphics.

M. Exhaust Air Temperature: The BAS shall monitor exhaust air temperature upstream and downstream of the heat recovery coil and shall display the temperatures on the head end.

N. Exhaust Air Relative Humidity: The BAS shall monitor exhaust air relative humidity upstream of the heat recovery coil and shall display the humidity on the head end.

O. System Safety: When the exhaust fan is stopped or airflow ceases for any reason other than a controlled stop (as sensed by a current sensing relay) the BAS shall start the next standby fan. If all fans fail to start, a high-level alarm shall be sent to the BAS head end, the associated AHU shall be commanded to stop.

3.10 TYPICAL LABORATORY ROOM CONTROL

A. General: The lab room supply/exhaust controls consist of a variable volume general exhaust air valve, a variable volume supply air valve with hot water reheat. The lab rooms are also served by a constant volume point exhaust (cabinets & snorkels) air valve, and variable volume lab hood with dedicated lab air valve for each fume hood. Quantities vary from lab to lab. All lab controls are electronically actuated, with high speed actuation on the fume hood, supply air terminal and general exhaust valves. The lab controls will operate in both occupied and unoccupied modes. The occupancy mode is set by the occupancy sensors within the lab. In all modes of operation the fume hood face velocity shall be maintained at 84 fpm.

B. Fume Hood Control:

1. The fume hood controller calculates the total fume hood open area based on the fume hood's fixed openings, bypass opening, leakage area and sash position as indicated by the sash sensor(s). The fume hood controller also continuously calculates the fume hood exhaust CFM required to maintain the average face velocity at set point based on the total open area of the fume hood and the average face velocity set point. The fume hood controller uses an integral velocity station at the fume hood exhaust valve inlet to measure actual fume hood exhaust CFM and modulate the fume hood exhaust valve to control and maintain the required fume hood average velocity using a proportional, integral and derivative (PID) closed loop control algorithm.
2. The fume hood controller maintains the fume hood exhaust CFM at the desired minimum set point value (adjustable) when the total fume hood open area results in less than the desired minimum fume hood exhaust CFM. This minimum fume hood exhaust set point

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

is set to the value recommended by the fume hood manufacturer to maintain adequate fume containment and dilution.

3. Fume hood control shall not be affected by the occupancy sensor or occupied/unoccupied set points for the room. Under all conditions, the fume hoods shall remain under their own controls to maintain face velocity.

C. Point Exhaust:

1. The constant volume flow controller will modulate the exhaust air valve to maintain a constant air flow from the point exhaust.
2. Point exhaust control shall not be affected by the occupancy sensor or occupied/unoccupied set points for the room. Under all conditions, the point exhaust shall remain operational at the scheduled flow rate.

D. Room Ventilation Control:

1. The Lab Room Controller (LRC) receives inputs from the constant volume air valve serving the point exhaust, and all fume hood exhaust air valves in the room to calculate the sum of exhaust from these devices, and measures the actual room general exhaust CFM via an integral flow station at the inlet of the general exhaust air valve.
2. The LRC calculates Total Room Exhaust CFM by adding the room general exhaust CFM, the fume hood exhaust and the point exhaust together. The LRC modulates the room general exhaust to ensure that a minimum Total Room Exhaust CFM necessary to meet the room ventilation rate is continuously maintained using a PID closed loop control algorithm. The minimum Total Room Exhaust CFM (Occupied & Unoccupied Air Change Rate) necessary is scheduled for each lab on the air balance drawings. The room ventilation control shall control the general exhaust and supply terminals to maintain the occupied air change rate or as required to maintain the fume hood and point exhaust flow rates whenever the occupancy sensor has sensed movement for a period of 30 minutes (adj). Whenever the occupancy sensor has not sensed movement for over 30 minutes (adj), the minimum total room exhaust CFM shall be set to the unoccupied air change rate or as required to maintain the fume hood and point exhaust flow rates.

E. Room Pressurization Control:

1. The LRC uses airflow sensors in the supply air valve to continuously measure the actual Room Supply Air cfm. The LRC calculates the required Room Supply Air cfm necessary to maintain the Flow Tracking Differential by subtracting the Flow Tracking Differential by the Total Room Exhaust CFM. The LRC modulates the Room Supply Air CFM to ensure that the Flow Tracking Differential CFM is always maintained by a PID closed loop algorithm.
2. A differential pressure sensor shall be supplied for each laboratory. The LRC shall monitor the DP sensor. If the laboratory does not maintain a negative pressure adjacent to the corridor averaged over 15 minutes, the Flow Tracking Differential shall be increased by 100 cfm. If the DP sensor still doesn't read a negative pressure in the laboratory 15 minutes after the adjustment an alarm shall be sent to the head end.

F. Room Temperature Control:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. The LRC measures the temperature in the room by the room temperature sensor and maintains the room temperature at set point by modulating the supply airflow and heating valve using a PID closed loop algorithm.
2. Room supply air is controlled to room set point. The LRC temperature control loop calculates a supply airflow required for cooling Temperature Control Volume. If the Room Supply Air is at its minimum limit and the room requires increased cooling beyond the amount of Room Supply Air CFM necessary to maintain the required Flow Tracking Differential, the LRC increases Room Supply Air CFM as well as the room general exhaust CFM to maintain the room temperature set point and the Flow Tracking Differential.

G. Set points

1. Occupied Mode:
 - a. Cooling: 75° F (Adj)
 - b. Heating: 70° F (Adj)
2. Unoccupied:
 - a. Cooling: 85° F (Adj)
 - b. Heating: 55° F (Adj)

3.11 TERMINAL UNIT WITH REHEAT COIL (NON-LAB SPACES ON LAB SUPPLY AIR SYSTEMS)

- A. DESCRIPTION: Cooling & heating with modulating hot water heating coil, ceiling mounted, primary air control, variable air volume terminal unit. The unit contains a characterized damper, a pitot type velocity measuring device with transducer, and a hot water heating coil. The velocity of air, as sensed by the velocity sensor/transducer combination using a calculation with a known diameter provides flow (CFM) information to the BAS. The temperature of the space, as sensed by the space temperature sensor, allows the controller to determine the required CFM for cooling, and whether to open or close the hot water control valve.

B. Set points

1. Occupied Mode:
 - a. Air Valve Minimum Air Flow: As scheduled. Refer to Terminal unit schedule on drawings.
 - b. Cooling: 75° F
 - c. Heating: 70° F
2. Unoccupied:
 - a. Air Valve Minimum Air Flow: 0 cfm.
 - b. Cooling: 85° F
 - c. Heating: 55° F

C. Cooling:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. On a rise in space temperature, as sensed by the space temperature sensor, above the cooling set point, the BAS shall modulate the terminal unit air valve open in response to the increase in space temperature until the maximum cooling indicated CFM is reached.
2. On a fall in space temperature, as sensed by the space temperature sensor, the reverse shall occur until the minimum cooling indicated CFM is reached.

D. Heating:

1. On a fall in space temperature, as sensed by the space temperature sensor, the BAS shall modulate open the hot water control valve and adjust the air valve to maintain the minimum air valve airflow indicated on the schedule or minimum box heating setpoint by the terminal unit manufacturer, whichever is greater. On a further fall in setpoint, the air valve shall be modulated open until it reaches the heating airflow scheduled on the drawings.
2. On a rise in space temperature, as sensed by the space temperature sensor, the reverse shall occur.

E. Exhaust:

1. The exhaust air terminal unit shall track the supply air unit supply air volume minus the offset indicated on the air balance drawings.

F. Monitoring points: The following information shall be sent to the BAS by the unitary controller and subsequently displayed on the head end graphics.

1. Air valve position feedback.
2. Measured/calculated primary air flow and exhaust air flow.

G. Deadband: A five-degree (5°F) deadband shall be maintained between heating and cooling set points at all times. This shall not be an adjustable value on the head end graphics.

3.12 TERMINAL UNIT WITH REHEAT COIL (LAB SPACES)

A. DESCRIPTION: Cooling & heating with modulating hot water heating coil, ceiling mounted, primary air control, variable air volume terminal unit. The unit contains a characterized damper, a pitot type velocity measuring device with transducer, and a hot water heating coil. The velocity of air, as sensed by the velocity sensor/transducer combination using a calculation with a known diameter provides flow (CFM) information to the BAS. The temperature of the space, as sensed by the space temperature sensor, allows the controller to determine the required CFM for cooling, and whether to open or close the hot water control valve. The unit shall operate in accordance with the Typical Laboratory Room Control specification above.

B. Set points

1. Occupied Mode:
 - a. Air Valve Minimum Air Flow: As scheduled. Refer to Terminal unit schedule on drawings.
 - b. Cooling: 75° F

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- c. Heating: 70° F
 - 2. Unoccupied:
 - a. Air Valve Minimum Air Flow: As scheduled. Refer to Terminal unit schedule on drawings.
 - b. Cooling: 85° F
 - c. Heating: 55° F
 - C. Cooling:
 - 1. Refer to Typical Laboratory Room Control specification above.
 - D. Heating:
 - 1. Refer to Typical Laboratory Room Control specification above.
 - E. Monitoring points: The following information shall be sent to the BAS by the unitary controller and subsequently displayed on the head end graphics.
 - 1. Air valve position feedback.
 - 2. Measured/calculated primary air flow.
- 3.13 BLOWER COIL UNIT / FAN COIL UNIT
- A. General: These units are provided to control conditions in mechanical rooms, stairways and similar spaces and consist of a fan, cooling coil and re-heating coil.
 - B. Initial Set Points:
 - 1. Space Temperature
 - a. Occupied:
 - 1) Cooling: 75°F.
 - 2) Heating: 70°F.
 - b. Unoccupied:
 - 1) Cooling: 85°F.
 - 2) Heating: 55°F.
 - C. Startup: Start time shall be based on the BAS optimum start programming in accordance with a predetermined schedule to be furnished by the Owner and programmed into the BAS.
 - D. Space Temperature Control:
 - 1. Cooling: On a rise in space temperature above set point (as sensed by the space temperature sensor), the BAS shall start the fan and modulate the cooling coil control valve open. On a fall to set point, the valve shall close and the fan shall stop.
 - 2. Heating: On a fall in space temperature below set point (as sensed by the space temperature sensor), the BAS shall start the fan and modulate the heating coil control valve open. On a rise to set point, the valve shall close and the fan shall stop.
 - E. Space Humidity Control:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. On a rise in the space humidity above set point, 55% RH (adj), (as sensed by the space humidity sensor), the BAS shall start the fan and modulate the cooling coil valve open 100%. The re-heat coil control valve shall be modulated to maintain space temperature. The unit shall be in dehumidification mode until the space humidity falls 5% below set point.
- F. The BAS shall monitor the drain pan float water level detection device in each fan coil units' condensate drain pan. If the drain pan is not draining properly and raises to activate the water level detection device, cooling shall be disabled and an alarm issued to the head end.
- G. Fan Failure Alarm: Should the supply fan fail (as sensed by its current sensing relay), an alarm shall be sent to the head end identifying the unit and stating that the supply fan has failed or air flow has ceased. The unit shall be disabled.

3.14 HOT WATER UNIT HEATER

- A. General: These units are provided to control conditions in mechanical rooms and consist of a fan and heating coil. Units are equipped with an integral thermostat to enable/disable the fan.
- B. Initial Set Points:
 1. Space Temperature
 - a. Occupied:
 - 1) Cooling: N/A
 - 2) Heating: 55°F.
 - b. Unoccupied:
 - 1) Cooling: N/A.
 - 2) Heating: 55°F.
- C. Space Temperature Control:
 1. Heating: On a fall in space temperature below set point (as sensed by the unit mounted thermostat), the integral thermostat shall start the fan. On a rise to set point, the fan shall stop.

3.15 CIRCUIT POWER MONITORING

- A. Switchboard Monitoring: The BAS shall monitor main distribution panel KW, KWH and phase continuously as indicated. A communication interface, coordinated with Division 26 shall be used. Refer to drawing E-5 series for switchboard drawings and schedules and section 262713 for additional requirements.
- B. Phase: The BAS shall monitor for phase failure continuously. On a loss of phase the BAS shall turn off all three-phase equipment.
- C. Branch Circuit Monitoring: The BAS shall monitor branch circuit KW and KWH continuously. A communication interface, coordinated with Division 26 shall be used. Refer to drawing E-5.1 for switchboard drawings and schedules for additional requirements. BAS records shall be archived as indicated.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- D. Branch Circuit Control Points: The BAS shall record power used for lighting loads, plug loads, and mechanical equipment loads individually.
1. Lighting loads: The BAS shall monitor loads through metering points indicated and totalized all lighting meters.
 2. Plug loads: The BAS shall monitor plug loads through metering points indicated and totalized all plug load meters.
 3. Mechanical equipment loads: The BAS shall monitor loads through metering points indicated and totalized all mechanical equipment meters.
- E. Records: For each of the three load types, records shall be maintained for each function as follows:
1. Daily:
 - a. The following records shall be maintained for lighting loads, plug loads, and mechanical equipment loads:
 - 1) At 12:00 AM, the BAS shall record the KW demand every 10 minutes. Records shall be maintained for the previous 30 days.
 - 2) At 12:00 AM, the BAS shall record the KWH used in the previous 24 hours. This record shall be kept for two years.
 - 3) At 12:00 AM, the BAS shall record the highest KW demand for the previous 24 hours. This record shall include the date and time. This record shall be kept for two years.
 2. Weekly:
 - a. The following records shall be maintained for lighting loads, plug loads, and mechanical equipment loads:
 - 1) On the 1st day of the week at 12:01 AM, the BAS shall record the KWH used that week. This record shall be kept for the life of the building.
 - 2) On the 1st day of the week at 12:01 AM, the BAS shall record the highest KW demand for the previous week. The record shall include the date and time. This record shall be kept for the life of the building.
 3. Monthly:
 - a. The following records shall be maintained for lighting loads, plug loads, and mechanical equipment loads:
 - 1) On the 1st of the month at 12:01 AM, the BAS shall record the KWH used that month. This record shall be kept for the life of the building.
 - 2) On the 1st of the month at 12:01 AM, the BAS shall record the highest KW demand for the previous month. The record shall include the date and time. This record shall be kept for the life of the building.
 4. Annually:
 - a. The following records shall be maintained for lighting loads, plug loads, and mechanical equipment loads:
 - 1) On January 1st of each year at 12:01 AM, the BAS shall record the highest KW demand for the previous year. The record shall include the date and time. This record shall be kept for the life of the building.
 - 2) On January 1st of each year at 12:01 AM, the BAS shall record the total KWH used during the previous year. This record shall be kept for the life of the building.

3.16 FLUID FLOW MONITORING

- A. Natural Gas Monitoring: The BAS shall monitor natural gas flow in standard units continuously. A communication interface on the gas meter shall be used. The BAS shall communicate with this device and be capable of receiving and sending data to be viewed at the head end graphics. The communication interface shall be native language, Modbus, LON, BACnet MSTP, or BACnet IP as available by the meter manufacturer. BAS records shall be archived as indicated.
- B. Domestic Water Use Monitoring: The BAS shall monitor domestic water flow in GPH continuously. A communication interface, coordinated with Div 22 provided meter shall be used. The BAS shall communicate with this device and be capable of receiving and sending data to be viewed at the head end graphics. The communication interface shall be native language, Modbus, LON, BACnet MSTP, or BACnet IP as available by the meter manufacturer. BAS records shall be archived as indicated.
- C. Chilled Water Use Monitoring: The BAS shall monitor chilled water flow in GPM continuously and building supply and return chilled water temperatures in °F to calculate BTU/HR and of chilled water continuously. BAS records shall be archived as indicated.
- D. Records: For the natural gas, chilled water and domestic water flow, records shall be maintained for each function as follows:
 - 1. Daily:
 - 1) At 12:00 AM, the BAS shall record the KBTUs or Gallons used in the previous 24 hours. This record shall be kept for two years.
 - 2. Weekly:
 - 1) On the 1st day of the week at 12:01 AM, the BAS shall record the KBTU's or Gallons used that week. This record shall be kept for the life of the building.
 - 3. Monthly:
 - 1) On the 1st of the month at 12:01 AM, the BAS shall record the KBTU's or Gallons used that month. This record shall be kept for the life of the building.
 - 4. Annually:
 - 1) On January 1st of each year at 12:01 AM, the BAS shall record the total KBTU's or Gallons used during the previous year. This record shall be kept for the life of the building.

3.17 DOMESTIC CIRCULATING PUMPS

- A. Initial set points:
 - 1. Occupied hours: Pump on.
 - 2. Unoccupied hours: Pump off.
- B. During occupied and unoccupied hours the BAS shall command the pump to set point. A separate schedule should be adjustable at the head end graphics to vary circulating pump operation hours.

3.18 DOMESTIC HOT WATER TEMPERATURE

- A. Description: The domestic hot temperature shall be monitored downstream of the thermostatic mixing valve. If the temperature rises above the high limit set point an alarm should be indicated on the head end graphics
- B. Initial set points:
 - 1. Alarm: 140° F

3.19 ELEVATOR SUMP PUMP MONITORING

- A. The BAS shall monitor the elevator sump pump package control panel for alarm status. If the elevator sump pump package control reports an alarm, the BAS shall forward an alarm to the head end stating that the elevator sump pump control panel has reported an alarm.

3.20 FIRE ALARM MONITORING

- A. The BAS shall monitor a set of dry contacts on the fire alarm system. When the fire alarm system issues an alarm, it shall be forwarded to the BAS head end. Provide a graphic with the alarm status on the head end graphics.

3.21 EMERGENCY GENERATOR MONITORING

- A. The BAS shall monitor a set of dry contacts on the emergency generator. When the generator system issues an alarm, it shall be forwarded to the BAS head end. Provide a graphic with the alarm status on the head end graphics.

END OF SECTION 230993

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

- A. Pre-submittal meeting: The contractor performing work under this section of the specifications shall attend a meeting for the purpose of coordinating with the control system. The meeting shall be held on the project site in the contractor's trailer or other location acceptable to the contractor. The contractor shall be responsible for arranging the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.
- B. Product Data: For each type of the following:
 - 1. Pressure-seal fittings.
 - 2. Valves-Include flow and pressure drop curves/information based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow control valves.
 - 3. Air control devices.
 - 4. Chemical treatment.
 - 5. Hydronic specialties.
- C. Maintenance Data: For hydronic specialties, balancing valves, automatic flow control valves, and special-duty valves to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1.4 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Penetration Firestopping Systems" for fire and smoke wall and floor assemblies.

1.5 BUILDING AUTOMATION SYSTEM COORDINATION:

- A. If indicated, all wells, valves, taps, dampers, flow stations, etc. furnished under Section "Building Automation System" shall be installed under this Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping, components, and installation shall withstand the following minimum working pressure and temperature unless otherwise indicated: 150 psig at 200 degrees F.

2.2 PIPING MATERIALS

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. DWV Copper Tubing: ASTM B 306, Type DWV.
- C. Wrought-Copper Fittings: ASME B16.22.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- D. Wrought-Copper Unions: ASME B16.22.

2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
1. Material Group: 1.1.
 2. End Connections: Butt welding.
 3. Facings: Raised face.
- H. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.
- I. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F and pressures up to 150 psig.
- J. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.5 POLYPROPYLENE (PP-R) PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
1. Aquatherm
- B. Polypropylene Pipe: Pipe shall be manufactured from PP-R resin (Fusiolon or similar) meeting the short-term properties and long-term strength requirements of ASTM F 2389. Pipe shall

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

contain no rework or recycled materials except that generated in the manufacturer's plant from resin of the same specification from the same raw material. All pipe shall be made in an extrusion process. Hot water pipe shall contain a fiber layer (Faser or similar) to restrict thermal expansion. All pipe shall comply with rated pressure requirements of ASTM F 2389. All pipe shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.

- C. Polypropylene Fittings: Fittings shall be manufactured from a PP-R resin (Fusiolen or similar) meeting the short-term properties and long-term strength requirements of ASTM F 2389. Fittings shall contain no rework or recycled materials except that generated in the manufacturer's plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.
- D. Underground Piping: Shall comply with ASTM D2774

2.6 PLASTIC PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, with wall thickness as indicated in "Piping Applications" Article.
 - 1. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.
- B. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.
 - 1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.7 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for CPVC Piping: ASTM F 493.
- H. Solvent Cements for PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.8 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
 - 1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.
- B. Plastic-to-Metal Transition Unions:
 - 1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.9 VALVES

- A. Valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- C. Calibrated Balancing Valves:
 - 1. Available Manufacturers:
 - a. NIBCO
 - b. Armstrong Pumps, Inc.
 - c. Flow Design, Inc.
 - d. Griswold Controls.
 - e. ITT Bell & Gossett; ITT Fluid Technology Corp.
 - f. NuTech Hydronic Specialty Products
 - g. Taco, Inc.
 - 2. NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
 - 3. NPS 2-1/2 and Larger: Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
- D. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

E. Pressure Relief Valves and Temperature & Pressure Relief Valves:

1. Available Manufacturers
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Conbraco Industries, Inc.
 - d. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
 - e. Kunkle Valve Division.
 - f. NuTech Hydronic Specialty Products
 - g. Spence Engineering Company, Inc. Pressure-Reducing Valves:
 - h. Watts Industries, Inc.; Watts Regulators.
2. Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

2.10 AIR CONTROL DEVICES

A. Available Manufacturers:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. NuTech Hydronic Specialty Products
5. Taco.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2
5. Discharge Connection: NPS 1/8
6. CWP Rating: 150 psig
7. Maximum Operating Temperature: 225 deg F

- C. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.

2.11 HYDRONIC PIPING SPECIALTIES

A. Compression/Expansion Tanks:

1. Available Manufacturers:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. ITT Bell & Gossett; ITT Fluid Technology Corp.
 - d. Taco, Inc.
2. Welded carbon steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible diaphragm securely sealed into tank. Include drain

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

fitting and tap for air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

3. Charge: Charge tank without applying system pressure to a pressure equal to that indicated for the domestic cold water makeup pressure reducing valve.

B. Air Dirt Separators:

1. Available Manufacturers
 - a. Spirovent Dirt.
 - b. Taco series 4900-AD.
 - c. Caleffi DISCALDIRT series.
 - d. Minikin EMFLEX
2. Tank: Fabricated steel tank; ASME constructed and stamped for 125-psig (862-kPa) working pressure and 270 deg F (130 deg C) maximum operating temperature.
3. Air Vent: Threaded to the top of the separator.
4. Blowdown Connection: Threaded to the bottom of the separator.
5. Size: Match system flow capacity.

C. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.

D. Basket Strainers: 125-psig working pressure; high-tensile cast-iron body (ASTM A 126, Class B), flanged-end connections, bolted cover, perforated stainless-steel basket, and bottom drain connection.

E. T-Pattern Strainers: 750-psig working pressure; ductile-iron or malleable-iron body, grooved-end connections, stainless-steel basket with 57 percent free area; removable access coupling and end cap for strainer maintenance.

F. Flexible Connectors:

1. Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.
2. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F and pressures up to 150 psig.
3. Combinations of grooved mechanical-joint couplings and short nipples when installed per instructions from Victaulic Company of America.

G. Pressure temperature test (P/T) port

1. Manufacturers:
 - a. NuTech Hydronic Specialty Products
 - b. Petersen
 - c. Sisco Manufacturing Co.
 - d. Omega
 - e. Watts Water Technologies, Inc.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Body: Brass.
3. Core: Nordel
4. Cap: Brass
5. Provide extension to allow insulation installation.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Heating Hot Water, Chilled Water, Glycol Energy Recovery, and Condenser Water 2" and Smaller:
 1. Aboveground shall be either:
 - a. Type L drawn-temper copper tubing with wrought-copper fittings and soldered joints.
 - b. Schedule 40 steel pipe; Class 125 cast iron or Class 150 malleable iron fittings; cast iron flanges and flange fittings; and threaded joints.
 - c. Polypropylene pipe and fittings and heat fused joints.
 2. Belowground and below slabs:
 - a. Type K annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
 - b. Polypropylene pipe and fittings and heat fused joints.
- B. Heating Hot Water, Chilled Water, Glycol Energy Recovery, and Condenser Water 2-1/2" and Larger:
 1. Inside building and aboveground:
 - a. Schedule 40 steel pipe, wrought steel fittings and wrought cast or forged steel flanges and flange fittings, and welded and flanged joints.
 - b. Type L drawn-temper copper tubing, wrought copper fittings, and soldered joints or mechanical-joint couplings.
 - c. Polypropylene pipe and fittings and heat-fused joints.
 2. Belowground and below slabs:
 - a. Type K annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use fewest joints possible.
 - b. Schedule 80 CPVC plastic pipe and fittings and solvent-welded joints.
- C. Chilled Water, and Condenser Water 2-1/2" and Larger Outside Building: As specified for Inside Building,
- D. Make-up Water 2" and Smaller: Type L drawn-temper copper tubing with wrought-copper fittings, and soldered joints.
- E. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC or CPVC plastic pipe and fittings with solvent-welded joints.
 1. Exceptions where PVC, CPVC, and other forms of plastic are not permitted:
 - a. Jails.
 - b. Prisons.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- c. Plenums.
 - d. Locations prohibited by codes or standards.
- F. Air-Vent Piping:
- 1. Inlet: Same as service where installed.
 - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- G. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.
- H. Miscellaneous: Same materials and joining methods as connecting service.

3.2 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
- 1. Shutoff Duty: Ball, and butterfly valves.
 - 2. Throttling Duty: Ball, and butterfly valves.
- B. Install shutoff duty valves at each branch connection to supply mains, unless only one piece of equipment is connected in the branch lines, and at supply connections to each piece of equipment. Install manual flow control device where indicated at branch piping.
- C. Install Automatic Flow Control Valves in the return water line of each heating or cooling element, each piece of equipment, and as indicated.
- D. Install check valves at each pump discharge and elsewhere to control flow direction.
- E. Install safety valves on hot-water generators and as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping without valves. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- F. Install pressure-reducing valves on makeup water piping to regulate system pressure.

3.3 PIPING INSTALLATIONS

- A. Install all wells, valves, taps, flow stations, etc. furnished under Division 25 Section "Building Automation System".
- B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- D. Install exterior piping at a uniform grade of 0.2 percent upward in direction of flow. Interior piping may be installed level.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- E. Install condensate drain piping at a minimum uniform slope of 1" in 10'-0" in the direction of flow.
- F. Reduce pipe sizes using concentric reducers, or eccentric reducers installed with level side up.
- G. Provide branch connections with the takeoff coming off the top of the main with dog leg.
- H. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and as indicated. Install 3/4" diameter by 8" long nipple and ball valve in blowdown connection of strainers 3/4" and larger. Match size of strainer blowoff connection for strainers smaller than 3/4".
- I. Install piping in concealed locations.
 - 1. Exceptions:
 - a. Equipment rooms.
 - b. Fan rooms.
 - c. Mechanical Rooms.
 - d. Loading Docks.
 - e. Storage Rooms.
 - f. Where indicated on the contract drawings to be exposed.
- J. Install piping above accessible ceilings allowing sufficient space for removal of ceiling panels.
- K. Install piping to permit servicing of valves.
- L. Install piping free of sags.
- M. Install fittings for changes in direction and branch connections.
- N. Install piping with 6" clear all around.
- O. Select system components with pressure rating equal to or greater than system operating pressure.
- P. Install groups of pipes parallel to each other.
- Q. Install drains, consisting of a tee fitting, 3/4" by 8" long nipple, ball valve, and cap, at low points in piping system mains and elsewhere for system drainage.
- R. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- S. Install unions in piping, 2" and smaller, adjacent to valves, at final connections of equipment, and as indicated.
- T. Install flanges in piping, NPS 2-1/2" and larger, at final connections of equipment and as indicated.
- U. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- V. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- Y. Install escutcheons for exposed piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."
- Z. Provide seal around piping penetrations of full height interior walls, both rated and non-rated, that occur above ceilings. Refer to Section 079200 Joint Sealants.
- AA. Where piping penetrates a non-fire-resistance-rated floor or floor/ceiling assembly or ceiling membrane of a non-fire-resistance-rated roof/ceiling assembly, provide the following:
 - 1. For noncombustible piping that connects not more than five stories, protect the annular space around the piping with an approved, noncombustible material to resist the free passage of flame and the products of combustion or with a tested and classified through-penetration firestop system.
 - 2. For piping that connects not more than two stories, protect the annular space around the piping with an approved, noncombustible material to resist the free passage of flame and the products of combustion.
 - 3. For piping that penetrates a non-rated wall, protect the annular space around the penetrating piping with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.

3.4 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are damaged.
 - 3. Damaged Welds: Do not use pipe sections that have cracked or open welds.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.
- B. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. 3/4": Maximum span, 7'-0"; minimum rod size, 1/4".
 - 2. 1": Maximum span, 7'-0"; minimum rod size, 1/4".
 - 3. 1 1/2": Maximum span, 9'-0"; minimum rod size, 3/8".
 - 4. 2": Maximum span, 10'-0"; minimum rod size, 3/8".
 - 5. 2 1/2": Maximum span, 11'-0"; minimum rod size, 3/8".
 - 6. 3": Maximum span, 12'-0"; minimum rod size, 3/8".
 - 7. 4": Maximum span, 14'-0"; minimum rod size, 1/2".
 - 8. 6": Maximum span, 17'-0"; minimum rod size, 1/2".
 - 9. 8": Maximum span, 19'-0"; minimum rod size, 5/8".
 - 10. 10": Maximum span, 20'-0"; minimum rod size, 3/4".
 - 11. 12": Maximum span, 23'-0"; minimum rod size, 7/8".
 - 12. 14": Maximum span, 25'-0"; minimum rod size, 1".
 - 13. 16": Maximum span, 27'-0"; minimum rod size, 1".
 - 14. 18": Maximum span, 28'-0"; minimum rod size, 1 1/4".
 - 15. 20": Maximum span, 30'-0"; minimum rod size, 1 1/4".
- C. Where hangers for steel piping are to be suspended from open-web steel joists, install hangers at maximum spacing that will result in hanger loads that comply with the requirements on the structural drawings.
- D. Install hangers for copper piping with the following maximum spacing and minimum rod sizes:
 - 1. 3/4": Maximum span, 5'-0"; minimum rod size, 1/4".
 - 2. 1": Maximum span, 6'-0"; minimum rod size, 1/4".
 - 3. 1 1/2": Maximum span, 8'-0"; minimum rod size, 3/8".
 - 4. 2": Maximum span, 8'-0"; minimum rod size, 3/8".
 - 5. 2 1/2": Maximum span, 9'-0"; minimum rod size, 3/8".
 - 6. 3": Maximum span, 10'-0"; minimum rod size, 3/8".
- E. Polypropylene Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- H. Where changes in direction or tees occur, place hangers 1/3 of the maximum allowed spacing distance from the change in direction or tee (i.e. if the maximum span is 12 feet, the hanger shall be 4 feet from the change in direction or tee). Pipe shall be supported from both sides of a change in direction.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at coils, and elsewhere as required for system air venting.
- B. Install automatic air vents in mechanical equipment rooms only at high points of system for air venting.
- C. Install in-line air separators in pump suction lines. Install piping to compression tank with a 2 percent minimum upward slope toward tank.
 - 1. Install drain valve on units NPS 2 and larger.
- D. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be 3/4" or match equipment connection size or as indicated on the drawings, whichever is greater.
- B. Install control valves in accessible locations near connected equipment.
- C. Install ports for pressure and temperature gages at equipment and coil inlet and outlet connections.
- D. Provide initial water treatment.

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during testing.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush system with clean water. Clean strainers.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test.
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

3.9 ADJUSTING

- A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- B. Perform these adjustments before operating the system:
 1. Open valves to fully open position. Close coil bypass valves.
 2. Check pump for proper direction of rotation.
 3. Set automatic fill valves for required system pressure.
 4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils and equipment are calling for full flow.
 6. Check and set equipment operating temperatures to design requirements.
 7. Lubricate motors and bearings.

3.10 CLEANING

- A. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers.

END OF SECTION 232113

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

- A. Product Data:
 - 1. Provide certified performance curves, rated capacities, final impeller dimensions, and operating weights of proposed pumps. Indicate pump operating points on curves.
 - 2. Provide specialties, and accessories for each type of product indicated.
- B. Maintenance Data:
 - 1. Provide maintenance manuals for pumps.

1.3 QUALITY ASSURANCE

- A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.
- B. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on the specific types and models indicated. Pumps manufactured by listed manufacturers with equal performance characteristics may be considered. Refer to Instructions To Bidders.
- C. Regulatory Requirements: Fabricate and test steam condensate pumps to comply with HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation," and HI 1.6, "Centrifugal Pump Tests."
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Mechanical Seals: One set for each pump.

PART 2 - PRODUCTS

2.1 GENERAL PUMP REQUIREMENTS

- A. Pumps: Factory assembled and tested centrifugal.
- B. Manufacturer
- C. Motors: Meet requirements of section "MOTORS FOR HVAC EQUIPMENT"

2.2 VERTICAL BASE MOUNTED

- A. Manufacturers:
 - 1. Armstrong Pumps, Inc.
 - 2. Bell & Gossett ITT; Div. of ITT Fluid Technology Corp.
 - 3. Patterson Pump Co.
 - 4. Taco; Fabricated Products Div.
- B. Description: Vertical inline, split coupled, floor level pump. Provide seal and outside balanced seal. Pump shall be supported by pipe supported from the housekeeping pad or PK floor. Refer to detail.
- C. Casing: Cast Iron with 125 PSIG ANSI/PN16 flanges for working pressures up to 175 PSIG at 150° F
- D. Flanges: Suction and discharge connections shall be flanged and shall be the same size.
- E. Gauge connections: Drill and tap each flange for seal flush and gauge connections.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- F. Impeller: Bronze, closed, dynamically balanced. Provide two plane balancing where installed impeller diameter is less than 6 times the impeller width.
- G. Shaft: Stainless steel.
- H. Seals: Mechanical stainless steel multi-spring outside balanced with Viton secondary seal, silicon carbide stationary seat and rotating face with 316 stainless steel gland plate. Equal technology by one of the listed manufacturers will be considered.
- I. Flush line: Factory installed with manual vent.
- J. Motor: Secured to mounting frame, with adjustable alignment. Where variable speed pumping is required pump motor shall be suitable for use with variable speed drive.

2.3 AUTOMATIC CONDENSATE PUMP UNITS (NON-PLENUM RATED)

A. Manufacturers:

- 1. Aspen Pumps.
- 2. Beckett Corp.
- 3. Hartell Div.; Milton Roy Co.
- 4. Liberty Pumps
- 5. Little Giant Pump Co.
- 6. Marsh Manufacturing, Inc.
- 7. Sauermann.

- B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Provide factory- or field-installed check valve and a 72-inch- minimum, electrical power cord with plug.

2.4 AUTOMATIC CONDENSATE PUMP UNITS (PLENUM-RATED)

A. Available Manufacturers:

- 1. Hartell - Accudyne Industries – Plenum Plus Pumps
 - a. Model KL-1DG
 - b. Model A2X-1965 DV
 - c. Model A3
 - d. Model A5
- 2. Blue Diamond Pumps, Inc.
 - a. Maxi Blue
- 3. Approved equal.

- B. Description: Plenum-rated UL 2043, packaged commercial grade units with corrosion-resistant pump, aluminum tank, and automatic controls. Provide factory- or field-installed check valve. Provide dual voltage, thermally protected motor. Provide auxiliary safety switch. Provide hard-wired power connection.

2.5 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser: Angle or straight pattern, 175 PSIG pressure rating, cast iron body and end cap, pump-inlet fitting; with bronze startup strainer and bronze or stainless steel permanent strainer. Provide bronze or stainless steel straightening vanes, drain plug, and factory or field fabricated support.
- B. Silent Check Valve:
 - 1. Wafer style, class 125, 200 PSIG non-shock cold working pressure, or 250, 400 PSIG non-shock cold working pressure, iron body, spring actuated, renewable Buna-N bonded to bronze seat, bronze disk, stainless steel spring, and stainless steel set screw.
 - 2. Twin disc wafer style, class 125, 200 psi non-shock cold working pressure, iron body, spring actuated, Buna-N seat, bronze disk, stainless steel spring, stainless steel hinge and stop pins, stainless steel thrust bearing, and steel hinge pin and stop pin retainers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation.
 - 1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
 - 2. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Install pumps according to manufacturer's written instructions.
- B. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.
- C. Support pumps and piping separately so piping is not supported by pumps. Inline pumps may be supported by piping only when in accordance with manufacturer's installation instructions.
- D. Suspend in-line pumps using continuous-thread hanger rod and vibration-isolation hangers. Install seismic bracing as required by authorities having jurisdiction.
- E. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

3.3 CONNECTIONS

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping to allow service and maintenance.
- C. Install electrical connections for power, controls, and devices.
- D. Electrical power and control wiring and connections are specified in Division 26 Sections.
- E. Ground equipment.
 - 1. 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.

3.4 COMMISSIONING

- A. Verify that pumps are installed and connected according to the Contract Documents.
- B. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.
- C. Perform the following preventive maintenance operations and checks before starting:
 - 1. Lubricate bearings.
 - 2. Remove grease lubricated bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
 - 3. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.
 - 4. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag.
 - 5. Check piping connections for tightness and leaks. Do not operate pumps with loose or leaking piping connections.
 - 6. Clean strainers.
 - 7. Verify that pump controls are in compliance with contract documents.
- D. Starting procedure shall be as recommended by manufacturer. If manufacturer chooses not to provide recommendations the starting procedure shall be as follows:
 - 1. Ensure shafts have been aligned where applicable.
 - 2. Prime pumps by opening suction valves and closing drains.
 - 3. Open cooling water supply valves in cooling water supply to bearings, where applicable.
 - 4. Open sealing liquid-supply valves if pumps are so fitted.
 - 5. Open warm-up valves of pumps handling hot liquids if pumps are not normally kept at operating temperature.
 - 6. Open suction valves.
 - 7. Start motors.
 - 8. Open discharge valves slowly.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

9. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Let packing "run in" before reducing leakage through stuffing boxes; then tighten glands.
 10. Check general mechanical operation of pumps and motors.
 11. Close circulating line valves once there is sufficient flow through pumps to prevent overheating.
- E. Refer to Division 23 Section "TESTING, ADJUSTING, AND BALANCING FOR HVAC" to obtain detailed requirements for testing, adjusting, and balancing of hydronic systems.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:
1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
 2. Review data in maintenance manuals.
 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 232123

SECTION 232350 - REFRIGERANT DETECTION AND ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes refrigerant monitors, notification appliances, and SCBA.

1.3 DEFINITIONS

- A. CMOS: Complementary metal-oxide semiconductor.
- B. LCD: Liquid-crystal display.
- C. LED: Light-emitting diode.
- D. NDIR: Non-dispersive infrared.
- E. SCBA: Self-contained breathing apparatus.

1.4 SUBMITTALS

- A. Product Data:
 - 1. For each type of refrigerant monitor, include refrigerant sensing range in ppm, temperature and humidity range, alarm outputs, display range, furnished specialties, installation requirements, and electric power requirement.
 - 2. For SCBA, include mounting details, service requirements, and compliance with authorized Federal agency.
- B. Shop Drawings:
 - 1. Air-Sampling Tubing: Size, routing, and termination including elevation above finished floor.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Include chiller room layout showing location of monitoring devices and air-sampling tubing with filter/inlet locations in relation to refrigerant equipment.
- D. Product Certificates: For monitoring devices and SCBA, signed by product manufacturer.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For refrigerant monitoring equipment and SCBA to include in emergency, operation, and maintenance manuals.

1.5 COORDINATION

- A. Coordinate refrigerant detection and alarm system with refrigerant contained in refrigeration equipment for compatibility.

PART 2 - PRODUCTS

2.1 PIR REFRIGERANT MONITOR

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Chillgard Refrigerant Monitors; MSA; Instrument Division.
 - 2. Haloguard Monitors; Thermal Gas Systems, Inc.
- B. Description: Sensor shall be factory tested, calibrated, and certified to continuously measure and display the specific gas concentration and shall be capable of indicating, alarming, and automatically activating ventilation system.
- C. ASHRAE: Monitoring system shall comply with ASHRAE 15.
- D. Performance:
 - 1. Refrigerant to Be Monitored: R-134a.
 - 2. Range: 0 to 1000 ppm.
 - 3. Sensitivity:
 - a. Minimum Detectability: 1 ppm.
 - b. Accuracy: 0 to 50 ppm; plus or minus 1 ppm. 51 to 1000 ppm; plus or minus 10 percent of reading.
 - c. Repeatability: Plus or minus 1 percent of full scale.
 - d. Response: Maximum 10 seconds per sample.
 - e. Detection Level Set Points:
 - 1) Detection Level 1: 50 ppm.
 - 2) Detection Level 2: 250 ppm.
 - 4. Operating Temperature: 32 to 104 deg F.
 - 5. Relative Humidity: 20 to 95 percent, non-condensing over the operating temperature range. Compensate sensor for relative humidity.
- E. Input/Output Features:
 - 1. Maximum Power Input: 120-V ac, 60 Hz, 75 W.
 - 2. Number of Air-Sampling Points: Four.
 - 3. Air-Sampling Point Inlet Filter: 0.10-micron filter element for each sampling point.
 - 4. Air-Sampling Point Analog Output: 0- to 10-V dc into 2k ohms, or 4- to 20-mA into 1k ohms matched to sensor output.
 - 5. Alarm Relays: Minimum 3 relays at a minimum of 5-A resistive load each.
 - 6. Alarm Set Points: Displayed and adjustable through keypad on front of meter.
 - 7. Alarm Silence Switch: Mount in the front panel of the monitor to stop audible and visual notification appliances, but alarm LED remains illuminated.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

8. Alarm Manual Reset: Momentary-contact push button in the front panel of the monitor stops audible and visual notification appliances, extinguishes alarm LED, and returns monitor to detection mode at current detection levels.
9. Display: Alphanumeric LCD, LED indicating lights for each detection level; acknowledge switch and test switch mounted on front panel; alarm status LEDs and service fault/trouble LEDs.
10. Audible Output: Minimum 75 dB at 10 feet.
11. Visible Output: Strobe light.
12. Sensor Analog Output: 0- to 10-V dc into 2k ohms, or 4- to 20-mA into 1k ohms.
13. Serial Output: RS-232 or RS-485 compatible with HVAC controls.
14. Enclosure: NEMA 250, Type 1, with locking quarter-turn latch and key.

2.2 MONITOR ALARM SEQUENCE

- A. Detection Level 1: Pass alarm to BAS head end of detection in the refrigeration equipment room on a rise or fall of refrigerant concentration to this level. Run refrigerant exhaust fan at high speed on a rise in concentration to this level, and change fan to low speed on a reduction in concentration below this level. Operate the ventilation fan for a minimum of five minutes. Cycle amber strobe lights.
- B. Detection Level 2: Pass alarm to BAS head end of the detection in the refrigeration equipment room on a rise or fall of refrigerant concentration to this level. Sound alarm horns and cycle red strobe lights inside and outside refrigeration equipment room. Terminate operation of any combustion process equipment (boilers) located in the refrigeration room. Provide manual reset for this detection level.
- C. Sensor Fault/Trouble: Pass general alarms for fault/trouble to BAS head end.

2.3 NOTIFICATION APPLIANCES

- A. Horns: Comply with UL 464; electric-vibrating-polarized type, listed by a qualified testing agency with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.
- B. Visible Alarm Devices: Comply with UL 1971; three color xenon strobe lights, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The words "REFRIGERANT DETECTION" printed in minimum 1/2-inch- high letters on the lens. Rated light output is 75 candela.

2.4 AIR-SAMPLING TUBING

- A. Polyethylene Tubing: ASTM D 2737, flame-retardant, nonmetallic tubing rated for ambient temperature range of 10 to 150 deg F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASHRAE Standard 15.
- B. Install air-sampling inlets, or diffusion type monitors in pits, tunnels, or trenches in machinery room that are accessible to personnel.
- C. Floor mount diffusion-type monitor, sensor/transmitters, or air-sampling inlets on slotted channel frame 12 to 18 inches above the floor in a location near the refrigerant source or between the refrigerant source and the ventilation duct inlet.
- D. Wall mount air-sampling multiple-point monitors with top of unit 60 inches above finished floor.
- E. Run air-sampling tubing from monitor to air-sampling point, in size as required by monitor manufacturer. Install tubing with maximum unsupported length of 36 inches, for tubing exposed to view. Terminate air-sampling tubing at sampling point with filter recommended by monitor manufacturer.
- F. Install air-sampling tubing with sufficient slack and flexible connections to allow for vibration of tubing and movement of equipment.
- G. Purge air-sampling tubing with dry, oil-free compressed air before connecting to monitor.
- H. Number-code or color-code air-sampling tubing for future identification and service of air-sampling multiple-point monitors.
- I. Extend air-sampling tubing from exhaust part of multiple-point monitors to outside.
- J. Place warning signs inside and outside each door to the refrigeration equipment room. Sample wording: "AUDIBLE AND VISUAL ALARM SOUNDING INDICATES REFRIGERANT DETECTION - ENTRY REQUIRES SCBA."
- K. Audible Alarm-Indicating Devices: Install at each entry door to refrigeration equipment room, and position not less than 6 inches below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- L. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn at each entry door to refrigeration equipment room, and position at least 6 inches below the ceiling.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Tests and Inspections:
 - 1. Inspect field-assembled components, equipment installation, and electrical connections for compliance with requirements.
 - 2. Test and adjust controls and safeties.
 - 3. Test Reports: Prepare a written report to record the following:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Repair or replace malfunctioning units and retest as specified above.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain refrigerant detection devices. Refer to requirements in Division 01 Section "Closeout Procedures."

END OF SECTION 232350

SECTION 232500 – HVAC WATER TREATMENT

PART 1 - GENERAL

A. RELATED DOCUMENTS

1. Provisions of the Contract and of the Contract Documents apply to this Section.

B. SUBMITTALS

C. Product Data Including:

1. Pumps.
2. Chemical solutions.
 - a. Sequestering agent.
 - b. pH adjuster
 - c. Corrosion inhibitor
 - d. Conductivity enhancer.
 - e. Chlorine release agent or microbiocide.
 - f. Emulsifying agent
 - g. Detergent
3. Control equipment and devices.
4. Filters.
5. Separators.
6. Test equipment.
7. Chemicals.
8. Filter feeders and filter bags.
9. Ozone system.
10. Water pressure drops.
11. Flow rates.
12. Weights; shipping, installed, and operating
13. Furnished products listed below:
 - a. Control equipment and devices
 - b. Test equipment including
 - 1) Coupons with installation instructions
 - 2) Valves
 - 3) Pipe & fittings if other than specified
 - 4) Ozone system - If not used contractor shall state such, i.e. "ozone system not used".
 - 5) Permanent magnetic field generator (Basis of design) - If not used contractor shall state such, i.e. "permanent magnetic field generator not used".
 - 6) Active oscillating magnetic field generator - If not used contractor shall state such, i.e. "active oscillating magnetic field generator not used".
 - 7) Copper silver ionization system (Basis of Design) - If not used contractor shall state such, i.e. "copper silver ionization system not used".
 - 8) Sediment removal device
 - 9) Sweeper system – Sweeper system may be submitted with tower. If so

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

submitted contractor shall state such, i.e. "sweeper system submitted with tower".

10) Recovery system.

D. Shop Drawings: Detail equipment assemblies indicating:

1. Dimensions
2. Weights
3. Loads
4. Required clearances
5. Method of field assembly
6. Components
7. Location and size of each field connection
8. Piping schematics. If the basis of design system is used piping schematics are not required and contractor shall state such, i.e. "the basis of design piping schematic shall be used".
9. Wiring Diagrams: Detail power and control wiring and differentiate between manufacturer-installed and field-installed wiring.

E. Water Analysis: Submit a copy of the project site water analysis.

F. Maintenance Data to include in maintenance manuals.

G. Description of all mechanical, electrical and control components.

H. QUALITY ASSURANCE

1. 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.

I. WARRANTY

1. One (1) year on all parts, labor and components supplied.

PART 2 - PRODUCTS

2.1 CHEMICAL FEED EQUIPMENT

A. Filter Feeder:

1. Description: A chemical bypass feeder with a 50 micron filter bag. Unit shall combine chemical addition and high capacity filtering.
2. Five gallon capacity with quarter turn or coarse thread cap, 3-1/2" opening, 50 micron filter bag, air-release valve, drain valve, and shutoff valves.
3. Strainer: #316 stainless steel strainer basket with 3/16" diameter opening to support bag.
4. Volume: 5 gallons.
5. Working Pressure: 150 psig

2.2 CHEMICALS

A. Provide closed loop with:

1. Chemicals compatible with piping system, components, and connected equipment.
2. Sequestering agent to reduce deposits and adjust pH, corrosion inhibitors, and conductivity enhancers.
3. Chlorine release agents or microbiocides.

B. Provide open and closed loops with:

1. System Cleaner: Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

- #### A.
- Perform an analysis of potable make up water to determine the system parameters needed to maintain water quality.

3.2 INSTALLATION

- #### A.
- Install systems according to manufacturer's recommendations.
- #### B.
- Install and circulate the system cleaner in accordance with manufacturer's recommendations.
- #### C.
- Install other chemicals in accordance with manufacturer's recommendations.

3.3 CONNECTIONS

- #### A.
- Install piping adjacent to equipment to allow service and maintenance.
- #### B.
- Insure that pump suction piping from cooling tower basin is installed below the level of the basin to permit flooding of the pump suction.
- #### C.
- Size and route ozone system piping as recommended by ozone system manufacturer to provide proper velocity and mixing time in piping before cooling tower basin.
- #### D.
- Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.
- #### E.
- Ground equipment.
1. 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.

3.4 FIELD QUALITY CONTROL

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
 - 3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
- B. Comply with specified commissioning requirements.

3.5 ADJUSTING

- A. A manufacturer's representative shall monitor system performance for the first year of operation.
- B. A manufacturer's representative shall perform an analysis of the following water parameters every two weeks for the first year. The chemical company representative shall check in with the UNCW HVAC supervisor (or his/her representative). At the time of the visit water samples will be taken the representative will coordinate with the UNCW representative to ensure that the equipment is being properly utilized.
 - 1. pH.
 - 2. Conductivity.
 - 3. Total Bacteria Count (TBC)

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water treatment systems and equipment.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
- B. Review manufacturer's safety data sheets for handling of chemicals.
- C. Review data in maintenance manuals, especially data on recommended parts inventory and supply sources and on availability of parts and service. Refer to Division 1 Section "Contract Closeout."
- D. Schedule at least four hours of training with Owner, through Architect, with at least seven days' advance notice.
- E. Comply with final commissioning and test requirements developed by the commissioning authority.

END OF SECTION 232501

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PERFORMANCE REQUIREMENTS

- A. Seal all ducts to seal class A as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005:
 - 1. Seal all longitudinal joints.
 - 2. Seal all transverse joints.
 - 3. Seal all penetrations.
- B. Seal Class: A
- C. Test pressure:
 - 1. 3.0" WC for round and flat oval duct.
 - 2. 6.0" WC for rectangular duct.
 - 3. Un-tested: NA
- D. Testing: Leak test all ductwork operating at 3.0" WC or greater.
- E. Duct Construction: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- F. Liner Airstream Surfaces: Liner surfaces in contact with the airstream shall comply with ASHRAE 62.1-2007, paragraph 5.5.
- G. Cleanliness: All factory fabricated duct shall be cleaned with a non-toxic, biodegradable cleaner/degreaser and shall be shrink wrapped prior to shipment.

1.3 ABBREVIATIONS

- A. BAS Building Automation System
- B. NRTL Nationally Recognized Testing Laboratory
- C. SMACNA Sheet Metal and Air Conditioning Contractors' National Association
- D. WC Water Column

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1.4 DEFINITIONS:

- A. Duct System: For the purposes of this section “duct system” shall mean all metal supply, return, and exhaust duct and fittings between the air moving device and the space.
- B. Low Pressure: Plus two (2.0) inches WC to minus one (1.0) inches WC
- C. Medium Pressure: More than two (2.0) inches WC to plus ten (10.0) inches WC or more than minus one (1.0) inch to minus ten (10.0) inches WC
- D. High Pressure: More than plus or minus ten (10.0) inches WC.

1.5 SUBMITTALS

- A. Product Data / Documentation: For each of the following:
 - 1. Sheet metal thicknesses.
 - 2. Liners and adhesives.
 - 3. Pre-manufactured ductwork.
 - 4. Sealants and gaskets.
 - 5. Statement of duct seal class. Describe how it will be achieved.
 - 6. VOC content for adhesives and sealants.
- B. CAD-generated Shop Drawings:
 - 1. Show fabrication and installation details for metal ducts.
 - 2. 1/4”=1’-0” scale minimum including duct layout indicating sizes and pressure classes for the following areas:
 - a. Areas indicated on the drawings at 1/4”=1’-0” scale.
 - b. Areas where sections are cut.
 - c. Finished spaces with exposed ductwork.
 - 1) Exceptions:
 - a) Janitors closets
 - b) Storage Rooms
 - c) Receiving Areas
 - 2) Include:
 - a) Plans, elevations and sections.
 - b) Elevations of top and bottom of ducts.
 - c) Dimensions of main duct runs from building grid lines.
 - 3. 3/4”=1’-0” scale minimum for the following:
 - a. Hangers and supports, including methods for duct and building attachment, vibration isolation.
 - b. Duct accessories, including access doors and panels.
 - c. Equipment installation based on approved equipment submittals.
 - d. Penetrations through fire-rated and other partitions.
 - e. Fittings.
 - f. Components.
 - 4. 3”=1’-0” scale minimum for the following:
 - a. Seam and joint construction.
 - b. Reinforcement and spacing.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- c. Fabrication including attachments to other work.
 - d. Trapeze Hangers.
 - e. Mockups may be provided in lieu of 3"= 1'-0" details. Notify Architect in writing if mock-ups will be provided
- C. Submittals during construction:
- 1. Leakage Test Report: Documentation of work performed for compliance with ASHRAE/IESNA 90.1-2007, Section 6.4.4.2.2 - "Duct Leakage Tests."
 - 2. Duct-Cleaning Test Report: Documentation of work performed for compliance with ASHRAE 62.1-2007, Section 7.2.4 - "Ventilation System Start-Up."

1.6 QUALITY ASSURANCE

- A. Provide work in compliance with applicable Building Code requirements.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
- C. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
- D. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
- E. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- F. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- G. ASHRAE/IESNA Compliance: Comply with applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6.4.4 - "HVAC System Construction and Insulation."
- H. Mockups (Contractor's option in lieu of 3"=1'-0" details):
 - 1. Before installing duct systems, build mockups. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 2. Three transverse joints.
 - 3. One Reinforced section with 3 reinforcements.
 - 4. One of each type; attachments to other work.
 - 5. Two typical flexible duct or flexible-connector connections.
 - 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 2-1, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved,

duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 2-2, "Rectangular Duct/Longitudinal Seams" for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."

2.2 LOW PRESSURE SINGLE-WALL ROUND DUCTS AND FITTINGS –CONCEALED

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 3, "Round, Oval, and Flexible Duct," based on specified static-pressure class unless otherwise indicated.
- B. Manufacturers:
 - 1. Eastern Sheet Metal.
 - 2. Hamlin Sheet Metal.
 - 3. Linx Industries - Lindab.
 - 4. McGill AirFlow LLC.
 - 5. MKT Metal Manufacturing
 - 6. Semco, Inc.
 - 7. Sheet Metal Connectors, Inc.
 - 8. Spiral Manufacturing Co., Inc.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Round Duct Transverse Joints"
 - 1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter: Flanged.
 - 2. Gasketed, EPDM, self sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
 - 3. Flanges may be substituted in ducts smaller than 48" in diameter.
- D. Duct support intervals, and other provisions: In accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-2, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
- F. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-5, "90° Tees and

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." Adjustable elbows are not permitted.

- G. All round duct shall not be less than 26-gauge.

2.3 MEDIUM PRESSURE SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS
–CONCEALED

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Manufacturers:
1. Eastern Sheet Metal.
 2. Hamlin Sheet Metal.
 3. Linx Industries - Lindab.
 4. McGill AirFlow LLC.
 5. MKT Metal Manufacturing
 6. Semco, Inc.
 7. Sheet Metal Connectors, Inc.
 8. Spiral Manufacturing Co., Inc.
- C. Flat-Oval Ducts: Dimensions are the inside duct width (major dimension) and inside diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Round Duct Transverse Joints"
1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter: Flanged.
 2. Gasketed, EPDM, self sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
 3. Flanges may be substituted in ducts smaller than 48" in diameter.
- E. Duct support intervals, and other provisions: In accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
- G. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-5, "90° Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." Adjustable elbows are not permitted.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- H. All seam types in Figure 3-2 are acceptable where approved by SMACNA.
- I. All round duct shall not be less than 26-gauge.

2.4 MEDIUM PRESSURE SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS
-EXPOSED

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 3, "Round, Oval, and Flexible Duct," "FIGURE 3-2 ROUND DUCT LONGITUDINAL SEAMS" "SPIRAL SEAM RL-1" to plus-or-minus 10" WC unless otherwise indicated.
- B. Manufacturers:
 - 1. Eastern Sheet Metal.
 - 2. Hamlin Sheet Metal.
 - 3. Linx Industries - Lindab.
 - 4. McGill AirFlow LLC.
 - 5. MKT Metal Manufacturing
 - 6. Semco, Inc.
 - 7. Sheet Metal Connectors, Inc.
 - 8. Spiral Manufacturing Co., Inc.
- C. Flat-Oval Ducts: Dimensions are the inside duct width (major dimension) and inside diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Round Duct Transverse Joints"
- E. Static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." And the following:
 - 1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter or Flat Oval with a Major Dimension Equal to or Larger Than 48": Flanged.
 - 2. Gasketed, EPDM, self sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
 - 3. Flanges may be substituted in ducts smaller than 48" in diameter.
- F. Longitudinal Seams: Duct shall be spiral according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-2, "Round Duct Longitudinal Seams"
- G. Tees and Laterals: Tees and laterals shall be created with fittings. Fabricate fittings according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." Adjustable elbows are not permitted.
- H. Static-pressure class: Applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."
- I. Longitudinal seams shall be spiral type.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- J. All round duct shall not be less than 26-gauge.

2.5 LABORATORY EXHAUST DUCTWORK

- A. General Fabrication Requirements: Comply with SMACNA's "Rectangular Industrial Duct Construction Standards," and "Round Industrial Duct Construction Standards" based on the static-pressure class unless otherwise indicated.
- B. Laboratory hazardous exhaust air ductwork shall be made tight with lap joints having a minimum lap of 1 inch (25 mm). Joints used in ANSI/SMACNA Round Industrial Duct Construction Standards and ANSI/SMACNA Rectangular Industrial Duct Construction Standards are also acceptable.
- C. All laboratory exhaust duct within the attic space and equipment room shall be fully welded.
- D. All ductwork required to be fire wrapped shall be constructed in accordance with the listing of the wrap.
- E. Refer to Duct Schedule in section 3 for additional details.

2.6 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 316, cold rolled, annealed, sheet. Exposed surface finish shall be No. 4.
- D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.7 DUCT LINER

- A. For double wall duct: Not required. All other duct: Provide where indicated.
- B. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Manufacturers:
 - a. CertainTeed Corporation.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 2. Maximum Thermal Conductivity:
 - 1) Type I, Flexible: 0.26 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 3. For supply ductwork, provide antimicrobial, erosion-resistant coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
- C. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B. Foam shall contain or be coated with EPA-approved or EPA-registered antimicrobial additive or paint.
1. Manufacturers:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
 2. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested according to ASTM C 518.
 3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- D. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.
1. Manufacturers:
 - a. Ductmate Industries, Inc.
 2. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested according to ASTM C 518.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.
 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- E. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- F. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
- G. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.8 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723.
 - 1. Materials: Certified by a NRTL.
- B. Tape sealing systems are not permitted.
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
 - 10. Indoor applications: Sealant with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 - 12. Service: Indoor or outdoor.
 - 13. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. Indoor applications: Sealant with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.9 HANGERS AND SUPPORTS

- A. Hanger Rods: Galvanized, all-thread.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved by Architect in writing.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" unless otherwise indicated.
- C. Install ducts with fewest possible joints.
- D. Install factory-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically or horizontally, and parallel or perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Maintain clearances for equipment maintenance.
- G. Install ducts with a clearance of 1 inch, plus allowance for installation of insulation at specified thickness.
- H. Do not route ducts through transformer vaults, electrical equipment rooms, elevator equipment rooms or electrical enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Provide fire dampers where ducts pass through fire-rated interior partitions, fire-rated exterior walls, fire-rated floor assemblies, or fire-rated shaft enclosures.
- K. Protect duct interiors from moisture, construction debris, dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 PROTECTION OF WALL AND FLOOR PENETRATIONS OF NON-RATED ASSEMBLIES

- A. Where ducts penetrate non-fire-resistance-rated wall or floor assemblies, protect the penetration with one of the following:
 - 1. For a duct that connects not more than two stories vertically, protect the annular space around the penetrating duct with an approved, noncombustible material that resists the free passage of flame and the products of combustion.
 - 2. For a duct that connects not more than three stories, protect the annular space around the penetrating duct with an approved, noncombustible material that resists the free passage of flame and the products of combustion and a fire damper at each floor line.
 - 3. For ducts that penetrate a smoke partition without a smoke damper, protect the annular space around the penetrating duct with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.
 - 4. For ducts that penetrate a non-rated wall, protect the annular space around the penetrating duct with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.

3.3 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding. Do not weld or grind lined ductwork.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of duct, fittings, hangers, supports, accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 DUCT SEALING

- A. Seal all ducts to seal class A as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005:
 - 1. Seal all longitudinal joints.
 - 2. Seal all transverse joints.
 - 3. Seal all penetrations.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 5, "Hangers and Supports."

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Building Attachments: Unless indicated otherwise, provide concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Do not use powder-actuated concrete fasteners for lightweight-aggregate concrete or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and channel supports.
- E. Support vertical ducts with channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor or at a maximum intervals of 18 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- G. Hanger Spacing for Laboratory Exhaust Ductwork: Maximum hanger spacing in horizontal and vertical shall be 10 feet.
- H. Maximum hanger spacing for ductwork indicated to have fire wrap shall have hanger spacing in accordance with it's listing. Refer to section 230713.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" for branch, outlet, inlet, and terminal unit connections unless otherwise indicated.
- C. Laboratory hazardous exhaust air ductwork shall be made tight with lap joints having a minimum lap of 1 inch (25 mm). Joints used in ANSI/SMACNA Round Industrial Duct Construction Standards and ANSI/SMACNA Rectangular Industrial Duct Construction Standards are also acceptable.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply two coats of flat black, latex paint over a compatible galvanized-steel primer.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Visually inspect, for proper seal application, all ductwork not tested prior to insulation application. Prepare inspection report.
- C. Leakage Test. Test ducts with operational pressures greater than 3" WC.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Prepare a report for each test.
2. Test ducts, disassemble, reassemble, reseal, and retest until leakage class 3 (as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005) is achieved.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested.
6. Give seven days' advance notice to Architect and Owner for testing.

D. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present. If visible contaminants are present, proceed to sub-paragraph 2 below. If not, no further cleaning shall be required.
2. Test sections of metal duct systems, up to one location per ten thousand (10,000) square feet of building area, or a minimum of two (2) per system, whichever is greater, chosen by the Owner's Representative, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems." Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm. Cut hole in duct and install access door at each location selected. Size shall be as indicated in Division 23 Section "Air Duct Accessories."
3. Duct system shall be considered dirty and in need of cleaning if any test location does not pass the cleanliness test. Cleaning shall be performed in accordance with this specification.

E. Prepare and submit test and inspection reports.

3.9 DUCT CLEANING

- A. Clean new duct systems before testing, adjusting, and balancing.
- B. Comply with SMACNA "Duct Cleanliness for New Construction Guidelines" dated 2000, for protection, cleaning, and installation methods for all ductwork. Adhere to the requirements for a duct cleanliness level of "C" (advanced level) as detailed in Section 3.1.
- C. For cleaning of existing ductwork, refer to Section 230130.52 "Existing HVAC Air Distribution System Cleaning."

3.10 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Minimum Duct Thickness: All Laboratory hazardous exhaust duct with fire barrier duct wrap shall meet the minimum duct thickness as specified to meet the UL listing requirements.

- C. Laboratory Exhaust Minimum Duct Thickness:

Diameter of Duct or Maximum Side Dimension	Nonabrasive Materials
0-8 inches	No. 24 gage
9-18 inches	No. 22 gage
19-30 inches	No. 20 gage
Over 30 inches	No. 18 gage

- D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 4-2, "Rectangular Elbows."
 - a. Velocity less than 1500 fpm or lower:
 - 1) Radius Type RE 1. Centerline radius = $3W/2$.
 - 2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 3) Transfer ducts indicated with mitered elbows do not require turning vanes.
 - b. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 3. Centerline radius = $3w/2$ and three vanes.
 - 2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," 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, Third Edition 2005," Figure 3-4, "Round Duct Elbows."
 - a. Minimum centerline radius-to-diameter ratio shall be 1.5 with a maximum of 5 Elbow Segments. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Table 3-1, "Mitered Elbows." Elbows with less than a 90 degree change of direction shall have segments per Table 3-1 in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005".
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped, segmented, spiral or pleated. Adjustable elbows not acceptable.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam, segmented, or spiral.
3. Flat Oval Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-7, "Flat Oval Ducts" for elbows.

- E. Branch Configuration:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 4-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Conical or bellmouth. No flanged or spin-in fittings permitted.
 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-6, "Conical Tees."
 - a. Conical fitting.
 - b. Conical saddle taps.
 - c. No 90 degree taps or 90 degree saddle taps permitted.
- F. Divided Flow Branches:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 4-5 Divided Flow Branches."

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Radius forming braces
 - 2. Volume dampers.
 - 3. Fire dampers.
 - 4. Flange connectors.
 - 5. Duct silencers. Include pressure drop and dynamic insertion loss data. Include breakout noise calculation for high transmission loss casings.
 - 6. Turning vanes.
 - 7. Remote damper operators.
 - 8. Duct-mounting access doors.
 - 9. Duct access panel assemblies.
 - 10. Flexible connectors.
 - 11. Flexible ducts.
 - 12. Duct security bars.
 - 13. Rooftop duct supports.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.
- C. Comply with SMACNA standards for manual airflow regulators (dampers).

1.4 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed. Minimum 1 of each type used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable duct installation methods unless otherwise indicated.
- C. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: [**G60**] [**G90**].
 - 2. Exposed-Surface Finish: Mill phosphatized.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a NO 2 finish for concealed ducts and NO 4 finish for exposed ducts.
- E. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- F. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches; compatible materials for aluminum and stainless-steel ducts.

2.2 RADIUS FORMING BRACES

- A. Available manufacturers:
 - 1. Titus, FlexRight (Basis of Design)
 - 2. Flexible Technologies, Inc., Thermaflex Division, FlexFlow
 - 3. Hart & Cooley, Smart Flow Elbow
- B. General: UL-2043 listed or NRTL approved product constructed of metal or plastic manufactured for use with flexible duct to form a kink free elbow using the flexible duct. Any flexible duct used in forming the elbow shall be included in the maximum permitted length. Resulting flexible duct shall comply with SMACNA HVAC Duct Construction Standards.
- C. Duct Size: 6" through 16" in diameter.
- D. Inside (Bend) Radius: Minimum of one duct diameter along centerline.
- E. Attachments: Plastic zip ties or stainless steel worm gear clamps.
- F. Support to Overhead: Shall meet SMACNA requirements. Use of specified attachments for support shall not be permitted.

2.3 MANUAL VOLUME DAMPERS

A. Steel, Manual Volume Dampers:

1. Manufacturers:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Elgen Manufacturing.
 - d. Greenheck Fan Corporation.
 - e. McGill AirFlow LLC.
 - f. Nailor Industries.
 - g. PCI Industries - Pottorff
 - h. Ruskin Company.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
 - a. Hat-shaped, 0.094-inch thick galvanized or 0.05-inch stainless-steel, match duct material.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Multiple or single blade.
 - b. Opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized or stainless-steel channels, match duct material.
6. Blade Axles: Galvanized steel or stainless steel. Dampers over 12" width/diameter shall include continuous axles. Dampers 12" and less may have non-continuous axles. Comply with SMACNA HVAC Duct Construction Standards Metal and Flexible – Third Edition Figure 7-4.
7. Bearings:
 - a. Molded synthetic. Provide bearing at both duct wall penetrations.
8. Tie Bars and Brackets: Galvanized steel.

2.4 CURTAIN TYPE FIRE DAMPERS (1½ HOUR)

A. Manufacturers:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries, Inc.
5. PCI Industries - Pottorff

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- 6. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by a NRTL.
- C. Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 4 in. WG
- D. Velocity: Dampers shall have a minimum UL 555 velocity rating of 2000 FPM.
- E. Fire Rating: 1½ hours.
- F. Frame: Curtain type with blades inside airstream unless otherwise indicated; fabricated of roll-formed galvanized steel; with mitered and interlocking corners.
- G. Sleeve: Factory-installed, galvanized sheet steel.
 - 1. Minimum Thickness: Per UL requirements.
 - 2. Minimum Length: To suit application.
- H. Mounting Orientation: Vertical or horizontal.
- I. Blades: Roll-formed, interlocking galvanized sheet steel. In place of interlocking blades, full-length galvanized-steel blade connectors may be used.
- J. Horizontal Dampers: Include stainless-steel closure spring.
- K. Fusible Link: Replaceable, 165 deg F rated.
- L. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing

2.5 CURTAIN TYPE FIRE DAMPERS (3 HOUR)

- A. Manufacturers:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries, Inc.
 - 5. PCI Industries - Pottorff
 - 6. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by a NRTL.
- C. Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 4 in. WG
- D. Velocity: Dampers shall have a minimum UL 555 velocity rating of 2000 FPM.
- E. Fire Rating: 3 hours.
- F. Frame: Type B with blades outside airstream; fabricated of roll-formed galvanized steel; with mitered and interlocking corners.
- G. Sleeve: Factory-installed, galvanized sheet steel.
 - 1. Minimum Thickness: Per UL requirements.
 - 2. Minimum Length: To suit application.
- H. Mounting Orientation: Vertical or horizontal.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- I. Blades: Roll-formed, interlocking galvanized sheet steel. In place of interlocking blades, full-length galvanized-steel blade connectors may be used.
- J. Horizontal Dampers: Include stainless-steel closure spring.
- K. Fusible Link: Replaceable, 165 deg F rated.
- L. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.

2.6 MULTI BLADE FIRE DAMPERS (1½ HOURS)

- A. Manufacturers:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries, Inc.
 - 5. PCI Industries - Pottorff
 - 6. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 4 in. WG
- D. Velocity: Dampers shall have a minimum UL 555 velocity rating of 4000 FPM.
- E. Fire Rating: 1½ hours.
- F. Frame: Multiple-blade type; fabricated of galvanized steel; with mitered and interlocking corners.
- G. Sleeve: Factory-installed, galvanized sheet steel.
 - 1. Minimum Thickness: Per UL requirements.
 - 2. Minimum Length: To suit application.
- H. Mounting Orientation: Vertical or horizontal.
- I. Blades: Blades: Damper blades shall be galvanized steel. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction. Provide symmetrical blades of varying size as required to completely fill the damper opening.
- J. Blade Stops: Locate blade stops at top and bottom of damper frame. They shall occupy no more than ½" of the damper opening area.
- K. Bearings: Axle bearings shall be sintered bronze.
- L. Horizontal Dampers: Include stainless-steel closure spring.
- M. Fusible Link: Replaceable, 165 deg F rated.
- N. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2.7 MULTI BLADE FIRE DAMPERS (3 HOURS)

- A. Manufacturers:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries, Inc.
 - 5. PCI Industries - Pottorff
 - 6. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 4 in. WG
- D. Velocity: Dampers shall have a minimum UL 555 velocity rating of 4000 FPM.
- E. Fire Rating: 3 hours.
- F. Frame: Multiple-blade type; fabricated of galvanized steel; with mitered and interlocking corners.
- G. Sleeve: Factory-installed, galvanized sheet steel.
 - 1. Minimum Thickness: Per UL requirements.
 - 2. Minimum Length: To suit application.
- H. Mounting Orientation: Vertical or horizontal.
- I. Blades: Blades: Damper blades shall be galvanized steel. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction. Provide symmetrical blades of varying size as required to completely fill the damper opening.
- J. Blade Stops: Locate blade stops at top and bottom of damper frame. They shall occupy no more than ½" of the damper opening area.
- K. Bearings: Axle bearings shall be sintered bronze.
- L. Horizontal Dampers: Include stainless-steel closure spring.
- M. Fusible Link: Replaceable, 165 deg F rated.
- N. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.

2.8 FLANGE CONNECTORS

- A. Available Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Match connecting ductwork.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- D. Gauge: 18, 20, or 24 as recommended by manufacturer or match connecting ductwork.

2.9 DUCT SILENCERS

A. Available Manufacturers:

1. Industrial Noise Control, Inc.
2. Kinetic Noise Control.
3. McGill AirFlow LLC.
4. Price
5. Ruskin Company.
6. Vibro-Acoustics.

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

- D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.034 inches thick minimum.

- E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel.

1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inches thick minimum.
2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inches thick minimum.
3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.052 inches thick minimum.
4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inches thick minimum.
5. Inner Casing and Baffles: ASTM A 653/A 653M, G90 galvanized sheet metal, 0.034 inches thick minimum, and with 1/8 inch diameter perforations.

- F. Special Construction: Provide high transmission loss to achieve STC 45.

- G. Connection Sizes: Match connecting ductwork unless otherwise indicated.

- H. Type: Film-lined with fill material.

1. Fill Material: Moisture-proof nonfibrous material.
2. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- I. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
 - 1. Flange connections.
 - 2. Suspend units using factory installed suspension hooks or lugs attached to frame spaced to prevent deflection or distortion.
 - 3. Provide cross or trapeze angle reinforcement for rigid suspension.
- J. Accessories:
 - 1. Factory-installed end caps to prevent contamination during shipping.
- K. Source Quality Control: Test according to ASTM E 477.
 - 1. Testing [of mockups] to be witnessed by [Architect] [Owner].
 - 2. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
 - 3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.
- L. Capacities and Characteristics: Refer to "Duct Silencer Schedule" on drawings

2.10 MANUFACTURED TURNING VANES

- A. Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- C. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.11 REMOTE DAMPER OPERATORS

- A. Manufacturers:
 - 1. Metropolitan Air Technology.
 - 2. PCI Industries – Pottorff.
 - 3. Ruskin Company.
 - 4. Ventfabrics, Inc.
 - 5. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Operator Mounting Location: As indicated. If not indicated;
 - 1. In airstream terminating at face of diffuser.
 - 2. Outside airstream terminating at round ceiling cup.
 - 3. If multiple diffusers are affected, then in nearest diffuser.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2.12 DUCT-MOUNTED ACCESS DOORS

- A. Available Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Flexmaster U.S.A., Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Kees
 - 5. McGill AirFlow LLC.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.13 DUCT ACCESS PANEL ASSEMBLIES

- A. Available Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Flame Gard, Inc.
 - 3. 3M.
 - 4. Selkirk Metalbestos
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon or 0.0428-inch stainless steel. Match duct material.
- D. Fasteners: Carbon or stainless steel. Match duct material. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2.14 FLEXIBLE CONNECTORS

- A. Do not use on smoke control/management fans. Install on all other fans and fan equipped units even when provided with internal isolation.
- B. Available Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Corporation.
 - 3. Ventfabrics, Inc.
 - 4. Hart & Cooley, Inc.
- C. Materials: Flame-retardant or noncombustible fabrics.
- D. Coatings and Adhesives: Comply with UL 181, Class 1.
- E. Connector: Factory fabricated with a fabric strip 3½ to 4½ inches wide attached to 2 strips of 2½ to 4½ inches wide, 23 to 25 gauge “0.0269 to .0209 inch thick” galvanized sheet steel, stainless sheet steel, or aluminum sheets. Provide metal compatible with connected ducts.
- F. Indoor System, Flexible Connector Fabric: Glass fabric double-coated with neoprene.
 - 1. Minimum Weight: 26 oz/sq yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- G. Outdoor System, Flexible Connector Fabric: Glass fabric double-coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz/sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- H. Thrust Limiters:
 - 1. Field fabricated cable restraints on equipment producing greater than 4.0” WC of positive pressure.
 - 2. Field fabricated cable restraints as detailed. If not detailed; Provide restraint consisting of a 1/16 inch diameter vinyl coated steel cable at 24” maximum on center, attached to flange bolts on each side of flexible connector. Cable length shall be such that, when in tension, ½” of movement in the flexible connection is preserved. If flanges are not used, contractor may provide steel, stainless steel, or aluminum angles for attaching cables. Match duct material. Cables shall attach to screw or fastener holding angle to duct and shall be routed through a 3/16” diameter hole in the bracket offset approximately 1” from duct.
 - 3. Direction of connector movement: Parallel with airflow, perpendicular to connector.

2.15 FLEXIBLE AIR DUCTS

- A. Manufacturers:
 - 1. Flexmaster U.S.A., Inc. (Basis of design, Provide Type 1M)
 - 2. Thermaflex
 - 3. Hart & Cooley, Inc.
- B. Provide bead on connecting duct for sizes greater than 12” in diameter.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- C. Maximum Length: 6'-0" unless noted otherwise.
- D. Insulated, Flexible Duct: UL 181, Class 1 air duct with vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch WC positive and 1.0-inch WC negative.
 - 2. Maximum Air Velocity: 5000 fpm.
 - 3. Vapor Barrier Permeance: 0.05 perm
 - 4. Temperature Range: Minus 10 to plus 160 deg F.
 - 5. Insulation R-value: 6.0
- E. Flexible Duct Connection Accessories:
 - 1. Low pressure (Not up stream of terminal units):
 - a. Clamps: Nylon strap in sizes 3 through 20", to suit duct size.
 - b. Sheet metal screws: No
 - c. Liquid adhesive: No
 - d. Tape: Yes
 - 2. Medium pressure (Up stream of terminal units):
 - a. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with worm-gear action in sizes 3 through 20 inches, to suit duct size.
 - b. Sheet metal screws: No
 - c. Liquid adhesive: Yes
 - d. Tape: Yes

2.16 ACCESSORY HARDWARE

- A. Temporary Test Holes: Drilled in duct as required.
- B. Permanent Test Holes: Cast iron, or cast aluminum, to suit adjacent material, including cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit wall + insulation thickness.
- C. Adhesives: High strength, quick setting, waterproof, and resistant to grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" 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 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.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Install aluminum volume dampers in aluminum ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install permanent test holes at fan inlets and outlets.
- F. Install permanent test holes where indicated.
- G. Provide temporary test holes where necessary for testing.
- H. Install temporary test hole plugs in temporary test holes.
- I. Repair insulation at temporary test holes.
- J. Install fire dampers according to UL listing.
- K. Connect ducts to duct silencers with flexible duct connectors.
- L. 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. At outdoor-air intakes and mixed-air plenums.
 3. Downstream of control dampers, and equipment.
 4. Adjacent to and close enough to fire or smoke dampers, to reset and reinstall fusible links.
 5. Upstream or downstream of duct silencers.
 6. At control devices requiring inspection.
 7. Elsewhere as indicated.
- M. Install access doors with swing against duct static pressure except at fire, smoke, and combination fire & smoke dampers.
- N. Access Door Size: Largest of the following permitted by duct dimensions:
 1. 8 by 5 inches.
 2. 12 by 6 inches.
 3. 18 by 10 inches.
 4. 21 by 14 inches.
 5. 24 by 24 inches.
- O. Label access doors to indicate purpose.
- P. Install flexible connectors to connect ducts to air moving equipment.
 1. Exception: Smoke control/management equipment.
- Q. For fans developing static pressures of 4" WC and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- R. Connect flexible ducts to metal ducts as follows:
 1. Low pressure (Not up stream of terminal units):
 - a. Clamps: Install in accordance with manufacturer's recommendations.
 - b. Sheet metal screws: Not required.
 - c. Liquid adhesive: Not required.
 - d. Tape: Install in accordance with manufacturer's recommendations.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- S. Connect flexible ducts to diffusers using a radius forming brace or rigid elbow. If using radius forming brace, deduct four (4) duct diameters from the indicated maximum flexible duct length.
- T. Install flexible duct fully extended with no more than 1/2" compression or sag. Do not provide excess length for future relocation of components. Bends shall equal or exceed one duct diameter bend radius based on the inside duct diameter (no sharp corners or kinks). Tape and mastic for sealing flexible duct to metal fittings shall be listed and labeled to UL Standard 181B. Hanging straps, if used, shall include a saddle to avoid crimping the duct. For ducts 12 inches and smaller in diameter, provide a 3" wide saddle. For ducts larger than 12 inches in diameter, provide a 5" wide saddle.
- U. Connect supply ceiling diffusers to low pressure supply ductwork with five feet maximum length of flexible duct. Provide a radius forming elbow to support flexible duct at diffuser connection unless noted otherwise.
- V. Install temporary test holes where required for testing and balancing purposes. Cap with neoprene, plastic or rubber plugs and repair insulation with like material.
- W. Install permanent test holes upstream and downstream of each fan within 6" of fan. Install in unit wall or adjacent duct.
 - 1. Exception: Outlet of roof mounted fans
- X. Install thrust limiters at all flexible connectors consisting of a 1/16-inch diameter vinyl coated steel cable at 24" maximum on center, attached to flange bolts on each side of flexible connector. Cable length shall be such that, when in tension, 1/2" of movement in the flexible connection is preserved. If flanges are not used, contractor may provide steel, stainless steel, or aluminum angles for attaching cables. Match duct material. Cables shall attach to screw or fastener holding angle and shall be routed through a 3/16" diameter hole in the angle offset approximately 1" from duct.
- Y. TURNING VANES:
 - 1. Install turning vanes in all duct elbows larger than 12" in height or width.
 - 2. Exceptions:
 - a. Where prohibited by the applicable code.
 - b. Where prohibited by laws or ordinances.
 - c. Where prohibited by local requirements.
 - d. Where specifically eliminated by contract.
- Z. FIELD QUALITY CONTROL
 - 1. Tests and Inspections:
 - a. Operate dampers to verify full range of movement without interference.
 - b. Inspect access doors. Verify that door can be opened and closed. Verify fire damper, and combination fire and smoke damper fusible links can be reset and changed. Verify fire damper, and combination fire and smoke damper doors open in the direction of air pressure (out on supply ducts and in on return and exhaust ducts).
 - c. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement, verify non-interference, and verify that the proper heat-response device is installed.
 - d. Inspect elbows for turning vanes. Verify they are installed where required.
 - e. Inspect turning vanes using access doors for proper and secure installation.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- f. Operate remote damper operators prior to ceiling installation to verify full range of movement of operator and damper. Verify no interference with damper movement.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

- A. Product Data: Provide manufacturer's technical data for each ventilator including rated capacities, dimensions, required clearances, operating characteristics, mounting requirements, and furnished specialties and accessories. Provide power and control wiring diagrams. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Roof curbs with required slope and dimensions. Indicate shimming if required.
 - 7. Fan speed controllers.
- B. Operation and Maintenance Data: For ventilators to include in emergency, operation, and maintenance manuals.
- C. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for grease (kitchen) hood exhaust shall also comply with UL 762.

1.4 COORDINATION

- A. Coordinate size and location of structural-steel support members.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.5 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set for each belt-driven fan. Mark belt set with fan ID and turn over to owner's representative.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL LABORATORY EXHAUST (LEF-1A – 3C)

- A. Manufacturers:
 - 1. Twin City Fan & Blower.
 - 2. Greenheck Fan Corporation.
 - 3. Loren Cook Company.
 - 4. M.K Plastics.
- B. Fan Housing and Construction:
 - 1. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence. Casings to be smooth exterior and resin rich interior.
 - 2. Fan housing shall be manufactured in specifically formulated resins, for maximum corrosion resistance, and reinforced with fiberglass for structural strength or minimum 14 gauge steel construction with all components fabricated of steel shall be coated with an electrostatically applied, high performance, baked phenolic epoxy powder coating with an ultraviolet protective topcoat. Fastening bolts holding the casing to the support plate are to be encapsulated in FRP. No uncoated metal fan parts in the corrosive air stream will be tolerated.
 - 3. All fiberglass parts shall include UV inhibitors in the resins to prevent chalking from the sunlight. Flame retardancy of 25 or less, is standard.
 - 4. A graphite liner and grounding strap shall be included to remove any possible build up of static electricity, if noted on the equipment schedule.
 - 5. An integral fan housing drain shall be used to drain rainwater when the fan is de-energized.
 - 6. A bolted housing access door shall be supplied for impeller inspection.
 - 7. Standard finish color to be light gray.
 - 8. Hub seal to be neoprene or Teflon, if noted on the equipment schedule.
 - 9. On AMCA arrangement 8 fans, M. K. Plastics will supply a Vacuum Hub Seal to avoid any contaminated air from escaping (patent pending), if noted on the equipment schedule.
 - 10. Units shall be Spark Resistant Construction to AMCA Spark Resistant Construction, Type B.
- C. High Plume Discharge/Dilution Nozzle:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Fans shall incorporate a double concentric accelerator fiberglass reinforced plastic (FRP) induction nozzle selected for optimal performance per the plans and specifications. Nozzle shall be constructed and designed to avoid extreme variations in velocity flows across the outlet, even against wind loading. Where required, CFD shall be provided demonstrating this on submitted nozzle.
2. Induction nozzle shall be constructed and designed to efficiently handle up to 7000 feet per minute outlet velocity and shall have a optimally matched accelerator for the specified design conditions.
3. All fiberglass parts shall include UV inhibitors in the resins to prevent chalking from the sunlight. Flame retardancy of 25 or less, is standard.
4. Finish color shall be custom color to match sample provided by architect

D. Centrifugal Fan Impeller:

1. Fan impeller shall be non-overloading, centrifugal, backward inclined, airfoil type. Blades shall be continuously welded to the backplate and deep spun inlet wheel shroud. A metal backplate integral to the FRP impeller and encapsulated in resin shall have the hub extending to the outside of the fan housing. A tight fitting removable FRP cap shall cover the impeller end of the shaft.
2. Fan impeller hub shall be keyed and securely attached to the fan shaft. Fan shaft shall be AISI C-1045 hot rolled or stainless steel and accurately turned, ground, and polished. Shafting shall be sized for a critical speed of at least 125% of maximum fan RPM.
3. Fan impeller shall be statically and dynamically balanced in accordance with AMCA Standard 204-96, "Balance Quality and Vibration Levels for Fans."
4. Fan impeller shall be coated with a finish to match the fan housing.
5. Belt driven fan bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreaseable ball or roller type in a cast iron pillow block housing utilizing concentric mounting locking collars.
6. Belt driven fan bearings shall be selected for a minimum L50 life of not less than 200,000 hours.

E. Bypass Air Plenum (On Energy Recovery Plenum), refer to section "Custom Energy Recovery Plenums).

F. Fan Motors and Drives:

1. Fan motors shall be premium efficiency, NEMA frame, nominal 1800 or 3600 RPM Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor.
2. Belt driven fan drive belts shall be oil and heat resistant, static conducting. Fixed drives shall be sized for a minimum 1.5 service factor (150% of the motor horsepower) and shall be readily and easily accessible for service, if required.

G. Overload (Running) Protection:

1. Provide motor overload protection as a requirement of this section.
2. Provide motor overload protection as recommended by the manufacturer
3. Comply with the Section 230513 "Motors for HVAC Equipment"

H. Accessories:

1. Provide disconnect switch.

2.2 INLINE CENTRIFUGAL FANS

- A. Manufacturers:
 - 1. Acme Engineering & Manufacturing Corporation.
 - 2. Greenheck Fan Corporation.
 - 3. Loren Cook Company.
 - 4. Twin City Fan & Blower.
- B. Housing: Manufacturer's standard steel, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Drive Units (where indicated in Fan Schedule): Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- D. Electrically-Commutated Motor (where direct drive fans indicated):
 - 1. Motor enclosure: Open type.
 - 2. Motor shall be DC electronic commutation type motor (ECM).
 - 3. Motor shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and prewired to the specific voltage and phase.
 - 4. Internal motor circuitry to convert AC power supplied to fan to DC power to operate motor.
 - 5. Motor shall be speed controllable down to 20% of full speed. Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- E. Belt-Driven Units (where indicated in Fan Schedule): Motor mounted on adjustable base, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- G. Provide accessories:
 - 1. Variable-Speed Controller: None. Provide manual damper on inlet for initial (rough) balancing.
 - 2. Companion Flanges: For inlet and outlet duct connections.
 - 3. Motorized Dampers: Parallel-blade dampers mounted in duct with electric actuator; wired to close when fan stops. When fan voltage exceeds 220 V, provide 50VA minimum transformer to operate damper.

2.3 MOTORS

- A. Refer to section "Common Motor Requirements for HVAC Equipment."
- B. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Motor Sizes: Size shall be as indicated. If not indicated, provide motor large enough to drive load and avoid operation in service factor range above 1.0.
2. Controls: Provide controllers, electrical devices, and wiring to comply with requirements specified in Division 26 Sections.

C. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install HVAC Power Ventilators level and plumb.
- B. Secure roof-mounted fans to roof curbs with security fasteners. Refer to Section "Roof Accessories" for other installation requirements for roof curbs.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 0.5 inches.
- E. Install units with clearances for service and maintenance.
- F. Label units.
- G. Kitchen Hood Fans:
 1. Install roof-mounted exhaust fans with fan discharge a minimum of 40" above the finished roof surface. Outlet shall be not less than 10 feet horizontally from parts of the same building and adjacent buildings. Outlet shall be not less than 10 feet above adjoining grade level. Outlet shall be not less than 10 feet horizontally from or not less than 3 feet above air intake openings into any building.
 2. Install sidewall exhaust fans not less than 10 feet above adjoining grade level. Outlet shall be not less than 10 feet horizontally from or not less than 3 feet above air intake

openings into any building. Termination shall not be located where protected openings are required and shall not be located within 3 feet of exterior openings.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that Shipping blocking and bracing are removed.
2. Verify that unit is secure and connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. For belt drive units disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align belts, adjust belt tension, and install belt guards.
5. Adjust damper linkages & operators for proper damper operation.
6. Verify lubrication for bearings and other moving parts.
7. Verify that manual and automatic volume control, fire, smoke, and fire/smoke dampers in connected ductwork systems are in a fully open position.
8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm.
9. Measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.3 TESTING, ADJUSTING, BALANCING, AND LUBRICATION

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section "Testing, Adjusting, and Balancing for HVAC".

C. Replace fan and motor pulleys to achieve design airflow.

1. Disable automatic temperature-control operators, energize motor and adjust fan to required rpm.
2. Measure and record RPM.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3. Measure and record motor voltage and amperage.

D. Re-lubricate bearings.

END OF SECTION 233423

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 ABBREVIATIONS

- A. BAS Building Automation System.
- B. CFM Cubic Feet per Minute.
- C. ECM Electronically Commutated Motor.
- D. PSIG Pounds per Square Inch Gauge.
- E. PSC Permanent Split Capacitor
- F. SCR Silicon Controlled Rectifier.
- G. VA Volt Amps. (A measure of transformer power)

1.3 SUBMITTALS

- A. Pre-submittal Meeting: A representative of the manufacturer producing equipment being provided under this section of the specifications shall attend a meeting for the purpose of coordinating with the contractor performing work under section "Building Automation System". The meeting shall be held at a location of the Contractor's choosing. The Contractor shall arrange the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.
- B. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
- C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.
 3. Hangers and supports, including methods for duct and building attachment, bracing, and vibration isolation.
- D. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Instructions for resetting minimum and maximum air volumes.
 2. Instructions for adjusting software set points.
- 1.4 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 SHUTOFF AIR TERMINAL UNITS (SUPPLY)

- A. Manufacturers:
1. Anemostat Products.
 2. Honeywell.
 3. MetalAire, Inc.
 4. Nailor Industries, Inc.
 5. Price Industries.
 6. Siemens.
 7. Titus.
 8. Trane.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

Casing: Single wall galvanized sheet steel.

1. Sheet Metal Thickness: Manufacturer's standard.
2. Casing Lining: Adhesive attached 1", fiberglass liner having a maximum flame spread index of 25 and a maximum smoke developed index of 50. Insulation shall comply with UL 181 erosion requirements.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment. Provide flexible connector.
 4. Air Outlet: S-slip and drive connections. Provide flexible connector.
 5. Access: Removable panels with airtight gaskets for access to parts requiring service, adjustment, or maintenance.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Damper Position: Normally open.
- D. When indicated provide a Hydronic Heating Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1", tested at 300 PSIG and rated for a minimum working pressure of 200 PSIG at a maximum entering-water temperature of 220° F. Include manual air vent and drain valve.
- E. Factory mounted and wired components:
1. Electrical components mounted in control box with removable cover. Incorporate single point electrical connection to power source.
 2. Control Transformer: 50 VA minimum factory mounted transformer for control voltage. Input voltage shall match the circuit provided. Coordinate output voltage with contractor performing work under Section "Building Automation System". Provide terminal strip in control box and field wiring of BAS unit controller to terminal strip. Wiring shall be as indicated.
 3. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors and BAS requirements. Enclose terminal lugs in terminal box sized according to NFPA 70.
 4. Disconnect Switch: Factory mounted fused.
- F. Control Sequence:
1. As indicated in Section "Sequences of Control."

2.2 EXHAUST AIR TERMINAL UNITS

- A. Manufacturers:
1. Accutrol.
 2. Siemens. (Basis of Design)
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud or vortex shedding technology.
- Casing: Galvanized steel.
1. Sheet Metal Thickness: Manufacturer's standard.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Air Inlet: Flanged connection.
 3. Air Outlet: Flanged connection.
 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Volume Damper: Galvanized steel with polyurethane blade seals with Teflon shaft bushings.
1. Damper Position: Normally open.
- D. Factory mounted and wired components:
1. Electrical components mounted in a galvanized steel control box with removable cover. Incorporate single point electrical connection to power source.
 2. Orifice plate airflow measurement. Accuracy of sensor shall be $\pm 3\%$.
 3. Control Transformer: 95 VA minimum factory mounted transformer for control voltage. Input voltage shall match the circuit provided. Coordinate output voltage with contractor performing work under Section "Building Automation System". Provide terminal strip in control box and field wiring of BAS unit controller to terminal strip. Wiring shall be as indicated.
 4. Fast Acting Controller and Actuator: Shall be equal to Siemens GNP191.1P.
 5. Wiring Terminations: Wire controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors and BAS requirements. Enclose terminal lugs in terminal box sized according to NFPA 70.
 6. Disconnect Switch: Factory mounted fused.
- E. Control Sequence:
1. As indicated in Section "Sequences of Control."

2.3 HANGERS AND SUPPORTS

- A. Hanger Rods: Cadmium-plated steel rods, neoprene 1/8" thick washers and nuts.
1. Vibration isolation washers should be used on both sides of threaded rod attachment to box to prevent vibration transmission to structure.
- B. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- C. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.4 SOURCE QUALITY CONTROL

- A. Label each air terminal unit with tag, nominal airflow, maximum and minimum factory-set airflows, coil type if coil is included, and ARI certification seal.
- B. For hydronic coils include hose kit and control valve shrink wrapped and labeled with terminal unit tag.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder actuated concrete fasteners for standard-weight aggregate concretes and for slabs equal to or more than 4" thick.
 - 4. Do not use powder actuated concrete fasteners for lightweight aggregate concretes and for slabs less than 4" thick.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to division 23 duct specification sections for metal and flexible ducts.
- D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.4 IDENTIFICATION

- A. Label each air terminal unit with tag, nominal airflow, and maximum and minimum factory set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs/labels.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

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

END OF SECTION 233600

SECTION 233600 – LABORATORY TEMPERATURE AND AIRFLOW CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK

- A. Section 014520 "Testing Adjusting and Balancing"
- B. Section 230900 "Building Management Systems"
- C. Section 230993 "Sequences of Control"
- D. Section 233600 "Air Terminal Units"

1.3 DESCRIPTION

- A. The intent of this Specification is to define the hardware and control requirements for the laboratory airflow control system (LACS). The system specified shall be based on variable fume hood exhaust volume with sash position reset control of fume hoods, synchronization of supply and exhaust airflows, and control of lab room temperature via reheat coils and airflow reset. The BAS shall integrate to the LACS through BACnet® interface directly from room control panels.
- B. All control equipment required to fulfill this Specification shall be manufactured and/or provided through the LACS.
- C. It shall be understood that the Drawings and Specifications describe the approximate locations of the work. Do not scale the drawings to determine exact positions and clearances. Obtain from Architect, Engineer, Commissioning Agent or the Owner any dimensions not shown.
- D. Details of construction and of workmanship where not specifically described herein or indicated on the drawings shall be subject to the Engineer's or Owner's approval. It is the intent of these Specifications to provide complete systems, left in good working order, ready for operation, including necessary labor and materials, whether or not specifically shown on the Drawings or mentioned herein.
- E. Before submitting proposals, examine the Specifications and all Drawings relating to the work and become fully informed as to the extent and character of the work and the relation of the work to that of other Sections. Examine the Drawings of other Sections to become familiar

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

with all the problems and details of the building construction and to note conditions, which affect the work.

- F. Any changes required in the ductwork, air handling equipment or any other mechanical systems, which would be required for the application of any proposed Laboratory Airflow Control airflow equipment other than the specified "Base Bid" or "Basis of Design" shall be the responsibility of the LACS supplier. Any additional engineering, sheet metal or mechanical equipment (i.e. upsized supply/exhaust systems) costs other than that as required by the "Basis of Design" shall be borne by the LACS supplier. All changes shall be subject to prior approval by the Architect/Engineer.
- G. Only those devices specifically named under "acceptable manufacturers" or through addendum shall be considered for approval. Other devices submitted after the bid opening will be returned without review.
- H. Being listed herein as an approved manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.
- I. All substitutions must be included in the Base Bid, and must be accompanied by a letter of equivalency certifying the products equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be all inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project specifications/documents shall not be revised to reflect the substitution should the substitution be approved.
- J. Minimizing energy consumption is of primary importance in the system design; therefore, any airflow control valve considered for this project must be submitted with test data showing the Minimum Operating Pressure of the valve as tested in accordance with ANSI/ASHRAE STD 130 Paragraph 5.3. The submitted test data must be in the form of an xy plot, with the y axis representing differential pressure measured across the fully opened valve and the x axis representing airflow volume measured through the fully opened valve. The test data for each size valve must include the entire published operating range of the valve.

1.4 DESCRIPTION OF WORK

- A. Furnish laboratory airflow control valves including supply and exhaust valves as listed in schedule and on drawings. All installation labor shall be as stated below under "Work By Others".
- B. Furnish all associated room control panels for laboratory airflow control system including supply and exhaust valves as listed in schedule and on drawings. All installation labor for associated control panels shall be by the BAS contractor.
- C. Furnish low pressure drop airflow control valves with vortex airflow measurement or flow ring and damper, high speed electric actuation and integral access panel for all associated devices as shown on drawings and as scheduled. All installation materials shall be as stated below under "Work By Others".

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- D. Furnish (where required) in addition to above, integral electronic pressure independent controller with standard "Native BACnet" interface.
- E. Furnish all associated room and duct temperature sensors as required for laboratory airflow control system spaces.
- F. Furnish fume hood controllers, sash sensors and monitors as required for laboratory airflow control system spaces.
- G. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and shall not be custom designed especially for this project. All components shall have been thoroughly tested and proven in actual use.

1.5 WORK BY OTHERS

- A. The Building Automation System (BAS) contractor shall be responsible for the following:
 - 1. BAS interface to all Laboratory Airflow Control System BACnet points required for monitoring, alarming and Demand Based Static Pressure Reset Control.
 - 2. Provision of all room reheat control valves and other associated zone control water/steam valves. Reheat and zone control valves shall be able to accept analog control signal.
 - 3. Installation of Fume Hood controllers, with exception to sash position sensors and fume hood monitor displays. (Sash sensors and fume hood monitor displays shall be supplied by the LACS contractor and factory mounted by fume hood manufacturer.)
 - 4. Provision, installation and final termination of all control wiring, including laboratory airflow control system controllers, airflow control valves and reheat control valves.
 - 5. Provision and installation of power wiring to all airflow control valves and reheat control valves as required. Power wiring above 24V shall be provided by others.
- B. The HVAC contractor shall:
 - 1. Install all room reheat valves (where required) as provided by BAS contractor.
- C. The sheet metal contractor shall:
 - 1. Install all room airflow control valves.
 - 2. Provide and install all standard fittings, hangers, and ancillary devices required to install duct devices shall be provided by this contractor.
- D. The air balancing contractor shall:
 - 1. Verify airflow volume readings and control points in each control mode.

1.6 SYSTEM TURNOVER

- A. The laboratory airflow control system shall be commissioned by the laboratory airflow control system contractor.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1.7 GURANTEE

- A. The LACS contractor shall provide five (5) years standard warranty on all airflow valves. Warranty shall commence upon date of shipment.

1.8 QUALITY ASSURANCE

- A. LACS contractor shall provide written approvals and certifications after installation has been completed.
- B. LACS contractor must prove that they have been engaged in the provision, installation and service of this type of equipment for at least five (5) years and has a fully equipped, factory trained and authorized service organization.
- C. For any equipment submitted for approval other than "Basis of Design", the LACS contractor shall state what, if any, specific points of the system operation differ from these Specifications.
- D. The LACS contractor shall continue to bear the liability for replacement of accepted substituted equipment in the event that the equipment fails to perform as specified, or to meet approval of all authorities having jurisdiction, within five (5) years after beneficial use by the Owner.

1.9 SUBMITTALS

- A. Pre-submittal Meeting: A representative of the manufacturer producing equipment being provided under this section of the specifications shall attend a meeting for the purpose of coordinating with the contractor performing work under section "Building Automation System". The meeting shall be held at a location of the Contractor's choosing. The Contractor shall arrange the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.
- B. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Supply, general exhaust, and fume exhaust air terminal units.
 - 2. Sash sensors
 - 3. Fume hood controllers/monitors.
 - 4. Controllers.
 - 5. Master Controllers.
 - 6. Space temperature/humidity sensors.
 - 7. Other accessories.
- C. Operation and Maintenance Data: For laboratory temperature and airflow control system and coponents to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.10 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. 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. Accutrol LACS / AccuValve Airflow Control Valves.
 2. Siemens LACS / Siemens LGS/LGE Control Valves.

2.2 GENERAL

- A. Materials shall be new and unused and free from defects and imperfections.
- B. Laboratory temperature and airflow control system shall be fully stand-alone for each individual laboratory or laboratory support space. System shall not use or rely on information from controllers in other laboratory areas or from outside laboratory space to control functions within its laboratory.
- C. Laboratory airflow control system shall employ individual Average Face Velocity controllers that directly measure area of fume hood sash opening and proportionally control hood's exhaust airflow in variable volume mode to maintain constant face velocity over minimum range of 25 to 100% of full sash opening. Safety and energy savings shall be insured through corresponding minimum change in hood exhaust flow of 4 to 1.
- D. Electrically actuated terminal units shall be pressure independent with airflow accuracy of $\pm 5\%$ over airflow range of terminal. Air terminal units shall be balanced to conform to requirements of Section 014520 – Testing and Balancing of HVAC.
- E. Laboratory airflow control system shall use volumetric offset to maintain room pressurization. Offset airflow is indicated for each space in the documents.
- F. Vertical sash sensor shall be provided to measure height of each vertically moving fume hood sash. Horizontal sash sensor shall be provided for each pair of horizontal or overlapping sashes

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

that are located on horizontal, combination, or walk-in type fume hoods. Operational life of sensors shall be minimum of 250,000 cycles. Sash sensors mounted on fume hood sashes shall extend to within 1/8" or less of the edge of the sash trim edge.

- G. Provide an individual fume hood controller for each fume hood, which shall maintain face velocity set point in response to sash position. Controller shall maintain constant average face velocity as fume hood sashes are opened and closed. Controller shall modulate exhaust airflow between minimum and maximum air flow rates scheduled in Air Terminal Device Schedules.
- H. Control panels (including routers and power supplies) shall be located in the ceiling cavity above each lab. Coordinate location of control panel with all trades to provide access to panel for maintenance. Provide communications jack as part of or adjacent to space temperature sensor to allow communication between laptop computer and control panel. Provide one control panel for each lab as shown on plans.
- I. Detailed graphics will be developed by the Controls Contractor to monitor all critical laboratory equipment. Below is an example of the graphics points required for the laboratory temperature and airflow controls portion of the Building Control System. Floor layouts and other comprehensive graphics are expected to be developed by the Controls Contractor to be viewed at the EMCS. For example the controls should include a navigational floor plan with clickable links from lab rooms to the associated lab control system graphics. The floor plan will represent the actual building layout and final room numbers. Please see minimum graphic points listed below.
 - 1. Laboratory Space Level Graphic:
 - a. Temperature Graphics will include the following: Actual Temp, Temp Setpoint
 - b. Reheat control valve command.
 - c. Flow graphics will include the following, where applicable to the room:
 - 1) Each supply air flow set point.
 - 2) Each supply air flow actual.
 - 3) General exhaust set point.
 - 4) General exhaust actual.
 - 5) Snorkel exhaust air flow set point.
 - 6) Snorkel exhaust air flow actual.
 - 7) Each fume hood exhaust air flow set point.
 - 8) Each fume hood exhaust air flow actual.
 - 9) Each fume hood face velocity.
 - 10) Total room offset setpoint.
 - 11) Total room offset actual flow.
 - 12) Total room supply air.
 - 13) Total room exhaust air.
 - d. Laboratory Alarms to be shown on graphics:
 - 1) Each fume hood low flow alarm.
- J. The airflow control valves shall include the following components:
 - 1. Air Terminal Devices – General:
 - a. All air terminals shall be pressure independent over 0.5" to 3.0" WG drop across the air terminal.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- b. Airflow accuracy shall be $\pm 5\%$ of airflow over the entire range of the scheduled airflow.
 - c. Provide differential pressure switch mounted across each air terminal or other means to signal alarm under low flow condition for each fume hood.
 - 2. Supply Air Valves
 - a. Consists of airflow control valve with vortex airflow sensor and high speed electric actuator or airflow control valve with pitot ring airflow sensor and high speed electric actuator.
 - b. Supply terminals shall either have an integral heating coil to the terminal or a duct mounted heating coil sized to match the heating performance as scheduled.
 - c. Provide external or internal insulation of each supply air terminal device.
 - d. Valve body and damper: Galvanized steel.
 - 3. General Exhaust Air Valves
 - a. Consists of airflow control valve with vortex airflow sensor and high speed electric actuator or airflow control valve with pitot ring airflow sensor and high speed electric actuator.
 - b. Valve body and damper: Galvanized Steel.
 - 4. Fume Hood Exhaust Air Valves (VAV)
 - a. Consists of airflow control valve with integrated high performance closed loop feedback controller, vortex airflow sensor or pitot ring airflow sensor and high speed electric actuator.
 - b. Valve body and damper: 316L Stainless Steel.
 - 5. Specialty Exhaust Air Valves (CV Point Exhaust)
 - a. Consists of airflow control valve with integrated high performance closed loop feedback controller, vortex airflow sensor and high speed electric actuator.
 - b. Valve body and damper: 316L Stainless Steel.
- 2.3 SUPPLY, EXHAUST AND FUME HOOD EXHAUST AIRFLOW CONTROL VALVES (Vortex Shedding)
- A. The Airflow Control Valve shall be:
 - 1. Supply, general exhaust, and point exhaust shall consist of a compression section, two airflow control surfaces, factory-mounted digital vortex airflow measuring device, factory-mounted high speed electric actuator (standard speed electric actuator for non-lab spaces) and integral access panel.
 - 2. Fume hood exhaust shall consist of a compression section, two airflow control surfaces, factory-mounted digital vortex airflow measuring device factory-mounted high speed electric actuator (standard speed electric actuator for non-lab spaces), integral access panel and integrated high performance closed-loop feedback controller with native BACnet MS/TP.
 - B. The compression section shall divide the airstream into at least two separate airstreams. Each airstream shall be approximately equal in size and the total open area shall be approximately

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

50% of the duct open area. The divided sections shall cause compression therefore creating a more laminar flow for better airflow measurement and turndown. The compression section shall be of an aerodynamic shape with a static regain section to insure minimal pressure drop. The valve shall not require any duct straight runs either upstream or downstream of the airflow valve to achieve required specified performance.

- C. Airflow control valves shall be a linear type and shall operate with a minimum turndown ratio of 8 to 1. Accuracy of the airflow valve shall be 5% of reading in the 8 to 1 range of the damper.
- D. The airflow control valve speed of response shall be <1 second (<2 seconds for standard speed actuation).
- E. The airflow control valve shall be capable of being mounted in any position (360° mounting plane) in ductwork without the need for recalibration. It shall not be required to specify mounting plane when ordering valve. Airflow valves that must be ordered and mounted in either a vertical or horizontal plane will not be acceptable.
- F. Valve body material for Fume Hood or other corrosive service shall be 304SS; 20gauge for body and 16gauge for blades. Valve shaft material shall be 316SS. Coated valves will not be acceptable.
- G. Valve body material for non-corrosive service such as for Supply or general Exhaust shall be 16 gauge aluminum for body and 16 gauge for blades. Valve shaft material shall be 316SS.
- H. Airflow control valves shall operate without linkages, springs, levers, or bearings, in the airstream due to the effect of exhaust air on those materials, and shall exhibit no deadband or hysteresis. Airflow control valves shall be provided as "fail last position". Airflow valves provided for Fume Hood Exhaust application shall be provided as "fail safe position".
- I. All critical components of the airflow control valve shall be easily accessible from one side of the valve. All linkages shall be out of the airstream to avoid possible corrosion and loss of accuracy. Airflow valves that cannot be mounted with accessible control components (i.e. pivot arm/actuator) in the 4-8 o'clock orientation will not be acceptable.
- J. Airflow control valves shall be of a low pressure drop design for energy efficiency. Valves shall not require greater pressure drop than listed at Max CFM (Max L/s or CMH) on project valve schedule or 0.28" wc (70Pa), whichever is less.
- K. Supply terminals shall be provided with a duct mounted heating coil sized for the performance on the schedule.
- L. Supply valves shall be wrapped in 1" fiberglass insulation where exposed to the air stream.

2.4 SUPPLY AIRFLOW CONTROL VALVES/TERMINALS (Pitot Ring Type)

- A. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

Casing: Single wall galvanized sheet steel.

1. Sheet Metal Thickness: Manufacturer's standard.
2. Casing Lining: Adhesive attached 1", fiberglass liner having a maximum flame spread index of 25 and a maximum smoke developed index of 50. Insulation shall comply with UL 181 erosion requirements.
3. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment. Provide flexible connector.
4. Air Outlet: S-slip and drive connections. Provide flexible connector.
5. Access: Removable panels with airtight gaskets for access to parts requiring service, adjustment, or maintenance.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Damper Position: Normally open.

C. Hydronic Heating Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1", tested at 300 PSIG and rated for a minimum working pressure of 200 PSIG at a maximum entering-water temperature of 220° F. Include manual air vent and drain valve.

D. Factory mounted and wired components:

1. Electrical components mounted in control box with removable cover. Incorporate single point electrical connection to power source.
2. Control Transformer: 50 VA minimum factory mounted transformer for control voltage. Input voltage shall match the circuit provided. Coordinate output voltage with contractor performing work under Section "Building Automation System". Provide terminal strip in control box and field wiring of BAS unit controller to terminal strip. Wiring shall be as indicated.
3. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors and BAS requirements. Enclose terminal lugs in terminal box sized according to NFPA 70.
4. Disconnect Switch: Factory mounted fused.

E. Control Sequence:

1. As indicated in Section "Sequences of Control."

2.5 EXHAUST AIR TERMINAL UNITS (Pitot Ring Type)

A. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

Casing: Stainless steel for fume hoods and point exhaust and galvanized steel for general exhaust.

1. Sheet Metal Thickness: Manufacturer's standard.
2. Air Inlet: Flanged connection.
3. Air Outlet: Flanged connection.
4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Volume Damper: Stainless steel with polyurethane blade seals with Teflon shaft bushings.

1. Damper Position: Normally open.

C. Factory mounted and wired components:

1. Electrical components mounted in a galvanized steel control box with removable cover. Incorporate single point electrical connection to power source.
2. Orifice plate airflow measurement. Accuracy of sensor shall be $\pm 3\%$.
3. Control Transformer: 95 VA minimum factory mounted transformer for control voltage. Input voltage shall match the circuit provided. Coordinate output voltage with contractor performing work under Section "Building Automation System". Provide terminal strip in control box and field wiring of BAS unit controller to terminal strip. Wiring shall be as indicated.
4. Fast Acting Controller and Actuator: Shall be equal to Siemens GNP191.1P.
5. Wiring Terminations: Wire controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors and BAS requirements. Enclose terminal lugs in terminal box sized according to NFPA 70.
6. Disconnect Switch: Factory mounted fused.

D. Control Sequence:

1. As indicated in Section "Sequences of Control."

2.6 FUME HOOD AIRFLOW VOLUME CONTROLLER

- A. The fume hood controller(s) function as stand-alone units, modulating the hood exhaust valves as required via the factory-mounted electronic high speed actuators. The fume hood controller has a local display which includes visual and audible alarm indicators. The fume hood controller will be capable of communicating read points indicating the calculated face velocity (fpm), face velocity set point (fpm), exhaust volume (CFM), sash position (% open), alarm status, DI status and emergency status to the BAS via BACnet MS/TP communications protocol. The fume hood controller shall be a BTL listed device. The fume hood controllers will be capable of providing the local (BAS) room controller with two mutually independent discrete analog outputs configured for either (face velocity, exhaust volume, sash position, or valve position) with the following signal types available; 0-10v, 2-10v, 0-5v, 1-5v, 0-20mA or 4-20mA. Fume hood alarms will be hardwired from the fume hood controller alarm relay

output to the local (BAS) controller. The occupied/unoccupied room status will be communicated via a hard wired digital input to each of the fume hoods in a given lab/room.

- B. The fume hood controller will measure the fume hood exhaust airflow and compare it to the current exhaust airflow set point. The exhaust airflow volume set point is based on the sash position, face velocity set point, the status of the digital inputs and the status of the “Emergency” switch.
- C. Under normal operating conditions, the fume hood display provides the average face velocity value with the alarm and emergency purge LEDs off and the audible buzzer silent.
- D. Should the exhaust volume, face velocity or sash position exceed the relevant alarm limits for a prescribed period of time, the fume hood controller will initiate a local alarm which will result in a change-of-state to the alarm relay contacts. During an alarm condition, the local display will provide a text message directly below the face velocity value to indicate which alarm limits have been exceeded. Additionally, the display’s red alarm LED indicator will turn on and the audible buzzer will sound. Pushing the mute button on the fume hood display will silence the buzzer however the red alarm LED will remain in an active state flashing until the alarm condition clears. When the alarm condition clears for the prescribed period of time, the alarm LED will turn off, the alarm relay returns to the normal state and the buzzer goes silent.
- E. All configuration parameters of the fume hood controller shall be programmed using the PC-based user interface software. The local display includes a mini USB port for connecting the PC with the fume hood controller configuration software. All configurable fume hood control and alarm parameters can be accessed and modified using the pc-based user interface software. Fume hood controllers provided with menu driven configuration will not be acceptable.
- F. In the event of a spill in the fume hood, the local display has an “Emergency” Purge button that the operator can push to override the control set point to a prescribed value; either the maximum volume limit or 100% open exhaust valve position. To indicate the emergency purge has been activated, the local display’s audible buzzer will sound and a red purge LED on the display will turn on. The audible buzzer can be silenced by pressing the mute button; however the red purge LED will remain on until the emergency purge has been reset by pushing the “Emergency” Purge button again.

2.7 ROOM LEVEL CONTROLLERS

- A. Each laboratory shall have a dedicated sub-network.
- B. System shall have capability for full stand alone operation and shall be capable of communicating digitally with the BMS.
- C. An Internet ready controller shall be field mounted and pre-programmed to provide control schemes applicable for a variety of room sequences. The controller shall be provided with a dual ARM processor and a built-in web server, with 16 Mbyte NOR Flash and 64 Mbyte SDRAM. The controller shall support BACnet and Modbus. The room level controller shall be powered by 24V AC/DC Power.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- D. The controller shall be provided with a minimum of 30 input and output (IO) points which comprise of 8 digital inputs, 8 universal inputs, 8 digital outputs, 2 open collector outputs and 4 analog outputs. The controller shall be also be provided with an Ethernet port and 2 RS485 ports.
- E. The controller shall be fully configurable via a lap-top computer or a PC utilizing a user-friendly Graphic User Interface software package. Display of current readings of all flows, outputs, tuning values, setpoints, and status values shall be available through this interface. Entry of control setpoints, and scaling and tuning constants shall also be provided by this interface.
- F. The LACS supplier shall provide a full documentation package to the Owner on completion of the project. Documentation shall include as-built drawings, device lists, and controller configuration lists for each controller.
- G. Power voltage requirements for the controllers shall be 24V AC/DC. Power can be provided by individual or centralized power transformers, provided by the installing contractor.
- H. The Controller shall have the following I/O compliment:
 - 1. Universal Input:
 - a. Resistance mode, input range: 0-30K Ohm, 0-10K Ohm, 0-1.5K Ohm
 - b. Voltage mode, input range: 0-10V, 0-5V
 - c. Current mode, input range: 0-20mA, 4-20mA
 - d. Thermistor: 10K, 10K Shunt, 1K Balco, 1K Platinum
 - 2. Digital Input:
 - a. Voltage free contact input (Limit +/-5V at 500 Ohm resistance)
 - 3. Digital Output:
 - a. Relay Contacts, SPST NO, 48VA at 24VAC, Pilot Duty
 - 4. Transistor Outputs:
 - a. Open Collector Output, Isolation, 3.75KV
 - 5. Analog Outputs:
 - a. Voltage mode, output range: 0-10V
 - b. Current mode, output range: 0-20mA, 4-20mA

2.8 SUPPORT SPACE ROOM TRACKING CONTROLLERS

- A. Provide a BTL Listed Native BACnet Laboratory Airflow Control room tracking controller. Controller shall be wall mounted and pre-programmed for the room airflow and temperature control sequence. The room level controller shall be powered by 24V Power.
- B. The controller shall have a color graphic LCD screen, animated icons and set-up menus for easy system configuration.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- C. The controller shall have a BACnet Schedule with hardware real-time clock and 72-hour Real Time clock battery backup power.
- D. The controller shall be capable of being provided with an integrated motion sensor.
- E. Controller shall support and auto-detect remote temperature and occupancy sensor.

2.9 HANGERS AND SUPPORTS

- A. Hanger Rods: Cadmium-plated steel rods, neoprene 1/8" thick washers and nuts.
 - 1. Vibration isolation washers should be used on both sides of threaded rod attachment to box to prevent vibration transmission to structure.
- B. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- C. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.10 SOURCE QUALITY CONTROL

- A. Label each air terminal unit with tag, nominal airflow, maximum and minimum factory-set airflows, coil type if coil is included, and ARI certification seal.
- B. For hydronic coils include hose kit and control valve shrink wrapped and labeled with terminal unit tag.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder actuated concrete fasteners for standard-weight aggregate concretes and for slabs equal to or more than 4" thick.
 - 4. Do not use powder actuated concrete fasteners for lightweight aggregate concretes and for slabs less than 4" thick.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to division 23 duct specification sections for metal and flexible ducts.
- D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.4 IDENTIFICATION

- A. Label each air terminal unit with tag, nominal airflow, and maximum and minimum factory set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs/labels.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 3. Verify that controls and control enclosure are accessible.
 4. Verify that control connections are complete.
 5. Verify that nameplate and identification tag are visible.
 6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

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

END OF SECTION 233600

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, mounting details, and performance data including throw, drop, static pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Installation Drawings: Drawn to scale (Minimum 1½" = 1'-0"), on which the following items are indicated:
 - 1. Trim & borders.
 - 2. Ceiling suspension assembly members.
 - 3. Method of attaching hangers to building structure.

PART 2 - PRODUCTS

2.1 DIFFUSERS, GRILLES, AND REGISTERS

- A. Manufacturers:
 - 1. Anemostat.
 - 2. Carnes.
 - 3. Krueger.
 - 4. MetalAire, Inc.
 - 5. Nailor Industries.
 - 6. Price Industries.
 - 7. Titus.
- B. General:
 - 1. The basis of design for each grille register and diffuser is indicated on the drawings. The contractor shall provide equivalent products by one of the listed manufacturers.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Where aluminum construction is indicated blades and frames shall be extruded.
3. All trim pieces shall be mechanically fastened. Friction fit trim rings/frames shall not be provided or shall be mechanically fastened in the field. Fasteners shall not be visible.
4. Units located on walls in heavy use areas including but not limited to basketball courts, gymnasiums, and shop areas shall be heavy duty steel.
5. Finish: Powder Coated or Baked enamel, white.
6. Filter Grille Mounting Frame: Shall accept a 2" deep MERV 8 (30%) pleated media filter. Refer to section "Filters" for filter requirements. Provide two sets of filters for each filter grille.
7. Mounting: As Scheduled.
8. Damper Type: Adjustable opposed-blade assembly where damper is indicated on the schedule.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Install diffusers, registers, and grilles flush with ceiling unless otherwise indicated in contract documents.
- C. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Install in locations indicated, as much as practical. For units installed in lay-in ceiling panels, center units in both directions in panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- D. Linear Slot Diffuser Installation: For typical diffuser, adjust each slot diffuser so half the slots throw horizontally along the ceiling in each direction unless indicated otherwise on drawings. For linear slot diffusers above windows at building perimeter, one half of the total slots at each diffuser shall be adjusted to throw air vertically downward to wash window and the other half of the slots shall be adjusted to throw air horizontally across ceiling unless indicated otherwise.
- E. Diffusers, registers and grilles shall be supported independently of the ceiling system and shall not be supported from conduit, piping or unrelated ductwork.
- F. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233723 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Louvered-penthouse ventilators.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ventilators, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.
- B. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator 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 wind speeds as indicated on Structural Drawings.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
- C. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
- D. Samples: For each exposed product and for each color and texture specified.
- E. Samples for Initial Selection: For units with factory-applied color finishes.
- F. Samples for Verification: For each type of louvered-penthouse ventilator indicated, in manufacturer's standard size.
- G. Delegated-Design Submittal: For shop-fabricated ventilators indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 1. Detail fabrication and assembly of shop-fabricated ventilators.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 1. Structural members to which roof curbs and ventilators will be attached.
 2. Sizes and locations of roof openings.
- B. Seismic Qualification Certificates: For ventilators, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating, mill phosphatized.
- D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 1. Use types and sizes to suit unit installation conditions.
- E. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- E. Perform shop welding by AWS-certified procedures and personnel.

2.3 LOUVERED-PENTHOUSE VENTILATORS

- 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. Acme Engineering & Mfg. Corporation.
 - 2. Greenheck Fan Corporation.
 - 3. Loren Cook Company.
 - 4. PennBarry.
 - 5. Twin City Fan Co.
- B. Construction: All-welded assembly with louvers, mitered corners, and aluminum sheet roof.
- C. Frame and Blade Material and Nominal Thickness: Extruded aluminum, of thickness required to comply with structural performance requirements, but not less than 0.080 inch (2.0 mm) for frames and 0.060 inch for blades with condensate deflectors.
- D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to fit roof opening and ventilator base.
 - 1. Overall Height: 12" above roof on all sides minimum.
- E. Bird Screening: Galvanized-steel, 1/2-inch- (12.7-mm-) square mesh, 0.041-inch (1.04-mm) wire Aluminum, 1/2-inch- (12.7-mm-) square mesh, 0.063-inch (1.6-mm) wire.
- F. Sheet Finish:
 - 1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
 - 2. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat and an overall minimum dry film thickness of 2 mils (0.05 mm).
 - a. Color and Gloss: As selected by Architect from manufacturer's full range to match roof color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Install gravity ventilators with clearances for service and maintenance.
- C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.
- E. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."
- F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

END OF SECTION 233723

SECTION 234100 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. HEPA: High-efficiency particulate air.
- G. Construction Filter: A filter maintained during construction to protect ductwork from construction dust, dirt, and debris. Construction filters shall be removed temporarily during balancing and permanently after the building is occupied.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated include dimensions, required operating clearances, required access clearances, and weights.
- B. Operating Characteristics: For each type of product indicated provide rated flow capacity, initial and final pressure drop at rated flow capacity.
- C. Efficiency: For each type of product indicated provide efficiency and test method.
- D. Fire Classification: For each type of product indicated provide the fire classification.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- E. Specialties and Accessories: For each type of product indicated provide furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.
- B. Replace all permanent filters with new filters of types specified.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
 - 2. Comply with ASHRAE 52.1 for arrestance and ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.
- C. Comply with NFPA 90A and NFPA 90B.

1.6 COORDINATION

- A. Coordinate sizes and locations:
 - 1. Within air handling units.
 - 2. On open return ducts during construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Air Filters, and Filter-Holding Systems:
 - a. AAF International.
 - b. Airguard Industries, Inc.
 - c. Barnebey & Sutcliffe Corp.
 - d. Columbus Industries, Inc.
 - e. Continental Air Filter Div.; NiCon Filter Corp.
 - f. Farr Co.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- g. Flanders Filters, Inc.
- h. International Air Filter, Inc.
- i. Koch Filter Corp.
- j. Research Products Corp.
- 2. Filter Gages:
 - a. Airguard Industries, Inc.
 - b. Dwyer Instruments Inc.

2.2 GENERAL FILTERS

- A. For return filter grilles, general filtration, and construction filters provide the following:
 - 1. Media: Cotton and synthetic pleated with an average efficiency of 25-30% and an average arrestance of 90-92% in accordance with ASHRAE test standard 52.1-1992.
 - 2. Thickness: Unless otherwise indicated thickness shall be 2".
 - 3. Media Support Grid: Welded wire on 1" centers with 96% free area bonded to the media.
 - 4. Filter Frame: High wet strength cardboard with diagonal support members bonded to the media on the entering side and exiting side of each pleat.
 - 5. Holding Frame: Galvanized steel with metal grid on outlet side, polyurethane gaskets, and spring fasteners.
 - 6. Farr 30/30 or equal.

2.3 PRE-FILTERS

- A. Where pre-filters are indicated and for construction filters provide the following:
 - 1. Media: Cotton and synthetic pleated with an average efficiency of 25-30% and an average arrestance of 90-92% in accordance with ASHRAE test standard 52.1-1992.
 - 2. Thickness: Unless otherwise indicated thickness shall be 4".
 - 3. Media Support Grid: Welded wire on 1" centers with 96% free area bonded to the media.
 - 4. Filter Frame: High wet strength cardboard with diagonal support members bonded to the media on the entering side and exiting side of each pleat.
 - 5. Holding Frame: Galvanized steel with metal grid on outlet side, polyurethane gaskets, and spring fasteners.
 - 6. Farr 30/30 or equal.

2.4 FINAL FILTERS (CARTRIDGE TYPE)

- A. Where [cartridge type] final filters are indicated on the drawings provide the following:
 - 1. Media: High density microfine glass fibers, laminated to a reinforcing backing to form a lofted filter blanket.
 - 2. Efficiency: Filter media shall have an average efficiency of 80-85% and an average arrestance of 98% in accordance with ASHRAE test standard 52.1-1992. Minimum MERV 13.
 - 3. Thickness: Unless otherwise indicated thickness shall be 12".
 - 4. Media Support Grid: Welded wire on 1" centers with 96% free area bonded to the media.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

5. Contour Stabilizers: Aluminized zinc finished steel strips permanently installed on the entering and leaving side of the filter. Filter shall withstand 10" of static pressure drop without noticeable distortion.
6. Filter Frame: Aluminized zinc finished steel with filter pack mechanically and chemically bonded to eliminate air bypass. Provide aluminized zinc finished steel diagonal supports
7. Holding Frame: 16 Gauge galvanized steel with polyurethane gaskets, and positive sealing fasteners.
8. Farr Riga-Flo 100 or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Position each filter with clearance for normal service and maintenance.
- B. Install filters to prevent passage of unfiltered air.
- C. Do not operate fan system until filters are in place. During construction, all ductwork must be protected from dirt and debris. Remove filters used during construction and testing. Replace all filters in units with new filters of types specified.
- D. Unit operation during construction:
 1. Install minimum MERV 8 construction filters to protect all return ductwork from dirt and debris. Supply fan shall operate at all times.
- E. Unit not operating during construction:
 1. Install plastic sheet material over all supply and return openings to protect all ductwork from dirt and debris.
 2. Fans shall be off.
- F. Construction filter installation: Adhere all edges of filter with metal foil peel-n-stick tape having an acrylic adhesive.

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 1. Check for leakage of unfiltered air while system is operating.
- B. Air filter and installation will be considered defective if they do not pass.
- C. Prepare a report for each filter.

3.3 TESTING AND BALANCING

- A. Immediately prior to testing and balancing, install new filters of the same type that shall be permanently installed.

3.4 CLEANING

- A. After construction ends and prior to occupancy, and with all interior finishes installed, clean unit filter housings and install new filters.

END OF SECTION 234100

SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Listed gas vents.
 - 2. Guy wires and connectors.
- B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that factory-fabricated breeching, chimneys, and stacks; accessories; and components will withstand indicated seismic forces. Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Breeching, Chimneys, and Stacks: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of anchorage devices on which the certification is based and their installation requirements.
- B. Manufacturer's Certification: Manufacturer's certified vent system sizing calculations.
- C. Warranty: Warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain listed system components through one source from a single manufacturer.
 - 1. Exception(s): Vent kit(s) provided with boiler(s).

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.
- C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.5 COORDINATION

- A. Coordinate installation of wall and roof penetrations.
- B. Coordinate installation of supports.

1.6 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.
- B. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LISTED GAS VENT

- A. Manufacturers:
 - 1. Heat-Fab Inc.
 - 2. Hart & Cooley Inc.
 - 3. Metal-Fab, Inc.
 - 4. Schebler Co. (The).
 - 5. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
 - 6. Van-Packer Co.
- B. Description: Double-wall metal vents within the mechanical room and single wall metal vents within the existing masonry chimney. All vents tested according to UL 1738 and rated for 550° F continuously, with positive or negative flue pressure complying with NFPA 211 and suitable for condensing-gas appliances.
- C. Construction: Inner shell and outer jacket separated by a minimum ½" airspace.
- D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.
- E. Outer Jacket: Aluminized, or stainless steel. (Double-wall only)

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners. Fabricate from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
- G. Termination: One of the following:
 - 1. Stack cap designed to exclude 90 percent of rainfall.
 - 2. Round chimney top designed to exclude 98 percent of rainfall.
 - 3. Exit cone with drain section incorporated into riser.

2.2 GUYING AND BRACING MATERIALS

- A. Cable: Three galvanized, stranded wires. Total diameter of cable shall be as follows:
 - 1. Minimum Size: $\frac{1}{4}$ ".
 - 2. For Stack ID 4" to 15": $\frac{5}{16}$ ".
- B. Pipe: Three galvanized steel, $1\frac{1}{4}$ " diameter.
- C. Angle Iron: Three galvanized steel, 2" by 2" by $\frac{1}{4}$ ".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF LISTED VENTS AND CHIMNEYS

- A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent. Terminate three feet zero inches above nearest adjacent roof or wall surface within a ten foot radius.
- B. Seal between sections of positive pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- D. Not required for non-condensing appliances: Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.
- E. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- F. Erect stacks plumb to finished tolerance of no more than one inch out of plumb from top to bottom.
- G. All parts exposed above the roof shall be painted to match the roof

3.3 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 235100

SECTION 235113 - DRAFT CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Draft inducer fans.
- B. Related Requirements:
 - 1. Section 235100 "Breechings Chimneys and Stacks" for listed, refractory-lined metal breechings and field-fabricated metal breechings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of product.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Detail fabrication and assembly of hangers and seismic restraints.
 - 4. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. System vendor shall coordinate equipment product data submittal sheets and shall provide a comprehensive set of interfaced drawings which shall serve as the basis for system evaluation by the Architect.
- B. Submit the following to the Architect:
 - 1. Comprehensive set of mechanical venting calculations based on the Chimney Design Equation published in the ASHRAE Handbook. Calculations shall show flue gas volumes, pressure losses, fluctuations in natural draft at different loads and seasonal temperatures as well as estimated temperatures in each venting section to assure compliance with fan temperature rating and detect potential condensation issues. The

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

total draft range shall be documented by mechanical venting calculations based on the actual ASHRAE degree range for the geographical location of the installation. The calculations shall show the draft over the entire firing range at low, medium and high design temperatures.

2. Damper and actuator descriptive literature, dimensional diagram and electrical diagram.
3. Draft Control descriptive literature, dimensional diagrams and electrical diagrams.
4. Specification review with respect to submitted equipment identifying all areas of compliance and exceptions.
5. Certification of listing by recognized testing laboratory.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For draft control fans to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture and shall be of a standard catalog product.
- B. Mechanical draft system guaranteed to operate satisfactory and efficiently and to provide a constant draft that does not fluctuate more than +/- 0.01" W.C. under stable load conditions.
- C. Scheduled equipment performance is minimum capacity required.
- D. The entire system shall conform to UL378, Standard for Draft Equipment and UL60947, Standard for Low-Voltage Switchgear and Controlgear

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of draft inducer fans that fail in materials or workmanship within specified warranty period.
 1. Failure includes failure of the fan due to corrosion.
 2. Warranty Period: Two years from date of Substantial Completion.
 3. The power venter is covered by a 10-year warranty against corrosion perforation.

PART 2 - PRODUCTS

2.1 DRAFT INDUCER FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1. ENERVEX Inc.
2. Tjernlund Products, Inc.
3. Wing Draft Inducers.

B. Fan Construction:

1. It shall be a Type B, Spark Resistant Construction in compliance with AMCA Standard 99-0401. The power venter housing shall be type 316L stainless steel with a minimum thickness of 0.063". The power venter shall be of the direct drive design and rated for use with temperatures up to 575°F. The drive unit consisting of the impeller and the motor shall be removable from the housing without having to remove the entire fan from the chimney system. The power venter must be listed for use with all types of heating appliances and this shall be acknowledged in the installation manual.
2. The backward inclined impeller shall be made of non-ferrous material to eliminate the possibility of sparks and the potential of igniting unburned fuel and/or explosive gases.
3. The motor must be an air-cooled, maintenance-free variable speed permanent magnet motor with pre-lubricated and sealed ball bearings. It must have an integrated insulated rotor and shaft system that protects the bearings from damages by keeping discharge voltage peaks on a bare shaft surface below 4 volts. The motor must be sensor-less and rated at 92% efficiency (motor and controller) and able to operate as low as 50 RPM when controlled via an externally mounted motor controller to allow operation at elevated temperatures. The motor must have integrated protection against overloading, blocking over and under voltage and over-heating.

2.2 BALANCING DAMPERS

- A. Furnish balancing baffles, type BBF is constructed of 316L stainless steel housing for each boiler/appliance where specified by manufacturer if applicable. The BBF is UL listed to UL 378 Draft Equipment and in Canada to ULC/ORD-C378 Draft Equipment. Any alternate baffles shall carry the same listings.

2.3 MODULATING OVER-DRAFT DAMPER SYSTEM DESIGN

A. Construction:

1. The multi-blade damper shall be constructed of 316L stainless steel with a minimum of .036 inches.
2. The damper actuator must be microprocessor based.
3. The damper shall be listed to UL378 Standard for Draft Equipment at 1400°F.

2.4 DRAFT INDUCER CONTROL SYSTEM

- A. The modulating fan control must be a true PID-based control with infinitely variable speed settings and in a NEMA 1 rated enclosure. It shall interfere with the operation of the heating appliances by preventing burner operation during emergencies where a mechanical or electrical problem occurs.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. The features must be part of the compliance with UL378, Standard for Draft Equipment and UL60947 Standard for Low-Voltage Switchgear and Controlgear.
1. Able to control three functions (Exhaust Fan, Supply Fan, and Overdraft Damper) simultaneously via a single control.
 2. Programmable microprocessor for selective programming of, but not limited to, draft, intermittent vs. continuous fan operation, purge times, sensor sensitivity, alarm limits and delays, manual overrides, low/high limit fan speeds via the operating panel.
 3. A standard board that interlocks with up to 6 boilers/appliances so a call for heat activates the power venter and releases the individual burner once the pre-set draft has been established.
 4. "Plug-and-Play" self-check that detects connections, setting requirements and accessories during each start-up.
 5. An integrated and programmable proven draft function that can be set for automatic and manual reset.
 6. An integrated Operating Priority option, which allows one or more appliances to operate during electrical or mechanical failure of the fan, provided the draft requirement can be met and safe operation assured. Set up of a default Operating Priority must be possible, so the most important appliance(s) have highest priority during calls for heat. It must automatically check for fan operation every two hours and go back to normal operation if appropriate.
 7. Bearing cycle activation every 7 days if the power venter has not been operating during the past 7 day period.
 8. A normally open (NO) contact is available within the control to interlock with the Building Management System.
 9. An alarm function that will display the fault code on the LCD display and signal an audible alarm (by others). The control shall log the last 10 fault codes.
 10. Ethernet port for TCP/IP networking:
 - a. Graphical web interface for monitoring the 0-10V in/outputs, alarms, and set points.
 - b. Upgrade of firmware can be done via the web interface to ensure controller is always up to date.
 - c. Remote monitoring and management capabilities standard, including the ability to adjust system configuration remotely.
 - d. Ability to upload or download configuration file via web interface or USB.
- C. The pressure sensor shall be certified for use with oil- or gas-fired appliances and shall include a chimney probe along with tubing for installation in the chimney or stack as shown on the manufacturer's submittal and feature:
1. The pressure drift shall be less than +/- 0.3% full scale, the offset longtime drift (1 year) shall not exceed +/- 0.0015 inWC (0.35Pa) and the sensor response time shall be less than 0.25 seconds.
- D. The Chimney Automation System will ensure that the draft set-point (in. W.C.) is reached and maintained within 20 seconds of burner light-off. This can be measured with an external manometer at the appliance outlet.
1. Ramp-up and ramp-down time of the fan will be no more than 20 seconds.
 2. The Chimney Automation System will maintain the draft set-point to within +/- 0.01" W.C.

3. The control will shut down the appliance(s) within 15 seconds if draft is not maintained as stated above.

- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 SEQUENCE OF OPERATION

- A. Each heating appliance must be interlocked with the control. Upon a call for heat, the control will activate the power venter to establish draft in the chimney system. Once the draft set-point is reached, the control will enable the appliance(s) calling for heat to fire. This sequence is repeated every time an appliance calls for heat without the control interrupting the sequencing of the heating appliances.
- B. When an appliance shuts down, the power venter will adjust its speed to satisfy the draft set-point. Once the last appliance has shut down, the power venter will continue to run in post-purge mode for a set period of time to remove residual flue gases.
- C. If proper draft cannot be maintained because of a mechanical or electrical failure, the control will go into alarm mode and the integrated proven draft function will shut down all appliances within 15 seconds. While in alarm mode, the control constantly monitors the draft. If the failure corrects itself or is corrected via intervention, the system will restart automatically.
- D. If the failure is not corrected, the control will utilize the integrated Operating Priority function. During a following call for heat, the control determines if one or more appliances can operate safely at the given draft conditions. If so, the heating appliance(s) will be able to operate without chimney fan operation. After two (2) hours, the control verifies chimney fan operation and, if present, the control will go back to normal operation. Otherwise, the control will continue to operate in Operating Priority mode. The self-check is repeated every two (2) hours infinitely. During a period without power venter operation, the control is in alarm mode to notify the Building Management System.
- E. If the power venter is out of commission for seven (7) consecutive days, the Bearing Cycle Activation function will allow the fan to operate at a low speed for a short time. This is automatically repeated every seven (7) consecutive days the chimney fan does not operate.

2.6 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
- B. Fan Motor: Electrically commutated motor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install listed components in a manner complying with the listing.
- B. Install draft inducer fans in single-wall vent section that is designed to couple with other vent materials.
- C. Secure draft inducer fans to appliances, breechings, or stacks with hardware compatible with connected materials.
- D. Install draft inducer fans with clearances for service and maintenance.
- E. Install intake duct that is sized according to manufacturer's written instructions.

3.2 OPERATING TESTS, START-UP, AND ON-SITE SERVICES

- A. System vendor's service organization shall employ service technicians having experience in all aspects of trouble shooting, corrective service, and preventive maintenance O&M reporting.
- B. After installation is completed:
 - 1. Test the operation of the chimney automation system and:
 - a. Increase and decrease draft setting to verify the mechanical draft system reacts as specified.
 - b. Increase and decrease firing rate to verify the mechanical draft system reacts as specified.
 - c. Verify that the ramp-up time during start up does not exceed 20 seconds. This is defined as the time from the burner is released until the draft settles at the specified draft value.
 - d. Use an external manometer (draft gauge) to verify that the draft does not drift more than +/- 0.01" W.C. during a stable load.
 - 2. Test safety control by firing boiler and:
 - a. Shut off the power venter.
 - b. Shut off the control.
- C. Provide services of factory representative of chimney automation system manufacturer to:
 - 1. Confirm proper installation of ventilator and controls.
 - 2. Start-up and adjust control and balancing baffles.
 - 3. Test individual controls for proper operation.
 - 4. Set draft for specified operation.
 - 5. Test safety system.
- D. Submit a written report signed by manufacturer's authorized representative, confirming that safety and operating controls have been properly installed.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.3 OPERATING INSTRUCTIONS

- A. Instruct Owner's Representative and designated personnel in the proper operation and maintenance of the packaged system

3.4 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 235113

SECTION 235216 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 ACTION SUBMITTALS

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other Work.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Warranty specified in this Section.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.
- C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- D. DOE Compliance:
 - 1. Not required for boilers in excess of 300,000 BTUH
 - 2. Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- E. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.7 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing boilers that fail in materials or workmanship within specified warranty period.
- B. Warranty Period:
 - 1. Boiler: Two years from date of Substantial Completion.
 - 2. Pressure Vessel / Heat Exchanger: Ten years from date of Substantial Completion for corrosion, thermal stress failure, material defects or workmanship.

PART 2 - PRODUCTS

2.1 CONDENSING BOILERS

- A. Manufacturers:
 - 1. Aerco International (BMK)
 - 2. Fulton (Endura +).
 - 3. Viessman (Vitrocrossal)
- B. Description: Factory-fabricated, -assembled, and -tested condensing boiler with heat exchanger sealed pressure-tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake; water supply, return, and condensate drain connections; and controls.
- C. Fabricate base and attachment to pressure vessel with reinforcement strong enough to resist boiler movement during a seismic event when boiler base is anchored to building structure.
- D. Condensing Boiler Components:
 - 1. Heat Exchanger: Type 316L, stainless-steel primary and secondary combustion chamber.
 - 2. Burner:
 - a. Fuel:
 - 1) Refer to drawings.
 - b. Blower:
 - 1) Centrifugal fan to operate only during start of each burner sequence.
 - c. Motor: Refer to section "Motors"
 - 3. Gas Train:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- a. Combination gas valve with manual shutoff and pressure regulator. Provide separate gas regulator for each boiler. Include 100 percent safety shutoff with electronic flame supervision.
4. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
5. Casing:
 - a. Control Compartment Enclosure: NEMA 250, Type 1A.
 - b. Finish: Factory standard protective finish.
 - c. Insulation: Minimum 2" thick. Surrounding the heat exchanger.
 - d. Draft Hood: Integral.
 - e. Combustion-Air Connection: Inlet duct collar and sheet metal closure over burner compartment.
6. Mufflers:
 - a. Required for pulse combustion.
 - b. Carbon steel intake muffler and stainless steel exhaust muffler.
7. Condensate Neutralization:
 - a. Non-metallic container filled with lime stone chips or other neutralizing media.
 - b. Neutralization container shall act as a trap and shall drain through an air gap to a floor drain.
 - c. Neutralization container may serve multiple boilers.

2.2 BOILER TRIM

- A. Include devices sized to comply with:
 1. ANSI B31.1, "Power Piping" when boiler operating pressure exceeds 160 psig.
 2. ANSI B31.9, "Building Services Piping." when boiler operating pressure is equal to or less than 160 psig.
- B. Aquastat Controllers:
 1. Operating.
 2. Firing rate.
 3. High limit.
- C. Safety Relief Valve: ASME rated to limit pressure in the boiler. Pressure setting shall be as recommended by the boiler manufacturer.
- D. Boiler Air Vent: Automatic.
- E. Drain Valve: Minimum 3/4" hose-end ball valve.

2.3 BURNER OPERATING CONTROLS

- A. Description: To maintain safe operating conditions, burner safety controls shall limit the operation of the burner.
 1. High Temperature and Pressure Cutoff: Independent of the high limit controller an automatic reset shall stop the burner if operating conditions rise above maximum boiler design pressure or temperature.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be automatic reset type.
3. Alarm Bell: Factory mounted on control panel with silence switch shall sound alarm for above conditions.

2.4 BOILER OPERATING CONTROLS

- A. Refer to Section "Building Automation System."
- B. Control Panel: Electric, factory-fabricated, and field-installed panel to control boiler burner firing rate and sequence boilers to maintain input rate required by BAS.
- C. Building Automation System Interface: Factory-installed hardware and software to enable building automation system to monitor and control set point and display boiler status and alarms.

2.5 ELECTRICAL POWER

- A. Single-Point Field Power Connection: Factory installed other electrical devices necessary to provide a single-point field power connection to boiler.
 1. House in NEMA 250, Type 1 enclosure.
 2. Wiring shall be numbered and color-coded to match wiring diagram.
 3. Install factory wiring outside of an enclosure in a metal raceway.

2.6 VENTING

- A. Refer to section 235100 "Breechings, Chimneys, and Stacks".

2.7 SOURCE QUALITY CONTROL

- A. Test and inspect boilers prior to shipping in accordance with the ASME Boiler and Pressure Vessel Code: Section I, for high-pressure boilers and Section IV, for low-pressure boilers.
- B. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

PART 3 - EXECUTION

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.1 EXAMINATION

- A. Before boiler installation, examine concrete housekeeping pads, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
 - 1. Boiler locations indicated on Drawings are approximate. Determine exact locations before roughing in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

- A. Install boilers level on concrete housekeeping pad.
- B. Concrete Bases: Anchor boilers to concrete base as recommended by boiler manufacturer.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18" centers around full perimeter of base.
 - 2. Place and secure anchorage devices using setting drawings, templates, diagrams, instructions, and directions furnished with the boiler and items to be embedded.
- C. Vibration Isolation: Rubber pads with a minimum static deflection of 0.25."
- D. Install gas-fired boilers according to NFPA 54.
- E. Assemble and install boiler trim.
- F. Install electrical devices, vent kit, and other accessories furnished with boiler but not factory mounted.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service.
 - 1. Exception: Boilers included as part of an HVAC Packaged Pumping System.
- C. Connect gas piping full size to boiler gas inlet with union, valve, and full size eight inch long dirt leg.
- D. Provide a separate gas pressure regulator in gas piping train to each boiler. Providing one gas regulator serving multiple boilers is not acceptable.
- E. Connect hot water piping to supply and return boiler tapings with shutoff valve and union or flange at each connection.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- F. Install piping from safety relief valves to six inches above concrete housekeeping pad unless indicated otherwise.
- G. Connect vent kit to boiler as recommended by boiler manufacturer.
- H. Install piping adjacent to boiler to allow service and maintenance.
- I. Ground equipment.
- J. Connect wiring.
- K. 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.

3.4 STARTUP SERVICE

- A. Engage a factory authorized service representative to test, inspect, and adjust boiler components and equipment installation and to perform startup service.
- B. Perform installation and startup checks according to manufacturer's written instructions.
- C. Closed Loop Water Chemistry: Test water chemistry of water loop served by boilers and confirm it complies with boiler manufacturer's requirements. Do not startup boilers until water or water/glycol mixture (if applicable) complies with manufacturer's requirements.
- D. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
- E. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
- F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- G. Adjust initial temperature set points.
- H. Set field adjustable switches and circuit breaker trip ranges as indicated.
- I. Occupancy Adjustments: Within 12 months of date of Substantial Completion and when the temperature is below forty degrees F., provide onsite service. Adjust system to suit actual occupied conditions.
- J. Within two weeks of Substantial Completion, prepare a written report that documents testing procedures and results.
- K. Within two weeks of Occupancy Adjustments, prepare a written report that documents adjustments made.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.5 DEMONSTRATION

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

END OF SECTION 235216

SECTION 236416 - CENTRIFUGAL WATER CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Packaged, water-cooled, electric-motor-driven centrifugal chillers.
 - 2. Microprocessor-based controls complying with ASHRAE 135.
- B. Related Section:
 - 1. Division 23 Section "Refrigerant Detection and Alarm" for refrigerant monitors, alarms, supplemental breathing apparatus, and ventilation equipment interlocks.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.
- C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.
- D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.
- E. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.
- F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.
- G. VSD: Variable speed drive.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1.4 SUBMITTALS

- A. Pre-Submittal Meeting: A representative of the manufacturer producing equipment provided under this Section of the specifications shall attend a meeting for the purpose of coordinating with the contractor performing work under section "Building Automation System." The Contractor shall arrange the meeting. Submittals shall be essentially complete and a pre-submittal shall be provided one week prior to the meeting.
- B. Product Data: For each type of product indicated. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
 - 1. Performance at ARI standard conditions and at conditions indicated.
 - 2. Performance at ARI standard unloading conditions.
 - 3. Minimum evaporator flow rate.
 - 4. Refrigerant capacity of chiller.
 - 5. Fluid capacity of evaporator, condenser.
 - 6. Characteristics of safety relief valves.
 - 7. Minimum entering condenser-fluid temperature.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, load distribution, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- D. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural supports.
 - 2. Piping roughing-in requirements.
 - 3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
 - 4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.
- E. Certificates: For certification required in "Quality Assurance" Article.
- F. Source quality-control reports.
- G. Startup service reports.
- H. Operation and Maintenance Data: For each chiller to include in emergency, operation, and maintenance manuals.
- I. Warranty: Sample of special warranty.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1.5 QUALITY ASSURANCE

- A. ARI Certification: Certify chiller according to ARI 550 certification program.
- B. ARI Rating: Rate chiller performance according to requirements in ARI 550/590.
- C. ASHRAE Compliance:
 - 1. ASHRAE 15 for safety code for mechanical refrigeration.
 - 2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2010.
- E. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, as applicable to chiller design. For chillers charged with R-134a refrigerant, include an ASME U-stamp and nameplate certifying compliance.
- F. Comply with NFPA 70.
- G. Comply with requirements of UL and include label by a qualified testing agency showing compliance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Ship each chiller with a full charge of refrigerant. Charge each chiller with nitrogen if refrigerant is shipped in containers separate from chiller.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of chillers that fail in materials or workmanship within specified warranty period.
 - 1. Extended warranties include, but are not limited to, the following:
 - a. Complete chiller including refrigerant charge.
 - b. Parts and labor.
 - c. Loss of refrigerant charge for any reason.
 - d. Chiller plant controls
 - 2. Warranty Period: Three years from date of Substantial Completion.

3. Extended Warranty: The compressor shall have a 10 year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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. Daikin
 2. Multistack
 3. Smardt

2.2 GENERAL

- A. Description: Factory-assembled and -tested chiller complete with compressor, compressor motor, compressor motor controller, lubrication system, evaporator, condenser, controls, interconnecting unit piping and wiring, and indicated accessories. The evaporator, condenser, and expansion valve shall be configured to operate as a single refrigerant circuit unless otherwise specified. The chiller unit compressors shall be designed for mechanical and electrical isolation to facilitate service and removal
- B. Unit shall consist of one or more magnetic bearing, oil-free centrifugal compressors with integrated variable frequency drive, refrigerant flooded evaporator, water cooled condenser and operating controls with equipment protection.
- C. Performance: Refer to schedule for specific operating conditions.
- D. Evaporator shall be designed to allow for the flow rate to be reduced to the rate of 1 gpm per ton without entering laminar flow to allow for variable chilled water flow and facilitate chilled water pump energy savings. The chiller shall be able to operate in a stable fashion at this condition for at least 8 hours continuously independent of condenser water flow rate or condenser water temperature relief.
- E. Condenser shall be designed to allow for the flow rate to be reduced to 1.5 gpm per ton without entering laminar flow to allow for variable condenser water flow and facilitate condenser water pump energy savings. The chiller shall be able to operate in a stable fashion at this condition for at least 8 hours continuously independent of chiller water flow rate or condenser water temperature relief.
- F. Minimum entering condenser water temperature shall be 12°F above leaving chilled water temperature. Chiller shall be able to operate in these conditions for at least 8 hours continuously to provide condenser water relief and allow compressor energy savings. Chiller shall be able to vary the condenser water temperature to the minimum condition independently of condenser water flow rate and chilled water flow rate.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- G. Each compressor shall be electrically and mechanically isolated so that if a compressor fails or needs service it can be serviced or removed from the chiller without disabling the other compressors or the chiller. The chiller shall be able to operate with the remaining compressors with (1) or more compressors removed.

2.3 COMPRESSOR-DRIVE ASSEMBLY

- A. Description: Each unit shall include one or more Turbocor, magnetic bearing, and variable-speed centrifugal compressors. Integrated variable frequency drive shall operate with inlet guide vanes.
- B. Compressor:
1. Compressors shall be of semi-hermetic centrifugal design and operate oil-free with 3 or more compressors, two-stages of compression, magnetic bearings, movable inlet guide vanes and integrated variable frequency drive system.
 2. The compressor shall be capable of coming to a controlled stop in the event of a power failure. The unit shall be capable of initializing an automatic restart in the case of power failure.
 3. Each compressor shall have integrated microprocessor control capable of capacity and safety control.
 4. Each compressor shall be installed with individual suction, discharge and motor cooling refrigerant line isolation valves. Chillers without discharge line isolation valves that rely on non return valves in discharge line for compressor removal shall not be accepted.
 5. Refrigerant Discharge line shall has a combination of shut off and check valve, Blank seal are not acceptable.
 6. Guide Vanes: Modulating with factory mounted electric operator, suitable for capacity reduction down to fifteen (15) percent of specified load without hot gas bypass.
- C. Motors:
1. Permanent-magnet, synchronous hermetically sealed motor of sufficient size to effectively provide compressor horsepower requirements. Motor shall include soft-start capabilities with an inrush current of no more than 4 amps. Motor shall be liquid refrigerant cooled with internal thermal overload protection devices embedded in the winding of each phase.
 2. Compressor motor and chiller unit shall include variable-frequency speed controls to match cooling load demand to compressor speed and inlet guide vane position.
 3. Each compressor shall be equipped with a 5% impedance AC line reactor and individual disconnect or circuit breaker.

2.4 REFRIGERATION

- A. Refrigerant:
1. Type: R-134a; ASHRAE 34, Class A1.
 2. Compatibility: Chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Refrigerant Flow Control: Manufacturer's standard refrigerant flow-control device satisfying performance requirements indicated.
- C. Pressure Relief Device:
 - 1. Comply with requirements in ASHRAE 15 and in applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. For Chillers Using R-123: Spring-loaded, pressure relief valve; single- or multiple-reseating type.
 - 3. For Chillers Using R-134a: ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger. Condenser shall have dual valves with one being redundant and configured to allow either valve to be replaced without loss of refrigerant.
- D. Refrigeration Transfer: Provide service valves and other factory-installed accessories required to facilitate transfer of refrigerant from chiller to a remote refrigerant storage and recycling system. Comply with requirements in ASHRAE 15 and ASHRAE 147.

2.5 EVAPORATOR

- A. Description: Shell-and-tube design with water in tubes and refrigerant surrounding tubes within shell. Shell is separate from condenser.
- B. Shell Material: Carbon-steel rolled plates with continuously welded seams or seamless pipe.
- C. Designed to prevent liquid refrigerant carryover from entering compressor.
- D. Provide evaporator with sight glass or other form of positive visual verification of liquid-refrigerant level.
- E. Tubes:
 - 1. Individually replaceable from either end and without damage to tube sheets and other tubes.
 - 2. Mechanically expanded into end sheets and physically attached to intermediate tube sheets.
 - 3. Material: Copper.
 - 4. Nominal OD: 3/4 or 1 inch.
 - 5. Minimum Wall Thickness: Manufacturer's choice.
 - 6. External Finish: Manufacturer's standard.
 - 7. Internal Finish: Enhanced or smooth.
- F. End Tube Sheets: Continuously welded to each end of shell; drilled and reamed to accommodate tubes with positive seal between fluid in tubes and refrigerant in shell.
- G. Intermediate Tube Sheets: Installed in shell and spaced along length of tube at intervals required to eliminate vibration and to avoid contact of tubes resulting in abrasion and wear.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2.6 CONDENSER

- A. Description: Shell-and-tube design with water in tubes and refrigerant surrounding tubes within shell. Shell is separate from evaporator.
- B. Shell Material: Carbon-steel rolled plates with continuously welded seams or seamless pipe.
- C. Designed to prevent direct impingement of high-velocity hot gas from compressor discharge on tubes.
- D. Provide condenser with sight glass or other form of positive visual verification of refrigerant charge and condition.
- E. Tubes:
 - 1. Individually replaceable from either end and without damage to tube sheets and other tubes.
 - 2. Mechanically expanded into end sheets and physically attached to intermediate tube sheets.
 - 3. Material: Copper.
 - 4. Nominal OD: 3/4 or 1 inch.
 - 5. Minimum Wall Thickness: Manufacturer's choice.
 - 6. External Finish: Manufacturer's standard.
 - 7. Internal Finish: Enhanced or smooth.
- F. End Tube Sheets: Continuously welded to each end of shell; drilled and reamed to accommodate tubes with positive seal between fluid in tubes and refrigerant in shell.
- G. Intermediate Tube Sheets: Installed in shell and spaced along length of tube at intervals required to eliminate vibration and to avoid contact of tubes resulting in abrasion and wear.

2.7 INSULATION

- A. Closed-cell, flexible elastomeric thermal insulation complying with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Thickness: 3/4 inch.
- B. Adhesive: As recommended by insulation manufacturer.
- C. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator shell and end tube sheets, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.
 - 1. Apply adhesive to 100 percent of insulation contact surface.
 - 2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3. Seal seams and joints to provide a vapor barrier.
4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.

2.8 ELECTRICAL

- A. Factory installed and wired, and functionally tested at factory before shipment.
- B. Single-point, field-power connection to non-fused disconnect switch. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 42,000 A.
 1. Branch power circuit to each motor, electric heater, dedicated electrical load, and controls with disconnect switch or circuit breaker.
 2. NEMA ICS 2-rated motor controller for auxiliary motors, hand-off-auto switch, and overcurrent protection for each motor.
 3. Control-circuit transformer with primary and secondary side fuses.
- C. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.

2.9 MOTORS

- A. Refer to Division 23 Section "Motors" for general requirements.
- B. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 1. Open-drive motors shall have flanged or flexible coupling suitable for direct connection to compressor.

2.10 MAGNETIC ENCLOSED CONTROLLERS

- A. Enclosure: Unit mounted, NEMA ICS 6, Type 1, with hinged access door with lock and key or padlock and key.
- B. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer of enough capacity to operate connected pilot and indicating and control devices.
- C. Overload Relay: Shall be sized according to UL 1995 or shall be an integral component of water chiller control microprocessor.
- D. Solid-State, Reduced-Voltage Controller: NEMA ICS 2.

2.11 MOTOR STARTER

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

A. VARIABLE SPEED DRIVE (VSD), UNIT MOUNTED

1. The centrifugal water chiller shall be furnished with a liquid cooled variable speed drive (VSD) as shown on the drawings. The VSD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested.
2. The VSD will be specifically designed to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. The VSD control logic shall optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If a surge is detected, VSD surge avoidance logic will make adjustments to move away from and avoid surge at similar conditions in the future.
3. The VSD efficiency shall be 97% or better at full speed and full load. Fundamental displacement power factor shall be a minimum of 0.96.
4. The VSD shall be solid state, microprocessor based pulse-width modulated (PWM) design. The VSD shall be voltage and current regulated. Output power devices shall be IGBT transistors.
5. Power semi-conductor and capacitor cooling shall be from a liquid cooled heatsink.
6. The centrifugal water chiller shall be furnished with a refrigerant cooled variable speed drive (VSD) to minimize maintenance and maximize cooling efficiency. If a water cooling design is used, especially an open loop condenser water design, a cleanable shell and tube heat exchanger must be supplied. Plate and frame heat exchangers are not allowed. The VSD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested.
7. The VSDs shall each be furnished in a NEMA 1 metal enclosure having as minimum a short circuit withstand rating of 65,000 amps per UL 508. It will include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars and all components properly segregated and completely enclosed in a single metal enclosure.
 - a. Enclosure shall include a padlockable, door-mounted circuit breaker with shunt trip and AIC rating of 65,000 amps.
 - b. The entire chiller package shall be UL/CUL listed.
8. The VSD shall be tested to ANSI/UL Standard 508 and shall be listed by a Nationally Recognized Testing Laboratory (NRTL) as designated by OSHA.
9. Compliance to recommendations stated in IEEE 519-1992 (not required for Daikin magnetic bearing chiller due to pre-approved analysis with standard internal harmonic filtration)
 - a. The VSD design shall include as standard integrated active rectification control system to limit total demand distortion (TDD) in current at the VSD to less than or equal to 5-percent as measured at the VSD input. If optional active filters are used to meet the less than or equal to 5% TDD, then the losses associated with the filter shall be included in the chiller performance on the selection.
10. Input shall be nominal 480 volts, three phase, 60 hertz AC power, ± 10 percent of nominal voltage.
11. Line frequency 38-60 hertz.
12. The VSD shall include the following features:
 - a. All control circuit voltages are physically and electrically isolated from power circuit voltage.
 - b. 150% instantaneous torque available for improved surge control.
 - c. Soft start, adjustable linear acceleration, coast-to-stop.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- d. Adjustable current limiting and UL approved electronic motor overload protection.
 - e. Insensitivity to incoming power phase sequence.
 - f. VSD and motor protection from the following faults: - Output line-to-line short circuit protection - Line-to-ground short circuit protection - Phase loss at AFD input - Phase reversal / Imbalance - Over-voltage - Under-voltage - Over temperature
13. The following VSD status indicators shall be available to facilitate startup and maintenance: - Output speed in hertz and rpm - Input line voltage - Input line kW - Output/load amps - Average current in percent RLA - Load power factor - Fault - VSD transistor temperature
14. Service Conditions - at full output power. No external venting or heat exchangers shall be required.
- a. Operating ambient temperature 32°F-104°F (0°C-40°C).
 - b. Room ambient up to 95% relative humidity.
 - c. Elevation to 3300 feet (1000 meters). For every 300 feet above 3300 feet, the rated output current shall be decreased by one percent.
15. Warranties
- a. The variable speed drive shall be warranted by the manufacturer for a period of twelve months from the date of installation. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory-authorized on-site service.

2.12 SOURCE QUALITY CONTROL

- A. Factory test and rate water chillers, before shipping, according to ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle." Stamp with ARI label. Provide a factory certified report for the full load run test showing that chiller tested within submitted performance.
- B. Factory test heat exchangers hydrostatically at 1.50 times the design pressure.
- C. Factory test and inspect evaporator and water cooled-condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.
- D. Factory test and inspect water boxes at 150 percent of working pressure.
- E. Rate sound power level according to ARI 575 procedure.

2.13 CONTROLS

- A. Control: Standalone and microprocessor based, with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.
- B. Enclosure: Unit mounted, NEMA 250, Type 1, hinged or lockable; factory wired with a single-point, field-power connection and a separate control circuit.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- C. Operator Interface: Multiple-character digital or graphic display with dynamic update of information and with keypad or touch-sensitive display located on front of control enclosure. In either imperial or metric units selectable through the interface, display the following information:
1. Date and time.
 2. Operating or alarm status.
 3. Fault history with not less than last 10 faults displayed.
 4. Set points of controllable parameters.
 5. Trend data.
 6. Operating hours.
 7. Number of chiller starts.
 8. Outdoor-air temperature or space temperature if required for chilled-water reset.
 9. Entering- and leaving-fluid temperatures of evaporator and condenser.
 10. Difference in fluid temperatures of evaporator and condenser.
 11. Fluid flow of evaporator and condenser.
 12. Fluid pressure drop of evaporator and condenser.
 13. Refrigerant pressures in evaporator and condenser.
 14. Refrigerant saturation temperature in evaporator and condenser shell.
 15. Compressor refrigerant suction and discharge temperature.
 16. Oil temperature.
 17. Oil discharge pressure.
 18. Phase current.
 19. Percent of motor rated load amperage.
 20. Phase voltage.
 21. Demand power (kilowatts).
 22. Energy use (kilowatt-hours).
 23. Purge suction temperature if purge system is provided.
 24. Purge elapsed time if purge system is provided.
- D. Control Functions:
1. Manual or automatic startup and shutdown time schedule.
 2. Entering and leaving chilled-water temperatures, control set points, and motor load limits.
 3. Current limit and demand limit.
 4. Condenser-fluid temperature.
 5. External chiller emergency stop.
 6. Variable evaporator flow.
- E. Manually Reset Safety Controls: The following conditions shall shut down chiller and require manual reset:
1. Low evaporator pressure or temperature; high condenser pressure.
 2. Low evaporator fluid temperature.
 3. Low oil differential pressure.
 4. High or low oil pressure.
 5. High oil temperature.
 6. High compressor-discharge temperature.
 7. Loss of condenser-fluid flow.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

8. Loss of evaporator fluid flow.
9. Motor overcurrent.
10. Motor overvoltage.
11. Motor undervoltage.
12. Motor phase reversal.
13. Motor phase failure.
14. Sensor- or detection-circuit fault.
15. Processor communication loss.
16. Motor controller fault.
17. Extended compressor surge.
18. Excessive air-leakage detection for chillers using R-123 refrigerant.

- F. Trending: Capability to trend analog data of up to five parameters simultaneously over an adjustable period and frequency of polling.
- G. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: view only; view and operate; and view, operate, and service.
- H. Control Authority: At least four conditions: Off, local manual control at chiller, local automatic control at chiller, and automatic control through a remote source.
- I. BAS Interface: Factory-installed hardware and software to enable the BAS to enable and disable the chillers, monitor and control chilled water temperature set point, and display chiller status and alarms. BACnet IP interface.
- J. VARIABLE EVAPORATOR FLOW CAPABILITY

1. The chilled water controller of each chiller shall include variable water-flow compensation capability to allow the chiller to respond quickly to accelerating or decelerating water. The variable water-flow control algorithm shall automatically adjust the control gain so that large changes in water-flow rate can be tolerated. The variable water-flow compensation capability shall allow control of the leaving chilled water temperature to within +/- 0.5F at a water flow rate change of 25% per minute and to within +/- 2F at a water flow rate change of 50% per minute.
2. The chiller shall be equipped from the chiller manufacturer with flow monitoring that shall provide feed-forward and auto-tuning control input to the chiller compressor capacity control. As flow changes are detected, the feed-forward logic shall work in concert with the water temperature control algorithms to initiate a change in compressor capacity proportional to the flow and resultant load change. In addition the change in flow shall cause the capacity controller to tune its control loop PID (proportional-integral-derivative) loop gains for best accuracy and stability.

2.14 FINISH

- A. Paint chiller, using manufacturer's standard procedures. Color of finish coat to be manufacturer's standard.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Provide Owner with quart container of paint used in application of topcoat to use in touchup applications after Project Closeout.

2.15 ACCESSORIES

A. Flow Switches:

1. Chiller manufacturer shall furnish a switch for each evaporator and condenser and verify field-mounting location before installation.
2. Paddle Flow Switches:
 - a. Vane operated to actuate a double-pole, double-throw switch with one pole field wired to the chiller control panel and the other pole field wired to the BAS.
 - b. Contacts: Platinum alloy, silver alloy, or gold-plated switch contacts with a rating of 10 A at 120-V ac.
 - c. Pressure rating equal to pressure rating of heat exchanger.
 - d. Construct body and wetted parts of Type 316 stainless steel.
 - e. House switch in a NEMA 250, Type 4 enclosure constructed of die-cast aluminum.
 - f. Vane length to suit installation.
3. Pressure Differential Switches:
 - a. Construction: Wetted parts of body and trim constructed of Type 316 stainless steel.
 - b. Performance: Switch shall withstand, without damage, the full-pressure rating of the heat exchanger applied to either port and exhibit zero set-point shift due to variation in working pressure.
 - c. Set Point: Screw type, field adjustable.
 - d. Electrical Connections: Internally mounted screw-type terminal blocks.
 - e. Switch Enclosure: NEMA 250, Type 4.
 - f. Switch Action: Double-pole, double-throw switch with one pole field wired to the chiller control panel and the other pole field wired to the BAS.

B. Vibration Isolation:

1. Chiller manufacturer shall furnish vibration isolation for each chiller.
2. Neoprene Pad:
 - a. Two layers of 0.375-inch- thick, ribbed- or waffle-pattern neoprene pads separated by a 16-gage, stainless-steel plate.
 - b. Fabricate pads from 40- to 50-durometer neoprene.
 - c. Provide stainless-steel square bearing plate to load the pad uniformly between 20 and 40 psig with a 0.12- to 0.16-inch deflection.

2.16 SOURCE QUALITY CONTROL

- A. Perform functional run tests of chillers before shipping.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Factory performance test chillers, before shipping, according to ARI 550/590.
 - 1. Test the following conditions:
 - a. Design conditions indicated.
 - 2. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.
- C. For chillers using R-134a refrigerant, factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. For chillers using R-123 refrigerant, factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Pressure test fluid side of heat exchangers, including water boxes, to 1.5 times the rated pressure. Pressure proof test refrigerant side of heat exchangers to a minimum of 45 psig. Vacuum and pressure test for leaks.
- E. For chillers located indoors, rate sound power level according to ARI 575.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine chillers before installation. Reject chillers that are damaged.
- B. Examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting chiller performance, maintenance, and operations before equipment installation.
 - 1. Final chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CHILLER INSTALLATION

- A. Install chillers on support structure indicated.
- B. Equipment Mounting: Install chiller on concrete bases using neoprene pads. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Charge chiller with refrigerant and fill with oil if not factory installed.
- E. Install separate devices furnished by manufacturer and not factory installed.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Division 23 Section "Hydronic Piping" and Division 23 Section "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to chiller to allow service and maintenance.
- C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with shutoff valve and pressure gage, flow meter, and drain connection with valve. Make connections to chiller with a flange or mechanical coupling.
- D. Condenser-Fluid Connections: Connect to condenser inlet with shutoff valve, flexible connector, thermometer, and plugged tee with pressure gage. Connect to condenser outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with shutoff valve and pressure gage, flow meter, and drain connection with valve. Make connections to chiller with a flange or mechanical coupling.
- E. Refrigerant Pressure Relief Device Connections: For chillers installed indoors, extend separate vent piping for each chiller to the outdoors without valves or restrictions. Comply with ASHRAE 15. Connect to chiller pressure relief device with flexible connector and dirt leg with drain valve.
- F. For chillers equipped with a purge system, extend separate purge vent piping for each chiller to the outdoors. Comply with ASHRAE 15 and ASHRAE 147.
- G. Connect each chiller drain connection with a union and drain pipe, and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that refrigerant charge is sufficient and chiller has been leak tested.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3. Verify that pumps are installed and functional.
 4. Verify that thermometers and gages are installed.
 5. Operate chiller for run-in period.
 6. Check bearing lubrication and oil levels.
 7. Verify that refrigerant pressure relief device is vented outside.
 8. Verify proper motor rotation.
 9. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.
 10. Verify and record performance of chiller protection devices.
 11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.
- C. Prepare test and inspection startup reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chillers. Video record the training sessions.

END OF SECTION 236416

SECTION 237200 – HIGH EFFICIENCY ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes
 - 1. Heat Exchanger Coils
 - 2. Hydronic Module
 - 3. System Controller
- B. Related Requirements:
 - 1. Section 237323 "Custom Air Handling Units".
 - 2. Section 237513 "Custom Energy Recovery Units".

1.3 SUBMITTALS

- A. Pre-submittal meeting: The contractor performing work under this section of the specifications shall attend a meeting for the purpose of coordinating with the control system. The meeting shall be held on the project site in the contractor's trailer or other location acceptable to the contractor. The contractor shall be responsible for arranging the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.
- B. Product Data: For each type of the following:
 - 1. Heat Exchanger Coils
 - 2. Hydronic Module
 - 3. System Controller
- C. Maintenance Data: For high efficiency energy recovery equipment and the controls to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.5 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Penetration Firestopping Systems" for fire and smoke wall and floor assemblies.

1.6 BUILDING AUTOMATION SYSTEM COORDINATION:

- A. Coordinate all interface requirements for a seamless operating system with Section "Building Management System".

PART 2 - PRODUCTS

2.1 MANUFACTURER

- 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. Konvekta USA Inc.

2.2 GENERAL

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- A. Provide a Run-Around Energy Recovery System, consisting of heat exchangers for supply and exhaust air handlers and a Hydronic Unit, having efficiencies as listed in the air handling unit and energy recovery unit coil schedules for both "Summer" and "Winter" conditions.
- B. The system shall be a multi-functional system, providing combined heat recovery and heating coils for the supply air handlers in winter operation and pre-cooling and reheat coils in summer operation.

2.3 HEAT EXCHANGER COILS

- A. The heat exchanger fins are of aluminum, 0.4mm thick, with spacing as defined in the coil data sheet, the headers of steel, coated to prohibit corrosion. Heat exchanger sizing and performance are according to attached coil data schedule.
- B. The heat exchangers are can be cleaned with high pressure water (up to 2600 psi), low-pressure steam, compressed air, hot water and detergent without damage or affecting recovery efficiency.
- C. All heat exchanger coils shall be coated in a baked phenolic coating, or equal, with chemical and corrosion resistance.
- D. Exhaust ERU coils are to be shipped to the ERU Manufacturer for installation within their unit. The supply side ERU coils shall be shipped to the AHU manufacturer for installation with their unit. Coils are sized as shown on the contract drawings. It is the responsibility of the Exhaust ERU and AHU supplier to size their equipment to accommodate these coils.

2.4 HYDRONIC MODULE

- A. The Hydronic Module contains the following elements installed/piped/wired and factory tested:
 - 1. 1 Centrifugal pump, 1 centrifugal redundancy pump incl. shut-off valves, each pump with a variable frequency drive, vibration damper and strainer.
 - 2. 1 Membrane expansion tank incl. check valves, pressure gauge, and pressure safety valve
 - 3. 1 Air Separator
 - 4. 1 Automatic bypass valve with drive for anti-freeze protection loop
 - 5. 1 Automatic control valve for exhaust by-pass
 - 6. Automatic zone control valves
 - 7. Balancing valves
 - 8. Manual shut-off valves
 - 9. Sight glass flow indicator
 - 10. Immersion pockets with PT100 temperature sensors built in
 - 11. Electrical cabinet with system controller
- B. The piping a part of the hydronic module is uninsulated. Insulation shall be under section "HVAC Insulation".

2.5 SYSTEM CONTROLLER

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- A. Demand-dependent regulation of the entire energy recovery system (reheat supply air temperature, circulation pumps, valves, heat exchangers, etc.), including controller hardware & software, display unit for energy efficiency, temperatures, volumetric flows. Built-in the electrical cabinet, mounted on Hydronic Module.
- B. The control software shall be based on a simulation/optimization algorithm with:
 - 1. Supply air set temperatures as set points or command signals (including reheat supply air set temperature in cooling mode)
 - 2. Glycol/Water temperatures and volumes in the supply air heat exchangers as the actuating variables
 - 3. Air volumes in the air handlers, outside air temperature, exhaust air temperatures and humidity as disturbance variables
- C. The simulation algorithm continuously calculates the theoretical system performance (energy recovery efficiency) based on all control variables, the pump and heat exchanger performance curves, and different Glycol/Water volumes pumped through the system. The optimization algorithm then sets the actuating variables based on the simulated optimal system performance.
- D. Controller Functions:
 - 1. Primary function: heat (winter operation) or pre-cool/reheat (summer operation) supply air to supply air set temperature
 - 2. Continuous measurement and recording of system operating parameters
 - 3. Starting/shutting down pumps and regulating flow rate (pump speed) for optimal energy recovery
 - 4. Minimizing pump power demand (flow rate increase only if additional pump power demand is smaller than marginal energy recovery)
 - 5. When reaching/exceeding supply air temperature (set-point provided by Building Management System), the energy recovery system is turned down
 - 6. Freeze protection at exhaust air heat exchangers, taking into account the exhaust air humidity
 - 7. Pre-cool and reheat supply air to re-set temperature in summer operation
- E. The system controller needs the following Input Signals from system components not installed on the Hydronic Unit:
 - 1. From Building Management System:
 - a. Operating mode (heating, cooling, reheat, or economizer mode)
 - b. Supply air set temperatures for each supply air handler
 - c. Air volumes in each supply and exhaust air handler
 - d. Air temperature before and after each coil bank (2 data points in each supply air handler without reheat coil, 4 data points in each supply air handler with reheat coil, 2 data points in each exhaust air handler).
 - 2. Other requirements:
 - a. The system control cabinet requires one power supply line (460V/3-phase).
 - b. Internet access to the ERS controller provided by Owner/BMS contractor.

PART 3 - EXECUTION

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.1 INSTALLATION

- A. Install heat exchangers (energy recovery coils) and hydronic module in compliance with system manufacturer's installation guidelines.
- B. Flush piping and fill system with premixed Propylene Glycol / Water mixture as defined on the coil data sheet.
- C. Provide/install temperature sensors in AHUs/EAHUs and connect either to the energy recovery system's electrical/control cabinet or the BMS and interface control cabinet with BMS. Install phone line or internet access to system controller.
- D. Install communication cable between electrical/control cabinet and BMS.
- E. Mechanical contractor or AHU manufacturer to install three 3-way automatic control valves to bypass reheat coils (valves delivered loose by energy recovery system manufacturer).
- F. Electrical contractor to install wiring from above referenced 3-way automatic control valves to controller cabinet.

3.2 SYSTEM STARTUP

- A. Remote functional inspection of system controller via phone/modem approximately two weeks before start-up.
- B. On-site start-up:
 - 1. Review/inspection of heat exchanger and piping installation
 - 2. Review/inspection of sensors and valves installation
 - 3. Inspection/programming of pump frequency converters
 - 4. Functional testing of valves and frequency converters
 - 5. Testing of interface with Building Management System
 - 6. Instruction/training of owner's operating/maintenance staff for a period of 8 working hours at project work site.
- C. Start-up takes place in cooperation with HVAC and BMS suppliers

3.3 REMOTE MONITORING, AUTOMATIC REPORTING, OPTIMIZATION

- A. Remote monitoring and optimization of system parameters and performance shall be done by the Manufacturer during the first year of operation (via phone/modem). Many system malfunctions or errors (such as installation or wiring errors, erroneous set values, etc.) can only be detected by monitoring the dynamic system operation. Target values are calculated by means of a system-specific simulation program (built in the system controller), taking into account the measured air temperatures and volumes and the performance curves/maps of heat exchangers, pumps and valves.

- B. Dynamic operations data, static measurements and computed values are made available to the Customer via Internet access. Automatic reporting includes:
 - 1. Calculation and comparison of Target/Actual energy recovered
 - 2. Monitoring of important functions and components of the system
 - 3. Display and cause-analysis of malfunctions or deviations from target values

3.4 SYSTEM GUARANTEE & VERIFICATION (FIRST YEAR OF OPERATION)

- A. Manufacturer shall assume responsibility for the optimal and malfunction-free operation of the energy recovery system during the first year of operation and shall guarantee the system efficiency and/or energy recovery rates at the specified nominal conditions.
- B. Manufacturer shall verify, at the end of the first year of operation that the guaranteed values have been achieved (or are not met, respectively):
 - 1. Verification of guaranteed efficiency and/or heat recovery rate
 - 2. Verification of optimal and malfunction-free operation of the entire energy recovery system
 - 3. Verification of total energy saved/recovered, corresponding to calculated target values

3.5 ROUTINE MAINTENANCE

- A. The system controller shall alert the operating staff of pending routine maintenance (e.g. pump routine maintenance).

END OF SECTION 237200

SECTION 237323 – CUSTOM AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Variable-air-volume custom air handling units serving terminal units.

1.3 PERFORMANCE REQUIREMENTS

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified or as denoted on the drawings and schedule.
- B. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 100 percent of the design static pressures indicated, without panel joints exceeding a deflection of $L/240$ where "L" is the unsupported span within the completed casings.
- C. Fans shall be rated in accordance with AMCA Standard 210 for performance and AMCA Standard 301 for sound and shall bear the AMCA seal.
- D. Motors shall meet requirements of NEMA, IEEE, ANSI, and NEC standard.
- E. Coils shall be rated in accordance with ARI Standard 410.
- F. Equipment within unit shall be UL listed where applicable.
- G. Complete air handling unit shall bear an ETL Label under UL Standard 1995.
- H. Unit construction shall meet NFPA 90 requirements and ASHRAE 62-1.
- I. The installation of electrical components shall meet the requirements of the National Electrical Code (NFPA 70).

1.4 SUBMITTALS

- A. Pre-submittal Meeting: A representative of the manufacturer producing equipment being provided under this section of the specifications shall attend a meeting for the purpose of coordinating with the contractor performing work under Section "Building Automation

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

System". The meeting shall be held on the job site in the Contractor's trailer or at another location satisfactory to the Architect and Owner. The Contractor shall arrange the meeting. Submittals shall be essentially complete at the time of the meeting so detailed control coordination items can be discussed.

- B. Product Data: For each custom air-handling unit indicated.
1. Shop drawings and datasheets that indicate unit components, installed dimensions, shipping and handling dimensions, weights, unit model number, capacities and clearances required for service/operation.
 2. Summary of all utility requirements (power/flow required, connection size, connection type, etc.) including but not limited to:
 - a. Electrical connections.
 - b. Hydronic connections.
 - c. Steam connections.
 - d. Drain connections.
 - e. Air (ductwork) connections.
 3. Cabinet materials, finishes, and accessories.
 4. Manufacturer's performance of each component and the custom air-handling unit in its entirety including:
 - a. Performance data for fans and coils.
 - b. Input data used for the selection.
 - c. Net capacity for all components stating the conditions used.
 - d. Rated load.
 - e. Fan curves..
 - f. Internal static pressure loss calculations, including fan system effects.
 - g. Finish and color chart.
 - h. Filters with performance characteristics for the worst case stated operating condition.
 5. Test procedures for the tests indicated to be performed at the manufacturer's facility.
 6. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 7. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Coordination Drawings: Prepare drawings for construction. Do not submit with Shop Drawings but have available for inspection at the job site. Show mechanical room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: Provide manuals with detailed description of installation, operation, and maintenance, including the following:
1. All approved "Certified for Construction" drawings.
 2. Written recommendations for field storage, both indoors and outdoors.
 3. Installation requirements including assembly instructions, lifting requirements and adjustments.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

4. Manufacturer's literature describing each piece of equipment including operation and maintenance instructions.
 5. Factory test reports.
 6. Manuals shall be provided within three weeks after shipment of the air handling units.
- F. Provide a printed copy of installation, operation, and maintenance (service) manual with equipment shipment.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air handling air-handling units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air handling units and components.
- D. ARI Certification: Air handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- E. Comply with NFPA 70.
- F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2013, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- G. ASHRAE/IESNA 90.1-2013 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2013, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

- A. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Filters: 2 sets of each pre-filter required and 1 set of final filters. Refer to Section "Filters" for requirements
 2. Gaskets: One set for each access door.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Buffalo (BOD)
 2. Governair
 3. Mammoth
 4. Temtrol
 5. TMI Climate Solutions
 6. Ventrol

2.2 CUSTOM AIR HANDLING UNITS

- A. General Descriptions:
1. Units shall be sizes as shown on the drawings. Units shall be completely factory assembled and tested. The equipment's cooling, heating, humidifying, ventilating, exhausting capacity and performance shall meet or exceed that shown on the schedule.
 2. Tags and decals to aid in service or indicate caution areas shall be provided.
 3. All VFD's will be provided as specified in section 230514 and shall be factory mounted and wired. VFD's may be shipped loose for field installation if required for shipping.
- B. Cabinet Construction:
1. Units shipped in multiple sections shall be engineered for field assembly and testing. Provide full length perimeter angles located inside units at shipping splits to allow for field bolting of modular sections. Unit manufacturer to provide necessary hardware, sealing gasket, and caulk required to field join and seal the shipping split sections.
 2. The manufacturer's standard cabinet construction shall result in a unit leakage rate that shall not exceed 1% of unit capacity at 1.15 times the operating static pressure.
 3. All panels shall be 2 inch double wall and fabricated of a 0.063 inch (14ga) embossed aluminum outer shell with a 0.050 inch (16ga) smooth aluminum inner liner.
 4. All unit casing panels and roof shall be insulated with 2 inch thick foam insulation fill injected between the outer wall and inner liner with a minimum U-value of 0.0735 btu/hr-sqft- deg F. The unit casing shall be of no through metal construction using aluminum extrusions with a polyurethane resin thermal bridge.
 5. All walls downstream of the cooling coil (inclusive) shall have an inner liner comprised of 18 ga 304 stainless steel.
 6. All panel seams are to be externally caulked with sealant.
- C. Base Construction:
1. The units shall be constructed on a minimum 8 inch tall, structural aluminum full perimeter channel base to minimize unit weight for installation. Floor shall be insulated with minimum 2 inch thick foam insulation. Tubular or formed channel steel shall not be used as the perimeter base unless the base is comprised of stainless steel. The under floor insulation shall be protected with a 0.040 inch (18ga) smooth aluminum coversheet.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

Floors and walls shall be designed so that deflection is limited to no more than $L/300$ of the span dimension at unit operating pressures.

2. The base frame shall have fixed lifting lugs. The lifting lugs shall be fabricated from 1/2 inch plate steel with an appropriate rigging hole. Lifting lugs shall be located and sized to allow rigging and handling of the unit.
3. Floor Construction:
 - a. The unit floor is to be constructed of a minimum of 3/16 inch aluminum treadplate.
 - b. Floor Seams: Continuously-welded seams.
 - c. Floor shall be welded to the base substructure and designed to prevent oil canning.

D. Drain Pans

1. Drain pans serving cooling and heat recovery coils shall be continuously-welded, positively draining, triple-sloped and constructed from 12 ga 304 stainless steel and shall extend a minimum of 3 inches upstream and 18 inches downstream. The drain pan shall be recessed with a minimum depth of 2 inches at the drain. Drain pan shall have a minimum connection size of 2 inches or sufficient size to remove condensate (whichever is greater) extended to the exterior for connection by others. Plastic drain pans and plastic drain lines are not acceptable. Caulking of the drain pan seams is unacceptable. The drain pan shall be insulated with a minimum of 1.5 inches thick foam insulation and covered by a minimum 0.040 inch (18ga) smooth aluminum coversheet.
2. Drain pans serving non-coil devices shall be continuously-welded, positively draining, triple-sloped and constructed from 3/16 inch aluminum treadplate and shall extend a minimum of 3 inches upstream and 24 inches downstream. The drain pan shall be recessed with a minimum depth of 4 inches at the drain. Drain pan shall have a minimum connection size of 2 inches or sufficient size to remove condensate (whichever is greater) extended to the exterior for connection by others. Plastic drain pans and plastic drain lines are not acceptable. Caulking of the drain pan seams is unacceptable. The drain pan shall be insulated with a minimum of 1.5 inches thick foam insulation and covered by a minimum 0.040 inch (18ga) smooth aluminum coversheet.

- E. Condensate Drainage: The custom air handling units shall use Trent Technologies model CXXBV condensate drain. Air handling unit manufacturer shall coordinate and provide factory openings in the casing to support the CXXBV condensate drain. Contractor shall provide kit and field install condensate drain in accordance with Trent Technologies installation instructions.

F. Access Doors:

1. Access doors shall be same construction as unit casing; double wall, completely insulated between the interior and exterior sheet metal of the door and attached to an extruded aluminum frame.
2. All doors shall have an offset-frame incorporating a double gasket seal.
3. Thermal Break: Provide doors and door frames downstream of the cooling coil section with an integral thermal break.
4. Hinges: Provide each door with a single-continuous heavy-duty stainless piano hinge.
5. High compression latches, operable from both sides of the door, shall be used. Latches shall be Ventlok 260 Standard Finish.
6. Minimum Door Size: The nominal door size shall be minimum 24 inches x 72 inches or as tall as unit allows, and shall open against the section's operating pressure.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

7. Door viewports shall be a minimum of 12 inches x 12 inches and constructed of a thermal double-paned Mylar shatter proof design with inert gas. Viewports shall be rated to prevent transmission of UVC rays.
 8. Test Port: Provide each door with a 3/4 inch NPT, schedule 80 CPVC test port complete with end cap.
 9. Door Stops: Door stops shall be provided to prevent the doors being opened wide enough to damage to the door, casing, or components.
 10. Drip Cap: All inswing doors on outdoor units shall be provided with a drip cap above the door (minimum width equal to the door width).
- G. Removable Panels:
1. Removable panels shall be provided for component removal and replacement only. Removable panels shall be of the same construction as panels described above. Removable panels shall be designed and constructed such that removal and replacement may be accomplished without disturbing adjacent panels.
- H. Corrosion Protection System:
1. Carbon steel components shall be shot-blasted and painted with a Red-Oxide epoxy primer to protect against corrosion.
- I. Fans (General):
1. All fans shall be selected to operate at a point no higher than 90% of the peak static pressure rating, as defined by the fan performance curve at the selected operating speed.
 2. All fans shall meet the air flow performance specified and shall not exceed the brake horsepower or sound power levels specified on the mechanical equipment schedule (if applicable). Fan performance shall be based on testing and be in accordance with AMCA Standards 210 and 300.
 3. Fan assemblies shall be designed for heavy-duty industrial applications.
 4. Fan framing assemblies shall be fabricated from structural steel. Formed members are not acceptable.
 5. Inlet cones shall be precision spun or die formed. Inlet cones shall be aerodynamically matched to the wheel side plate to provide streamlined airflow in the wheel and ensure full loading of the blades.
 6. All fans shall be coated and designed for rugged industrial duty and suitable for continuous operation at the maximum-rated fan speed and motor horsepower.
 7. All centrifugally housed fans should be epoxy coated and include an access door, scroll drain and inlet screens.
 8. Fan shafts shall be solid AISI 1040 or 1045 steel. Shafts shall be turned, ground and polished to a minimum 16 micro-inch finish. Shafts shall be sized to run at a minimum of 20% greater than the maximum AMCA class speed.
- J. Plenum Fan Assembly:
1. All single width airfoil centrifugal plenum type shall be direct drive, Arrangement #4, minimum Class 2 or Class 3 construction, with a welded aluminum wheel and designed for rugged industrial duty and suitable for continuous operation. These fans shall be furnished with an open-mesh protective enclosure screen completely enclosing all sides and the back of the fan wheel. The enclosure should be removable to provide access to the motor and wheel. A protective screen should be mounted at the inlet of the fan to prevent foreign objects from entering. All fans shall be selected to operate at a point no

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- higher than 90% of the peak static pressure rating, as defined by the fan performance curve at the selected operating speed.
2. Motors and Motor Bases: All supply and return fan motors shall be Variable Frequency Drive rated. All motors shall be NEMA Class B insulation constructed of a cast iron motor frame to eliminate motor vibration. Motors shall have electrical characteristics and horsepower as specified on the mechanical schedule. All motors shall have a minimum service factor of 1.15. Motors shall have ball bearings. Motors shall be open drip proof, be designed for 1750 RPM, and meet EPACT min efficiency requirements. The brake horsepower requirement of the fans shall not exceed 90% of the motor horsepower. Motor to be provided with AEGIS or equal shaft grounding device.
 3. The inlet of the fan is to be separated from the unit casing by means of a factory installed flexible connection and horizontal thrust restraints.
 4. The entire fan assembly shall be supported with a heavy channel steel base, with 2" deflection seismic type springs.
- K. Fan Section Accessories:
1. The fan section shall include a monorail integral with the unit casing that is capable of lifting the fan/motor through a removable panel in the side of the unit.
 2. Extended Lubrication Lines: Provide extended nylon lubrication lines from the zerk fitting location of each fan and motor to the exterior of the air handling unit casing.
 3. Extended Piezometer Ring Lines: Provide nylon extended piezometer ring lines from each fan to the exterior of the air handling unit casing.
- L. Motors: Comply with section 230513 "Motors for HVAC Equipment".
- M. Cooling Coils:
1. All coils shall meet or exceed all capacities specified on the mechanical schedule for the project. All water coil performances shall be certified by the manufacturer to be in accordance with ARI Standard 410. Coils shall be mounted in the unit for horizontal airflow. Coil air face velocities shall not exceed 500 FPM.
 2. All coils shall be tested to 250 psig compressed air under water. Coils shall be designed to operate at 250 psig internal pressure and up to 300°F.
 3. Coils shall be circuited to provide the required performance. The use of internal restrictive devices, or turbulators, to obtain turbulent flow will not be acceptable.
 4. Coils shall not act as structural component of unit.
 5. Fabricate coil section to allow removal, replacement, service, and maintenance of the coil(s).
 6. Provide removable access panels in the unit casing for ease of coil removal.
 7. Chilled water coils shall be constructed with the following characteristics:
 - a. Fluid: See schedule.
 - b. Tubes: 0.025 inch thick, 5/8 inch diameter, seamless copper tubes.
 - c. Fins: 0.0095 inch alumin fins.
 - d. Headers: Non-ferrous headers with steel MPT connections.
 - e. Drain and Vent: Minimum 3/8 inch diameter MPT drain and vent connections.
 - f. Coil casings shall be constructed of minimum 16 gauge 304 stainless steel. (galvanized when Heresite Coated)
 - g. Coil connections are to be extended through the unit casing wall by the unit manufacturer. Drain and vent connections shall be terminated internally.
 - h. Coil casing reinforcement: Required for fin lengths exceeding 42 inches.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- i. Maximum Finned Height per Coil: 48 inches.
- j. Maximum Fin Density: Shall not exceed 12 fins per inch.
- k. Tube fluid velocities shall be between 2 fps and 8 fps.
- l. Baked Phenolic Coating

N. Heating Coils:

- 1. All coils shall meet or exceed all capacities specified on the mechanical schedule for the project. All water coil performances shall be certified by the manufacturer to be in accordance with ARI Standard 410. Coils shall be mounted in the unit for horizontal airflow. Coil air face velocities shall not exceed 600 FPM.
- 2. All coils shall be tested to 250 psig compressed air under water. Coils shall be designed to operate at 250 psig internal pressure and up to 300°F.
- 3. Coils shall be circuited to provide the required performance. The use of internal restrictive devices, or turbulators, to obtain turbulent flow will not be acceptable.
- 4. Coils shall not act as structural component of unit.
- 5. Fabricate coil section to allow removal, replacement, service, and maintenance of the coil(s).
- 6. Provide removable access panels in the unit casing for ease of coil removal.
- 7. Hot water coils shall be constructed with the following characteristics:
 - a. Fluid: See schedule.
 - b. Tubes: 0.025 inch thick, 5/8 inch diameter, seamless copper tubes.
 - c. Fins: 0.0095 inch aluminum fins.
 - d. Headers: Steel headers with steel MPT connections.
 - e. Drain and Vent: Minimum 3/8 inch diameter MPT drain and vent connections.
 - f. Coil casings shall be constructed of minimum 16ga galvanized steel.
 - g. Coil connections are to be extended through the unit casing wall by the unit manufacturer. Drain and vent connections shall be terminated internally.
 - h. Coil casing reinforcement: Required for fin lengths exceeding 42 inches.
 - i. Maximum Finned Height per Coil: 54 inches.
 - j. Maximum Fin Density: Shall not exceed 12 fins per inch.
 - k. Tube fluid velocities shall be between 2 fps and 8 fps.
 - l. Baked Phenolic Coating
- 8. Provide removable access panels in the unit casing for ease of coil removal.

O. High Efficiency Energy Recovery Coils:

- 1. High efficiency energy recovery heat exchanger coils shall be supplied by section 237200 "High Efficiency Energy Recovery System" and shipped to the custom air handling unit manufacturer factory for factory installation in the custom air handling unit.

P. Filters:

- 1. General:
 - a. Comply with section "Particulate Air Filtration".
 - b. Provide all filters of type, quantity, size and capacity as required for air handling system indicated on drawings and as stated in these specifications.
 - c. Filters to be selected for a maximum face velocity of 500 FPM.
 - d. Filter initial pressure drop shall not exceed the rating indicated for each filter media type listed below.
 - e. Fan(s) will be rated based on the final resistance indicated for each filter type listed below.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- f. Each cell shall be 24 inches x 24 inches, or 12 inches x 24 inches.
- g. Media shall be approved and listed as Underwriters Laboratories (UL) Standard 900.
- h. Media shall be tested in accordance with the latest version of ASHRAE Standard 52.2.
- 2. Filter Media:
 - a. Medium Efficiency Pleated Pre-filters:
 - 1) Depth: 2 inch.
 - 2) MERV Rating: 8.
 - 3) Initial resistance at 500 FPM shall not exceed 0.28 in H₂O.
 - 4) Final resistance at 500 FPM: 0.90 in H₂O.
 - 5) Based on AAF Perfect Pleat HC M8 | Camfil 30/30.
- 3. High Efficiency Rigid Final Filters:
 - a. Depth: 12 inch.
 - b. MERV Rating: 14.
 - c. Initial resistance at 500 FPM shall not exceed:
 - 1) MERV 9/11: 0.30 in H₂O.
 - 2) MERV 13: 0.50 in H₂O.
 - 3) MERV 14/15: 0.60 in H₂O.
 - d. Final resistance at 500 FPM: 1.30 in H₂O.
 - e. Based on AAF Varicel RF | Camfil Riga-Flo.
- 4. Differential Pressure Dial Gauge: A differential pressure gauge for measuring the pressure drop across each filter bank shall be installed. The gauge shall be dial type with white dial face, black or blue figures and graduations and pointer zero adjustment. Gauge shall be surface mounted. Recessing gauges into unit casing shall not be acceptable.

Q. Dampers:

- 1. Tamco Series 9000 SW, thermally broken. (No Substitutions)

R. Electrical:

- 1. General:
 - a. All electrical work shall be installed in full compliance with the National Electric Code and all local codes and requirements.
 - b. Where applicable, components shall bear UL listed, UL recognized, or ETL listing marks.
 - c. All wiring and components inside air handling plenums shall be weatherproof and rated for such use.
- 2. Routing:
 - a. Conduit
 - 1) All wiring shall be run in EMT conduit utilizing compression type fittings.
 - 2) All conduit in wet sections (including but not limited to outdoor air intakes, humidifier, and cooling coil sections) shall be rigid aluminum.
 - 3) All conduit penetrations in the unit housing and penetrations across air seal and insulated walls shall be internally sealed airtight with caulk to prevent the migration of water vapor in the conduit.
 - b. Conductors: All power conductors to be 600V rated, copper MTW, THHN, or THWN.
 - c. Shipping-splits:

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- 1) A junction box shall be provided at each shipping-split to aid in field connection of wiring.
 - 2) All conductors servicing circuits 300V or less shall be spliced with wire nuts at each shipping split.
 - 3) All conductors servicing circuits greater than 300V shall be pulled back to the shipping split nearest to the component served. Alternatively, circuits may be spliced with the aid of panel mounted terminal blocks rated for the voltage and current of the application. Other means of splicing are not permitted.
- d. Boxes, Enclosures, and Cabinets:
 - 1) All boxes, enclosures and cabinets exposed to the outdoor environment shall be NEMA 3R rated.
 - 2) All boxes, enclosures, and cabinets exposed to the indoor environment or within a service corridors shall be NEMA 1 rated.
3. Motors:
 - a. Each motor shall be wired to a junction box located on the exterior of the unit (unless size prohibits).
 - b. Each motor shall be wired to a VFD located on the exterior of the unit (unless size prohibits). If the VFD is remotely mounted, one non-fused disconnect or manual motor starter shall be provided on the air handling unit for each motor connection.
 - c. Motor wiring to each motor shall be in separate conduits. Wiring multiple motors within the same conduit, wireway, or trough is not permitted.
 - d. Control wiring shall not be located in the same conduit(s) as power wiring.
4. Lighting: Each access section of the unit shall be provided one vapor-proof marine light fixtures wired a common 120V feed location. Lighting shall be controlled with 20A rated, 2-way w/ pilot light switches. Bulbs for light fixtures shall be provided by others.
5. For units 20 feet long or greater, a minimum of two light switches shall be provided. Light switches shall be located at the fan and filter section access doors.
6. Convenience Receptacles: Each fan section shall be provided with a duplex, 20-amp GFCI receptacle wired to a common 120V feed location. Receptacles for use in outdoor or wet environments shall bear the "WR" mark and be enclosed with a while-in-use cover.

2.3 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 UNIT FACTORY TESTING

- A. Standard Factory Tests: The fans shall be factory run tested to ensure structural integrity and proper RPM. All electrical circuits shall be tested to ensure correct operation before shipment of unit. Units shall pass quality control and be thoroughly cleaned prior to shipment. A representative of the owner, the installing contractor, and the engineer may witness the testing if they choose. The manufacture must notify the parties involved a minimum of two weeks prior to testing.
- B. Cabinet Leak Testing: The cabinet shall be tested at the unit's design operating static pressures for both the high and low pressure sides. Unit leakage rate shall not exceed 1.0% of unit airflow capacity at 1.1 times the design static pressure (50 cfm minimum per air tunnel). Leak testing shall be performed by measuring the airflow used to pressurize the air handling unit positively or negatively at the cabinet design operating static pressure via a calibrated orifice method. All supply and return air openings shall be sealed along with the air seal at the supply fan bulkhead wall to isolate the high and low side of the unit. The unit shall then be pressurized with air until the appropriate design static pressures are achieved.
- C. Fan Vibration Testing: Fan wheel and shaft assemblies shall be dynamically analyzed after the fan, motor and drive assemblies have been installed in the unit. The fan is analyzed with an electronic balance analyzer with a tunable filter. Vibration measurements are taken on each bearing housing in the horizontal, vertical, and axial positions with the filter tuned to the fan RPM. The maximum acceptable filter-in vibration reading for at any of the tested positions shall not exceed 0.16 inches per second. The testing shall be performed at the factory and witnessed by the owner's representatives. A detailed report, including all data and test methods, shall be presented to the owner.

3.2 EXAMINATION

- A. Examine casing insulation materials and filter media before air handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- B. Examine roughing-in for hydronic and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.3 INSTALLATION

- A. Equipment Mounting: Install air handling unit without vibration isolation devices. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."
- B. Arrange installation of units to provide access space around air handling units for service and maintenance.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

3.4 CONNECTIONS

- A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air handling unit to allow service and maintenance.
- C. Connect piping to air handling units mounted on vibration isolators with flexible connectors.
- D. Connect Trent Technologies condensate drain to unit. Extend to nearest floor drain. Construct in accordance with the manufacturer's written instructions.
- E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- F. Connect duct to air handling units with flexible connections. Comply with requirements in Division 23 Section "Air Duct Accessories."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, fill water coils with water and test coils and connections for leaks. Test all condensate pans.
 - 2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- C. Air handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations.
 - 5. Verify that bearings, pulleys, and other moving parts are lubricated with factory-recommended lubricants.
 - 6. Verify that outdoor- open and close.
 - 7. Comb coil fins for parallel orientation.
 - 8. Verify that proper thermal-overload protection is installed for electric coils.
 - 9. Install new, clean filters.
- B. Starting procedures for air handling units include the following:
 - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.

3.7 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Division 01 Section "Testing, Adjusting, and Balancing for HVAC" for air handling system testing, adjusting, and balancing.

3.8 CLEANING

- A. After startup service, clean air handling units internally on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- B. After completing system installation and testing, adjusting, and balancing air handling unit and air-distribution systems, clean filter housings and install new, clean filters.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.9 DEMONSTRATION

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

END OF SECTION 237323

SECTION 237513 – CUSTOM ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Custom energy recovery plenums serving lab exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Casing deflection shall not exceed $L/240$ at negative 12" w.g. in all negative-pressure sections, where L is defined as the panel span.
- B. Air Leakage: Unit air leakage shall not exceed 1.0% of design volumetric airflow at negative 8" w.g. in all negative-pressure sections. Leakage shall be calculated by totaling all leakage either in to or out of the unit.
- C. Thermal Performance: Casing shall not produce condensation on the exterior of the unit at an ambient condition of 80 F dry bulb and 72 F wet bulb.

1.4 SUBMITTALS

- A. Product Data:

For each type of energy recovery unit indicated include the following:

- 1. Certified coil-performance ratings with system operating conditions indicated.
- 2. Material gages and finishes.
- 3. Dampers, including housings, linkages, physical size, blade configuration and torque requirements.
- 4. Wiring Diagrams: Power, signal, and control wiring.
- 5. Required clearances for installation.
- 6. Manufactures technical data.
- 7. Rated capacities.
- 8. Dimensions.
- 9. Color Sample. Provide color sample for color as selected by Architect.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Coordination Drawings: Prepare drawings for construction. Do not submit with Shop Drawings but have available for inspection at the job site. Show mechanical room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- C. Field quality-control reports.
- D. Operation and Maintenance Data: For energy recovery units to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of energy recovery units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2013, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1-2013 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

- A. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Gaskets: One set for each access door.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Buffalo
 2. Governair
 3. Mammoth
 4. MK Plastics
 5. Temtrol
 6. TMI Climate Solutions
 7. Ventrol

2.2 CUSTOM ENERGY RECOVERY PLENUMS

- A. General Descriptions:
1. Custom Energy Recovery Plenums serving Laboratory exhaust fans: Factory-assembled; designed for exterior installation; consisting of glycol heat recovery coil, air mixing section, and dampers. Unit shall be custom configuration as indicated on drawings.
 2. The unit cabinet shall be constructed with a true no-thru-metal design. All interior and exterior metal components must be isolated from contact with each other by a minimum of one inch of non-metallic material, including the distance between interior or exterior metal sheets and any fasteners penetrating these sheets. If an alternate thermal break method of construction is provided the alternate design must be clearly identified, and, at a minimum, include thermal break material that is at least 1" deep in the direction of heat flow. Simple thermal break gaskets will not be acceptable.
 3. The minimum thermal resistance value of the wall, floor or roof panels as measured at the panel joints is to be R-1.46. Panel thermal performance to be tested according to ASTM C 518 by an independent testing agency, with report included in submittal package.
- B. Module Assembly:
1. Each mating section to have a flush surface around its entire mating perimeter.
 2. Provide 3/4" closed cell neoprene gasket for field installation on one mating surface.
 3. Unit modules to be drawn together using a field supplied come-along chain and integral lifting lugs mounted on unit baserail.
 4. Provide F.R.P. or stainless steel assembly brackets, bolts and rods at roof level to assist in compression of module gasket.
- C. Unit Baserail:
1. Baserail to be manufactured of FRP profiles or structural FRP, or fully welded and epoxy coated structural steel members adequately braced and reinforced to withstand all loads during shipment, rigging, installation, and operation. If a structural steel baserail is provided, the baserail must be protected from the ambient environment by epoxy paint or fiberglass-reinforced-plastic (FRP) laminate jacket that can withstand 8,000 hours of salt spray testing per ASTM B 117 with no corrosion or lifting present at the scribe.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Unit baserail must be of suitable strength for the service required, and provided with cross-members as required to meet shipping and rigging loads.
 3. Baserails manufactured from steel or structural FRP must be designed for a maximum of L/360 deflection.
 4. For outdoor units mounted on roof curbs, the outside perimeter of the baserail must overhang the curb by 2". This overhang must create a positive positioning system that ensures that the equipment is properly located on the curb, and that the unit is prevented from slipping off the curb by the geometric shape of the baserail, not through the use of fasteners or brackets.
- D. Fasteners
1. All fasteners, including bolts and self-tapping or self-drilling screws, are to be fabricated of solid 316 stainless steel. Series 304 or any 400 series stainless steel is not acceptable. Documentation showing conformance to this specification is required in the submittal package
- E. Cabinet :
1. Wall, roof and Floor Panels:
 - a. Minimum 1.25" thick double-wall panels providing an R-value of 1.46 or better at the panel joints and corners.
 - b. True no thru-metal construction is required.
 2. Outside Liner:
 - a. Minimum 4mm thickness F.R.P. or 16 gauge 316 stainless steel sheet steel exterior.
 - b. Finish:
 - 1) Finish color is Industrial Grey for unit exterior.
 - 2) Provide finish coat or pigment that provides a minimum of 8,000 hours of salt spray resistance without corrosion or lifting along the scribe when tested according to ASTM B- 117.
 - c. Fasteners may be uncoated if they are fabricated from 316 stainless steel.
 - d. All exterior roof and wall panels shall have no exposed bolts or screws.
 - e. Self-drilling or self-tapping screws which penetrate the exterior liner are not permitted
 3. Inside Liner:
 - a. Minimum 4mm thickness F.R.P. or 22-gauge 316 stainless steel sheet steel exterior.
 4. Floor Liner:
 - a. The floor panels shall be of the same construction as the roof and wall panels. The floor panels shall be installed on top of the unit structural baserail so that the baserail forms a complete sub-base underneath the floor panels. Floor systems that require insulated baserails or insulated baserail cavities are not acceptable.
 - b. Minimum 4mm thickness F.R.P. or 16-gauge 316 stainless steel sheet steel walk-on surface
- F. Filters: Provide filter frame and filters for 2" Merv-8 Filters.
- G. Space for Future Evaporative Cooling: The energy recovery cabinet shall be provided with a 60" long section between the filter section and the high efficiency energy recovery coils. The

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

entire section shall have a 2" deep, 316 stainless steel or FRP drain pan. The inside walls of the section shall be 316 stainless steel or FRP.

- H. High Efficiency Energy Recovery Coils:
 - 1. High efficiency energy recovery heat exchanger coils shall be supplied by section 237200 "High Efficiency Energy Recovery System" and shipped to the custom air handling unit manufacturer factory for factory installation in the custom air handling unit.
- I. Provide lights in each section requiring maintenance with single point power connection (120V/ 1 PH/ 60 HZ) and exterior unit mounted light switch.
- J. Access Doors: Access doors shall be constructed with double-wall insulated panels of same material and thickness as casing. Door gasketing shall be mounted to the perimeter of the door and shall seal against a raised door frame. Door frame shall channel water away from gasket. Access door hinges shall include a minimum of two ball-bearing hinges and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential. Access doors shall not require any tools to open.
- K. Dampers:
 - 1. A. The unit shall be complete with an outdoor air bypass section which will allow the fan(s) to maintain the required outlet velocity and system pressure when the exhaust airflow is turned down. Include the following:
 - a. Bypass air damper(s) shall be opposed-blade, airfoil design, extruded aluminum with a clear anodized finish (salt water resistance), with linkage hardware installed in the side frame. All aluminum linkage hardware parts shall be clear anodized and all non-aluminum linkage hardware parts shall be type 316 stainless steel. Dampers shall be suitable for applications up to 10 inches wg., in extruded aluminum.
 - b. Each bypass damper shall be housed inside a fiberglass reinforced plastic (FRP) weather cowl and birdscreen, to prevent the possibility of rainwater entrainment.
 - c. All dampers shall have an extended control shaft for electronic control actuation
 - 2. Damper Operators: Comply with requirements in Division 23 Section "Building Management System."
 - 3. Low leakage 316L stainless steel. Dampers are made of 316L stainless steel airfoil blades with silicone blade edge seals.
 - 4. Provide dampers in the following locations:
 - a. Outside air bypass intake.
 - b. Fan isolation dampers.

2.3 ELECTRICAL

- A. Provide a 120/1 single point power panel with non-fused disconnect. Power panel to include all power components for integral lights and GFI outlets. All wiring from the panel to the lights and GFI outlets is to be provided by the manufacturer. All wiring shall be in EMT conduit. At module section breaks, provide required length of wire coiled up inside the unit. A factory supplied piece of EMT conduit shall be provided for field connections between modules.
- B. Units are equipped with 10W LED vapor proof light fixtures. Unit drawing's fixture locations are approximate. Lights shall be controlled by one switch Conduit for lights and outlets shall be

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

electrical metallic tube (EMT). Flexible conduit connections shall be liquid tight. All junction boxes shall be gasketed.

- C. 120 volt G.F.I convenience outlets provided at intake plenum section factory wired to the 120V power panel.
- D. ERU tag must bear the ETL label

2.4 SOURCE QUALITY CONTROL

- A. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine casing insulation materials and filter media before energy recovery unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- B. Examine roughing-in for hydronic and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Equipment Mounting: Install energy recovery unit without vibration isolation devices. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."
- B. Arrange installation of units to provide access space around energy recovery units for service and maintenance.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to energy recovery unit to allow service and maintenance.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- C. Connect piping to energy recovery units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans using ASTM B 88, Type M copper tubing. Extend to nearest acid waste drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- E. Glycol-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, fill water coils with water and test coils and connections for leaks. Test all condensate pans.
 - 2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Energy recovery unit or components will be considered defective if unit or components do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 - 4. Verify that outdoor-air dampers open and close, and maintain minimum outdoor-air setting.
 - 5. Comb coil fins for parallel orientation.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Division 01 Section "Testing, Adjusting, and Balancing for HVAC" for energy recovery system testing, adjusting, and balancing.

END OF SECTION 237513

SECTION 238126 – DUCTLESS MINI-SPLIT AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes ductless mini-split air-conditioning units consisting of separate evaporator-fan and compressor-condenser components. Evaporator fan units are designed for ceiling or wall mounting. The compressor-condenser unit shall be remote and located on the roof where indicated on the Drawings.

1.3 DEFINITIONS

- A. Evaporator-Fan Unit: The part of the ductless mini-split air-conditioning unit that contains a coil for cooling and a fan to circulate air to conditioned space.
- B. Compressor-Condenser Unit: The part of the ductless mini-split air-conditioning unit that contains a refrigerant compressor and a coil for condensing refrigerant.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For ductless mini-split air-conditioning units to include in maintenance manuals specified in Division 1.
- D. Warranties: Special warranties specified in this Section.
- E. LEED Submittals: Refer to Division 1 "Sustainable Design Requirements."

1.5 QUALITY ASSURANCE

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of ductless mini-split units and are based on the specific system indicated. Other manufacturers' systems with equal performance characteristics may be considered.
- B. Units shall be tested by a Nationally Recognized Testing Laboratory and shall bear the ETL label.
- C. All wiring shall be in accordance with the governing version of the National Electrical Code.
- D. Units shall be rated in accordance with ARI Standard 210 and bear the ARI Certification label.
- E. Units shall be precharged with refrigerant for 70 feet of refrigerant tubing.
- 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.
- G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2010.

1.6 COORDINATION

- A. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 7 Section "Sheet Metal, Flashings and Roofing Accessories."

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: One year from date of Substantial Completion. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. Warranty does not include labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Liebert Corporation
 - 2. Mitsubishi Electronics America, Inc.; HVAC Division.
 - 3. Sanyo HVAC.
 - 4. LG

5. Carrier

2.2 WALL-MOUNTED, EVAPORATOR-FAN COMPONENTS

- A. The evaporator section shall be designed to be wall-mounted by means of a factory supplied mounting plate. Air distribution shall be integral to the wall-mounted unit.
- B. Cabinet and Chassis: Cabinet shall be high strength molded plastic with front panel access for the filter. Cabinet color shall be white. Include drain pan with drain connection. Indoor unit shall be factory assembled, wired and tested. Contained within unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit in conjunction with the wall mounted controller shall have a self-diagnostic function, three minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant piping shall be purged with dry nitrogen before shipment from the factory.
- C. Refrigerant Coil: Evaporator coil shall be nonferrous construction with pre-coated aluminum fins on copper tubing. All tube joints shall be brazed with silver alloy. Coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.
- D. Fan and Motor: Evaporator fan shall be double inlet, forward curved, direct drive fan with a single motor. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall have two speeds: low and high.
- E. Vane: Unit shall include a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall significantly decrease downward air resistance for lower noise levels and shall close when unit stops.
- F. Filters: Return air shall be filtered with a removable and washable filter.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A. General: Outdoor unit shall be the same capacity as the indoor unit and include a control board that interfaces with the indoor unit to perform all necessary operation functions. Outdoor unit shall be capable of operating at 0°F ambient temperature without additional low ambient controls. Outdoor unit shall be able to operate with a maximum height difference of 100 feet from indoor unit to outdoor unit and a maximum refrigerant tubing length of 165 feet between the indoor and outdoor unit without the need for line size changes, traps, or additional oil
- B. Casing: Casing shall be galvanized steel plate coated with an electrostatically applied thermally fused acrylic or polyester powder coating. The fan grille shall be ABS plastic.
- C. Compressor: The compressor shall be a DC rotary compressor with variable compressor speed inverter technology. The compressor shall be driven by inverter circuitry to control compressor speed. Compressor speed shall be varied to match space load. Outdoor unit shall include an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- D. Refrigerant Coil: Condenser coil shall be copper tubing with aluminum fins. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be controlled by a microprocessor-controlled step motor.
- E. Fan: The fan motor bearings shall be permanently lubricated. The fan shall have horizontal discharge airflow. The fan shall be mounted in front of the coil. The fan shall include a raised guard to prevent contact with moving parts.

2.4 ACCESSORIES

- 1. Control: The control system shall be microprocessor-based and include one microprocessor on the outdoor unit and one on the indoor unit. Wall-mounted controller shall have a liquid crystal display indicating operating status and alarm condition and shall include a temperature sensor. A membrane keypad shall be included for program control and set point adjustment.
 - 2. The controller shall consist of On/Off button, increase/decrease set temperature buttons, a cool/dry/fan mode selector, timer menu button, timer on/off button, set time buttons, fan speed selector, vane position selector, a ventilation button, a test run button, and a check mode button.
 - 3. The controller shall display operating conditions such as set temperature, room temperature, pipe temperatures (i.e. liquid, discharge, indoor and outdoor), compressor operating conditions (including running current, frequency, input voltage, On/Off status and operating time), LEV opening pulses, sub-cooling and discharge super heat.
 - 4. Normal operation of the controller shall provide individual system control in which one controller and one indoor unit are installed in the same room.
 - 5. The control voltage from the controller to the indoor unit shall be 12 volts, DC. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Up to two wired controllers shall be able to be used to control one unit.
 - 6. Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off and mode switching. The controller shall have the capability to provide sequential starting with up to fifty seconds delay.
- B. Refrigerant Line Sets: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends. Pre-charge line sets in proper lengths for application. Final length shall be field verified. Refer to section "Refrigerant Piping" for additional requirements.
 - C. Factory-installed and –wired disconnect to be provided under this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb, firmly anchored, in accordance with the manufacturer's written recommendations.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted compressor-condenser components on equipment supports specified in Division 7 Section "Sheet Metal, Flashings and Roofing Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Install compressor-condenser components on Elastomeric pads. Refer to Division 15 Section "Vibration Control for HVAC."
- E. Connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect condensate drain piping. Unit drain shall be internally trapped.
- C. Install piping adjacent to unit to allow service and maintenance.
- D. Unless otherwise indicated, connect piping with unions and shutoff valves to allow units to be disconnected without draining piping. Refer to piping system Sections for specific valve and specialty arrangements.
- E. Ground equipment.
 - 1. 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.

3.3 FIELD QUALITY CONTROL

- A. Installation Inspection: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to prepare a written report of inspection.
- B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

3.4 COMMISSIONING

- A. Engage a factory-authorized service representative to perform startup service.
- B. Verify that units are installed and connected according to the Contract Documents.
- C. Lubricate bearings, adjust belt tension, and change filters.
- D. Perform startup checks according to manufacturer's written instructions and do the following:
 - 1. Fill out manufacturer's checklists.
 - 2. Check for unobstructed airflow over coils.
 - 3. Check operation of condenser capacity-control device.
 - 4. Verify that vibration isolation devices and flexible connectors dampen vibration transmission to structure.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining units.
 - 2. Review data in maintenance manuals. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 238126

SECTION 238219 - FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes fan-coil units and accessories.

1.3 DEFINITIONS

- A. BAS: Building automation system.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Closeout Procedures," include the following:
 - 1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.
- E. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1-2007 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

- A. Coordinate layout and installation of fan-coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan-Coil-Unit Filters: Furnish one spare filter for each unit.
 - 2. Fan Belts: Furnish one spare fan belt for each unit installed.

PART 2 - PRODUCTS

2.1 FAN-COIL UNITS

- A. Available Manufacturers:
 - 1. Daikin Applied.
 - 2. Price Industries.
 - 3. Trane.
 - 4. York / Johnson Controls.
- B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.
- C. Coil Section Insulation: 1-inch thick foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
 - 1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1-2007.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.
- F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.
- G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, 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.
- H. Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
 - 1. Motor: Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - a. Type: ECM.
- I. Control devices and operational sequence are specified in Division 23 Sections "Building Automation System" and "Sequence of Operations."

2.2 BLOWER COIL UNITS

- A. Available Manufacturers:
 - 1. Daikin Applied.
 - 2. Price Industries.
 - 3. Trane.
 - 4. York / Johnson Controls.
- B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.
- C. Coil Section Insulation: 1-inch thick foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
 - 1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1-2007.
- E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.
- F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, 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.
- H. Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
 - 1. Motor: Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - a. Type: ECM.
- I. Control devices and operational sequence are specified in Division 23 Sections "Building Automation System" and "Sequence of Operations."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units level and plumb.
- B. Install units to comply with NFPA 90A.
- C. Suspend units from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 - 1. Install piping adjacent to machine to allow service and maintenance.
 - 2. Connect condensate drain to indirect waste.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

- a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.
- B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. 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. 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.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238219

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Propeller unit heaters with hot-water coils.
 - 2. Propeller unit heaters with electric heating coils.

1.3 DEFINITIONS

- A. BAS: Building automation system.

1.4 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, operating characteristics, furnished specialties, and accessories.
 - 4. Location and arrangement of piping valves and specialties.
 - 5. Location and arrangement of integral controls.
 - 6. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 HOT WATER PROPELLER UNIT HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Airtherm; a Mestek Company.
 2. Engineered Air Ltd.
 3. McQuay International.
 4. Ruffneck Heaters; a division of Lexa Corporation.
 5. Trane.
- B. Description: An assembly including casing, coil, fan, and motor in vertical horizontal discharge configuration with adjustable horizontal and vertical discharge louvers.
- C. Cabinet: Removable panels for maintenance access to controls.
- D. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
- E. Discharge Louver: Vertical and horizontal adjustable fin diffuser.
- F. General Coil Requirements: Test and rate hot-water propeller unit heater coils according to ASHRAE 33.
- G. Hot-Water Coil: 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. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- I. Fan Motors: Comply with requirements in Division 23 Section "Motors for HVAC Equipment."
1. Motor Type: Permanently lubricated, multispeed.
- J. Control Devices:
1. Unit-mounted, fan-speed switch.

DOBO HALL RENOVATION,
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No: 580999

2. Wall-mounted heavy duty combination heat/cool thermostat w/sub base and locking cover.
3. Line-voltage two-way, two-position hot water control valve and actuator, spring closed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install unit heaters to comply with NFPA 90A.
- B. Install unit heaters level and plumb.
- C. Suspend unit heaters from structure with all-thread hanger rods and elastomeric hangers. 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 Control for HVAC."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Comply with safety requirements in UL 1995.
- D. 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. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. 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.

3.5 ADJUSTING

- A. Adjust initial temperature set points.

END OF SECTION 238239

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cerro Wire LLC.
 - 2. General Cable; General Cable Corporation.
 - 3. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3M.
 - 2. Hubbell Power Systems, Inc.
 - 3. ILSCO.
 - 4. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: 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-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions: Type THHN-2-THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits: Type THHN-2-THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, and Walls, and Partitions other than Stud Walls: Type THHN-2-THWN-2, single conductors in raceway.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- H. Branch Circuits Concealed in Stud Walls to wiring devices: Type MC with ground wire.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Branch Circuits Concealed in Casework: MC cable may be used to feed to outlet boxes fish concealed in built-in casework. Route cable supported tight in upper inside corners of casework, not in conflict with drawers or cabinet doors.
- G. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- H. Whips from Junction Box Concealed in Ceilings to Lighting Fixtures:
 - 1. Type MC Cable with ground or FMC, with minimum #12AWG copper THHN/THWN and full size equipment grounding conductor. Maximum whip length 72".
 - 2. Type MC Cable and FMC shall be supported within 24" of fixture connection so that whip is not in contact with ceiling or grid. Securing to fixture support wires with batwings is acceptable but not to ceiling support wires.
 - 3. Do not connect fixture whips from fixture to fixture (daisy chain). No more than 4 whips shall be connected to any one junction box.
- I. All single-phase circuits shall include a dedicated neutral (grounded) and grounding conductor, unless specifically noted otherwise.
 - 1. The intent of this is to eliminate multiwire branch circuits and allow disconnection of one circuit without requiring disconnection of other(s) as would be required to comply with NEC. Per NEC each of these neutral (grounded) conductor is not considered to be load-bearing so derating is not required.
- J. Contract drawings are based upon a maximum of 3 current-carrying conductors in a conduit. Contractor may rework indicated circuitry to install a maximum of (6) L-N circuits (120 or 277V)

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

in a single conduit. There shall be no more than 2 each A, B, C phase conductors per homerun. Each shall have dedicated neutral (grounded) conductor.

1. Do not group L-L circuits in a homerun, unless specifically indicated on the drawings.
2. Where there are more than 3 current-carrying conductors in a conduit, derate conductor ampacities in accordance with NEC
3. When running more than 3 ungrounded conductors in a raceway, increase size of conduits beyond those indicated in contract documents, as required to not exceed NEC Chapter 9, Table 1 conduit-fill requirements. As-built drawings shall clearly indicate which circuits are grouped in homeruns.

- K. Unless otherwise indicated, minimum conductor size shall be 12 AWG.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
- 2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Burndy: Part of Hubbell Electrical Systems.
 2. ERICO International Corporation.
 3. Galvan Industries, Inc.; Electrical Products Division, LLC.
 4. ILSCO.
 5. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. 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.
- C. 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.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

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. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed 5 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. ERICO International Corporation.
 - c. Thomas & Betts Corporation.
 - d. Unistrut; an Atkore International company.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. 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.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Hilti, Inc.
 - 2) MKT Fastening, LLC.
 - 3) Simpson Strong-Tie Co., Inc.
2. Mechanical-Expansion Anchors: Insert-wedge-type, 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Hilti, Inc.
 - 3) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

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 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.
- 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- 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 Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "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.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. Touchup: Comply with requirements in Division 9 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

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Boxes, enclosures, and cabinets.
- B. Part 2 of this section includes material requirements for all raceways and boxes that may or may not be used on the project. Part 3 of this Section defines where a given type of product shall be or is permitted to be utilized.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For raceways, wireways and fittings, floor boxes, and cabinets.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Allied Tube & Conduit.
 2. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 3. Robroy Industries.
 4. Thomas & Betts Corporation.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Setscrew or compression.
 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. AFC Cable Systems, Inc.
 2. Electri-Flex Company.
 3. RACO; Hubbell.
 4. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Rigid HDPE: Comply with UL 651A.
- F. RTRC: Comply with UL 1684A and NEMA TC 14.
- G. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Fittings for LFNC: Comply with UL 514B.
- I. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. Hoffman; a brand of Pentair Equipment Protection.
 3. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. EGS/Appleton Electric.
 - 2. Erickson Electrical Equipment Company.
 - 3. Hoffman; a brand of Pentair Equipment Protection.
 - 4. Hubbell Incorporated.
 - 5. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 - 6. RACO; Hubbell.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- J. Gangable boxes are prohibited.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

K. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.

2.5 FLOOR BOXES AND SERVICE FITTINGS

A. Floor Boxes.

1. Floor boxes mounted on first floor grade shall be manufactured from cast-iron and be approved for use on grade and above grade floors. There shall be four independent wiring compartments that allow capacity for up to four duplex receptacles and/or communication services. The box shall permit tunneling from adjacent or opposite compartments. The box shall be fully adjustable, providing pre-pour and after-pour adjustment.
2. Floor boxes not on grade slab shall be manufactured from stamped-steel and be approved for use on above-grade floors. There shall be four independent wiring compartments that allow capacity for up to four duplex receptacles and/or communication services. The box shall permit feed through tunneling from adjacent compartments. The box shall be fully adjustable.
3. Activation covers shall be manufactured of die-cast aluminum or die-cast zinc, and be available in a brushed aluminum finish, plated brass finish, or a powder-coated paint finish. The activation cover shall be listed by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, terrazzo, wood, and carpet covered floors. The floor box manufacturer shall provide a complete line of faceplates and bezels to facilitate mounting of UTP, STP (150 ohm), fiber optic, coaxial, and communication devices within the box.
4. Activation covers shall be flangeless cast aluminum with aluminum, black, bronze, brass, nickel or gray finish. Covers shall be available with options for tile or carpet inserts, flush covers, or furniture feed
 - a. Unless indicated otherwise, provide the following cover configurations:
 - 1) Power/Telecom Outlets: Brushed aluminum flanged with blank lid flush with floor and carpet/tile cutouts.
 - 2) Furniture Floor Feed: Brushed aluminum flanged with 1" trade size screw plug opening and one combination 1 1/4" and 2" trade size screw plug openings.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete or reinforced concrete or fiberglass.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Quazite: Hubbell Power Systems, Inc.
 2. Standard: Comply with SCTE 77.
 3. Color of Frame and Cover: Gray.
 4. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
 5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 7. Cover Legend: Molded lettering.
 8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
6. Use MC Cable for HVAC Units less than 40 Amps,

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC . Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 - e. Electrical room
4. Concealed in Ceilings and Interior Walls and Partitions other than Stud Walls: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 3R in damp or wet locations.
8. Use MC Cable in Stud Walls and for Lighting and receptacles other than homeruns,

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel or cast-metal fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install surface raceways unless directed by the architect.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. All conduit to be installed on exterior masonry shall not run continuously within the wall cavity.
- I. Support conduit within 12 inches of enclosures to which attached.
- J. Raceways Embedded in Slabs:
 - 1. Are not permitted, except as required for entry into recessed floor boxes.
 - 2. Conduits run below slab on ground floor level shall be buried within the porous fill and stub-up at the required location. Transition from RNC to RGS with RGS elbow before rising above the floor. After RGS elbow, stub-up conduit shall be type indicated in Part 3.1 above.
 - 3. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to GRC before rising above floor.
- K. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- L. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- V. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements and also refer to Architectural elevations. Install boxes with height measured to center of box unless otherwise indicated.
- Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- AA. Locate boxes so that cover or plate will not span different building finishes.
- BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- DD. Set metal floor boxes level and flush with finished floor surface.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Provide handholes where required by code, where directed by the utility, or when conduit bends exceed 270 degree.
- B. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- C. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- D. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- E. Install handholes with bottom below frost line, below grade.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07.

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

(blank)

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
- 2. Sleeve-seal systems.
- 3. Sleeve-seal fittings.
- 4. Grout.
- 5. Silicone sealants.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:

- 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
- 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Advance Products & Systems, Inc.
 - b. Metraflex Company (The).
 - c. Proco Products, Inc.
 - 2. Sealing Elements: rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Connecting Bolts and Nuts: of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. HOLDRITE.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall have low VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
- 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.
- 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION
- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
 - B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- 3.3 SLEEVE-SEAL-FITTING INSTALLATION
- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, 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.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."
- D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- I. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.2 METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Cables Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER HIGH VOLTAGE WIRING."
- D. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.
- F. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
- D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- F. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- G. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.
- H. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.
- F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- G. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 2. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.5 FLOOR MARKING TAPE

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

A. Tape:

- 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
- 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
- 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

- 1. Comply with ANSI Z535.1 through ANSI Z535.5.
- 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.
- 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.

C. Warning Tape:

- 1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
- 2. Overall Thickness: 5 mils.
- 3. Foil Core Thickness: 0.35 mil.
- 4. Weight: 28 lb/1000 sq. ft..
- 5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.7 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

1. Warning labels and signs shall include, but are not limited to, the following:
 - a. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - b. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES"
 - c. Arc Flash Hazard Warning: Refer to Section 260574 for requirements.

2.8 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

2.9 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.10 CABLE TIES

- A. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- J. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Concealed Raceways and Ductbanks, more Than 600 V, within Buildings: Tape and stencil 4-inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to raceways concealed within wall.
 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot maximum intervals.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.
- D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
1. Emergency Power.
 2. Power.
 3. UPS.
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Grounded (Neutral): White.
 - 5) Ground: Green.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Grounded (Neutral): Gray.
 - 5) Ground: Green.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- F. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.
- G. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- H. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- I. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes or self-adhesive, self-laminating polyester labels with the conductor designation.
- J. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- K. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- L. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- M. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- N. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- b. Controls with external control power connections.
- O. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- P. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer and load shedding.
- Q. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Adhesive film label with clear protective overlay. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 - 2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Switchboards.
 - d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - e. Emergency system boxes and enclosures.
 - f. Enclosed switches.
 - g. Power transfer equipment.
 - h. Contactors.
 - i. Power-generating units.

END OF SECTION 260553

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Time switches.
- 2. Photoelectric switches.
- 3. Indoor occupancy dimming sensors.
- 4. Lighting contactors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
 - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. Leviton Manufacturing Co., Inc.
 4. NSi Industries LLC.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Contact Configuration: DPDT.
 3. Contact Rating: 30-A inductive or resistive, 240-V ac.
 4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
 6. Astronomic Time: All channels.
 7. Automatic daylight savings time changeover.
 8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. NSi Industries LLC.
 4. Tyco Electronics.
- B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
 3. Time Delay: Fifteen second minimum, to prevent false operation.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

4. Surge Protection: Metal-oxide varistor.
 5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
- C. Description: Solid state, with SPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
 3. Time Delay: Thirty-second minimum, to prevent false operation.
 4. Lightning Arrester: Air-gap type.
 5. Mounting: Twist lock complying with NEMA C136.10, with base.

2.3 INDOOR OCCUPANCY DAYLIGHTING SENSORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Hubbell Building Automation, Inc.
 2. Leviton Manufacturing Co., Inc.
 3. Lithonia Lighting; Acuity Brands Lighting, Inc.
 4. Lutron Electronics Co., Inc.
 5. Sensor Switch, Inc.
 6. Watt Stopper.
- B. General Requirements for Sensors: Ceiling-mounted, solid-state indoor occupancy sensors.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 6. Bypass Switch: Override the "on" function in case of sensor failure.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
 8. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
 9. Sensitivity Adjustment: Separate for each sensing technology.
 10. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 11. Detection Coverage:
 - a. **Standard Height Units:** In areas that have ceiling heights of 12 feet or lower, provide Detect occupancy anywhere within a circular area up to 2000 square feet. Detectors shall be networkable to allow coverage of larger or irregularly shaped areas.
 - b. **High Ceiling Units:** In areas that have ceiling/mounting height over 12 feet up to 40 foot mounting including but not limited to Gymnasium, Auditorium, Cafeteria (commons) and forum spaces. Detect occupancy anywhere within a circular area up to 3500 square feet. Detectors shall be networkable to allow coverage of larger or irregularly shaped areas.
- C. General Requirements for Switchbox-Mounted Occupancy Sensors
1. Automatic-wall-switch occupancy sensor with dimmer, suitable for mounting in a single gang switchbox.
 2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 4. Switch Rating: Not less than 1200-VA
 5. Standard Range: 210 degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 2100 sq. ft.
 6. Sensing Technology: Dual technology.
 7. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
 8. Voltage: Dual voltage, 120 and 277 V; dual-technology type.
 9. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. Dims lights from turning on when the light level is higher than the set point of the sensor.
 10. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 11. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 12. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.4 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Allen-Bradley/Rockwell Automation.
 2. ASCO Power Technologies, LP.
 3. General Electric Company.
 4. Square D.
- B. Description: Electrically operated and electrically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

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; with single-pole or three-way switching. Comply with UL 1472.
- C. LED Dimmer Switches: Modular; compatible with dimmer drivers; trim potentiometer to adjust low-end dimming; dimmer-driver combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

(blank)

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: dry-type transformers rated 600 V and less, with capacities up to 1500 kVA.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
 - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton Electrical Sector; Eaton Corporation.
 - 2. Siemens Power Transmission & Distribution, Inc.
 - 3. Square D; by Schneider Electric.
- B. Source Limitations: Obtain each transformer type from single source from single manufacturer.
- C. All panelboards, switchboards, circuit breakers, dry type transformers and disconnect switches shall be of the same manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Transformers Rated 15 kVA and Larger: Comply with NEMA TP 1 energy-efficiency levels as verified by testing according to NEMA TP 2.
- D. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
- E. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
- F. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.
- G. Shipping Restraints: Paint or otherwise color code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Totally enclosed, nonventilated.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
- D. Transformer Enclosure Finish: Comply with NEMA 250.
1. Finish Color: Gray.
- E. Taps for Transformers 3 kVA and Smaller: None.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class, Smaller than 30 kVA: 185 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.
- I. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
 2. Ratio tests at the rated voltage connections and at all tap connections.
 3. Phase relation and polarity tests at the rated voltage connections.
 4. No load losses, and excitation current and rated voltage at the rated voltage connections.
 5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
 6. Applied and induced tensile tests.
 7. Regulation and efficiency at rated load and voltage.
 8. Insulation Resistance Tests:
 - a. High-voltage to ground.
 - b. Low-voltage to ground.
 - c. High-voltage to low-voltage.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

9. Temperature tests.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Secure transformer to concrete base according to manufacturer's written instructions.
- D. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- E. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS for dry-type, air-cooled, low-voltage transformers. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: Perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. 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.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

END OF SECTION 262200

(blank)

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. SPD: Surge Protection Device.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.
 - 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.5 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

B. Panelboard Schedules: For installation in panelboards.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Series rating of panelboards is not acceptable.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.9 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.10 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.11 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 Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. All panelboards, switchboards, circuit breakers, dry type transformers and disconnect switches shall be of the same manufacturer.
- B. For panelboards that are a part of the life safety (NEC 700), legally required (NEC 701) and optional standby systems (NEC 702) shall be electronic type with LSI (long time, short time and instantaneous) settings to aid in achieving coordination.
- C. Enclosures: Flush and surface-mounted cabinets as indicated on the drawings.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

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,, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 2. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 3. Directory Card: Inside panelboard door, mounted in transparent card holder.
- D. Incoming Mains Location: Top or bottom to match incoming conduit location.
- E. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- F. 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.
- G. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- H. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
- J. All doors shall be keyed alike.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. [Eaton Electrical Sector; Eaton Corporation.](#)
2. [General Electric Company.](#)
3. [Siemens Industry, Inc.](#)
4. [Square D.](#)

- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or Lugs only per 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.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
 - 1. Siemens Industry, Inc.
 - 2. General Electric Company.
 - 3. Square D.
 - 4. [Eaton Electrical Sector; Eaton Corporation.](#)
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only per the drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 LOAD CENTERS

- A. Load centers are not allowed unless specifically indicated on the drawings.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. 90 inches to top of trim above finished floor unless otherwise indicated or as required to ensure that the operating handle of the top most switch or circuit breaker is not higher than 79" above the finished floor level.
- 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 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.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "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 Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- 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.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION 262416

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes equipment for electricity metering by utility company and electricity metering by Owner.

1.3 DEFINITIONS

- A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.
- B. PC: Personal computer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For electricity-metering equipment.
 - 1. Dimensioned plans and sections or elevation layouts.
 - 2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Application and operating software documentation.
2. Software licenses.
3. Software service agreement.
4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center according to NECA 400.

1.9 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
 1. Comply with requirements of utilities providing electrical power services.
 2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING FOR UTILITY COMPANY

- A. Meters will be furnished by utility company.
- B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- C. Meter Sockets: Comply with requirements of electrical-power utility company.

2.2 EQUIPMENT FOR ELECTRICITY METERING FOR OWNER

- 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. E-Mon.
 2. National Meter Industries.
 3. Square D.
- B. General Requirements for Owner's Meters:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Comply with UL 1244.
 2. Meters used for billing shall have an accuracy of 0.5 percent of reading, complying with requirements in ANSI C12.20.
 3. Enclosure: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing.
 4. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
 5. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
 6. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
 7. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.
 8. Interface with DDC System for HVAC: One digital KY pulse to a user-definable increment of energy measurement. Match signal to DDC system for HVAC input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.
- C. Kilowatt-hour/Demand Meter: Electronic three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.
1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
 2. Display: LCD with characters not less than 0.25 inch high, indicating accumulative kilowatt-hours, current time and date, current demand, and historic peak demand, and time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.
- D. Data Transmission Cable: Transmit KY pulse data over Class 1 control-circuit conductors in raceway. Comply with Section 260523 "Control-Voltage Electrical Power Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install modular meter center according to NECA 400 switchboard installation requirements.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Equipment Identification Labels: Adhesive film labels with clear protective overlay. For residential meters, provide an additional card holder suitable for typewritten card with occupant's name.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
 - 2. Turn off circuits supplied by metered feeder and secure them in off condition.
 - 3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
 - 4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
- C. Electricity metering will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 262713

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Receptacles with integral GFCI, and associated device plates.
 - 2. Tamper-resistant receptacles.
 - 3. Twist-locking receptacles.
 - 4. Snap switches and wall-box dimmers.
 - 5. Wall-switch and exterior occupancy sensors.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. SPD: Surge Protective Device.
- F. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Wiring Devices, Inc.
 - 2. Hubbell.
 - 3. Leviton Manufacturing Co., Inc.
 - 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements in this Section.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.3 STRAIGHT-BLADE RECEPTACLES

- A. **Tamper-Resistant** Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596 with spring load shutters to prevent improper use.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices, Inc.
 - b. Hubbell Premise Wiring.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2.4 GFCI RECEPTACLES

- A. General Description:
1. Straight blade, Tamper-Resistant feed-through type.
 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 3. Include indicator that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices, Inc.
 - b. Hubbell.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2.5 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices, Inc.
 - b. Hubbell.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- c. Leviton Manufacturing Co., Inc.
- d. Pass & Seymour/Legrand (Pass & Seymour).

2.6 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

- 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. Single Pole:

- 1) Cooper; AH1221.
- 2) Hubbell; HBL1221.
- 3) Leviton; 1221-2.
- 4) Pass & Seymour; CSB20AC1.

- b. Two Pole:

- 1) Cooper; AH1222.
- 2) Hubbell; HBL1222.
- 3) Leviton; 1222-2.
- 4) Pass & Seymour; CSB20AC2.

- c. Three Way:

- 1) Cooper; AH1223.
- 2) Hubbell; HBL1223.
- 3) Leviton; 1223-2.
- 4) Pass & Seymour; CSB20AC3.

- d. Four Way:

- 1) Cooper; AH1224.
- 2) Hubbell; HBL1224.
- 3) Leviton; 1224-2.
- 4) Pass & Seymour; CSB20AC4.

C. Key-Operated Switches, 120/277 V, 20 A:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Cooper Wiring Devices, Inc.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- b. Hubbell.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - 2. Description: Single pole, with factory-supplied key in lieu of switch handle.
- D. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices, Inc.
 - b. Hubbell.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2.7 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
- 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
 - 3. Material for Unfinished Spaces: Galvanized steel.

2.8 FINISHES

- A. Device Color:
- 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All straight-blade receptacles shall be Tamper-Resistant
- B. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- C. Coordination with Other Trades:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

D. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted, provided the outlet box is large enough.

E. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

F. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- H. 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.
- I. 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.
- J. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number with durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- B. Wiring device will be considered defective if it does not pass tests and inspections.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- C. Prepare test and inspection reports.

END OF SECTION 262726

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 262816 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible & Nonfusible switches.
 - 2. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- B. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.9 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

- 2.1 All panelboards, switchboards, circuit breakers, dry type transformers and disconnect switches shall be of the same manufacturer.

2.2 FUSIBLE AND NON-FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton Electrical Sector; Eaton Corporation.
 - 2. General Electric Company.
 - 3. Siemens Industry, Inc.
 - 4. Square D.
- B. Type HD, Heavy Duty, Single Throw: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 4. Service-Rated Switches: Labeled for use as service equipment.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton Electrical Sector; Eaton Corporation.
 - 2. General Electric Company.
 - 3. Siemens Industry, Inc.
 - 4. Square D.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Install fuses in fusible devices.
- C. Comply with NECA 1.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION 262816

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual.
 - 2. Full-voltage magnetic.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- c. Nameplate legends.
- d. Short-circuit current rating of integrated unit.
- e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
- f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

- 2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for enclosed controllers and installed components.
 - 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - 3. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.10 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton Electrical Sector; Eaton Corporation.
 - b. General Electric Company.
 - c. Siemens Industry, Inc.
 - d. Square D.
 - 2. Configuration: Nonreversing.
 - 3. Surface mounting.
- C. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton Electrical Sector; Eaton Corporation.
 - b. General Electric Company.
 - c. Siemens Industry, Inc.
 - d. Square D.
2. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
4. Nonfusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 1. Dry and Clean Indoor Locations: Type 1.
 2. Outdoor Locations: Type 3R.
 3. Kitchen Areas: , stainless steel.

2.3 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- B. Install fuses in each fusible-switch enclosed controller.
- C. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- D. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Bundle, train, and support wiring in enclosures.
- B. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage solid-state controllers.

END OF SECTION 262913

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets for emergency and standby power supply with the following features:
1. Diesel engine.
 2. Unit-mounted cooling system.
 3. Outdoor enclosure.
- B. Related Sections include the following:
1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBSTITUTIONS

The generator system has been designed to the Basis of Design manufacturer's electrical and physical characteristics. The equipment sizing, spacing, amounts, electrical wiring, ventilation equipment, fuel, and exhaust and other physical and electrical components have all been sized and designed around Caterpillar supplied equipment. Should any other manufacturer's equipment be submitted for use on the project, the equipment provider shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs, which may result. Other generator manufacturers are known to produce equipment capable of meeting the functional requirements of this section, but have not been evaluated to confirm they are compatible with the space limitations or any other installation requirements that may differ from the Basis of Design Equipment.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.5 SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- 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. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators.
 - 3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 - 4. Wiring Diagrams: Power, signal, and control wiring.
- C. Qualification Data: For manufacturer and testing agency.
- D. Source quality-control test reports.
 - 1. Certified summary of prototype-unit test report.
 - 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 - 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 - 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 - 5. Report of sound generation.
 - 6. Report of exhaust emissions showing compliance with applicable regulations.
 - 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
- G. Warranty: Special warranty specified in this Section.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with ASME B15.1.
- C. Comply with NFPA 37.
- D. Comply with NFPA 70.
- E. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- F. Comply with UL 2200.
- G. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- H. Noise Emission: Less than 75 dBA of noise 23 feet from generator due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 to plus 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet (300 m).

1.8 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators, Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Caterpillar; Engine Div.- Basis of Design
 - 2. Cummings
 - 3. Kohler Co.; Generator Division.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
- C. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
 - 2. Output Connections: Three-phase, four wire.
 - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
 - 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 - 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
 - 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
 - 7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
 - 8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

- A. Fuel: Fuel oil, Grade DF-2.
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).
- D. Lubrication System: The following items are mounted on engine or skid:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz.
 2. Sound level measured at a distance of 23 feet (3 m) from exhaust discharge after installation is complete shall be 75 dBA or less.
- J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- K. Starting System: 24-V electric, with negative ground.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
 7. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.
- L. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
1. Tank level indicator.
 2. Capacity: Fuel for 48 hours' continuous operation at 100 percent rated power output.
 3. Vandal-resistant fill cap.
 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.
 5. Fuel polishing system

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.4 CONTROL AND MONITORING

- A. Provide a fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. The control shall provide all operating, monitoring, and control functions for the generator set.
- B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- D. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers.
- E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. DC voltmeter (alternator battery charging).
 - 5. Engine-coolant temperature gage.
 - 6. Engine lubricating-oil pressure gage.
 - 7. Running-time meter.
 - 8. Ammeter-voltmeter, phase-selector switch(es).
 - 9. Generator-voltage adjusting rheostat.
 - 10. Start-stop switch.
 - 11. Overspeed shutdown device.
 - 12. Coolant high-temperature shutdown device.
 - 13. Coolant low-level shutdown device.
 - 14. Oil low-pressure shutdown device.
 - 15. Generator overload.
- F. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- G. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."
- H. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
1. Low oil pressure
 2. High water temperature
 3. Low coolant level
 4. Overspeed
 5. Overcrank
 6. Emergency stop depressed
 7. Approaching high coolant temperature
 8. Approaching low oil pressure
 9. Low coolant temperature
 10. Low voltage in battery
 11. Control switch not in auto. position
 12. Low fuel main tank
 13. Battery charger ac failure
 14. High battery voltage
 15. Voltage regulator alarm
 16. Voltage regulator fault
- I. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- J. Remote Start-Stop Switch: Outdoor Rated, Wall mounted, unless otherwise indicated; and labeled. Push buttons shall be protected from accidental operation. This is a separate switch from the one incorporated into the Remote Alarm Annunciator
- K. Functional Requirements
1. The following functionality shall be integral to the control panel.
 2. Audible horn for alarm and shutdown with horn silence switch
 3. Standard ISO labeling
 4. Remote start/stop control
 5. Local run/off/auto/cooldown snap action control switch
 6. Cooldown timer
 7. Lamp test
 8. Push button emergency stop button
 9. Circuit breaker open / close pushbutton

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 2. Trip Settings: Selected to coordinate with generator thermal damage curve.
 3. Mounting: Adjacent to or integrated with control and monitoring panel
 4. The breaker shall be UL/CSA Listed, connected to engine/generator safety shutdowns. Breakers shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.
- B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Dripproof.
- G. Instrument Transformers: Mounted within generator enclosure.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

H. Digital Voltage Regulator:

1. The digital voltage regulator shall be microprocessor based with fully programmable operating and protection characteristics and shall maintain generator output voltage within +/- 0.25% for any constant load between no load and full load.
2. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode.
3. The regulator shall provide an adjustable dual slope regulation characteristic in order to optimize voltage and frequency response for site conditions.
4. The voltage regulator shall communicate with the Generator Control Panel via a communication network with generator voltage adjustments made via the controller keypad. Additionally, the controller shall allow system parameter setup and monitoring, and provide fault alarm and shutdown information through the controller. A PC-based user interface shall be available to allow viewing and modifying operating parameters in a windows compatible environment.

I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

J. Subtransient Reactance: 12 percent, maximum.

2.7 OUTDOOR GENERATOR-SET ENCLOSURE

- A. The complete diesel engine generator set, including generator control panel, engine starting batteries and fuel oil tank, shall be enclosed in a factory assembled, weather protective enclosure mounted on the fuel tank base meeting the sound requirement specified herein.
- B. A weather resistant enclosure of steel with electrostatically applied powder coated baked polyester paint. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel. Handles shall be lockable with all doors keyed alike and hinges shall be zinc die cast or stainless steel. Access doors shall be hinged, have hold open devices and can be easily removed without the use of tools. Intake openings shall be screened to prevent the entrance of rodents or pests.
- C. Lube oil and coolant drains shall be extended to the exterior of the enclosure and terminated with drain valves. Cooling fan and charging alternator shall be fully guarded to prevent injury.

2.8 MOTORS

- A. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.9 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
- B. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
1. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.10 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.11 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 2. Full load run.
 3. Maximum power.
 4. Voltage regulation.
 5. Transient and steady-state governing.
 6. Single-step load pickup.
 7. Safety shutdown.
 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
 9. Report factory test results within 10 days of completion of test.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.12 ACCESS STAIRS

- A. If generator controls are located more than 6 feet above the finished grade, provide a permanently mounted, exterior rated, OSHA approved platform and stair as required to access the controls for the generator. Provide a safety chain with padlocking capability across the entrance to the stair to deter unauthorized access to the platform.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases.
- D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
- E. Install platform and stair after the generator has been placed and set but before witness testing by the owner and/or the Architect

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect engine exhaust pipe to engine with flexible connector.
- C. Connect fuel piping to engines with a gate valve and union and flexible connector.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:

- 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
- 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
- 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
- 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
- 6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
- 7. Exhaust Emissions Test: Comply with applicable government test criteria.
- 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
- 9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations 50 feet from generator, and compare measured levels with required values.
- B. Coordinate tests with tests for transfer switches and run them concurrently.
- C. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- D. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- G. Remove and replace malfunctioning units and retest as specified above.
- H. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- I. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- J. The contractor shall provide a full tank of diesel fuel for the completion of all testing and refill the tank at the completion of the project.

3.6 DEMONSTRATION

- A. Contractor shall train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 263213

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.
 - 2. Remote annunciation systems.
 - 3. Remote annunciation and control systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
- C. Short Circuit Study Report: The findings of the Section 260572 Overcurrent Protective Device Short Circuit Study may affect the overcurrent protective devices and fault-current withstand requirements for switchboards, panelboards, and transfer switches. Also, the preparation of the study is dependent upon the manufacturer's data for this equipment. Therefore until Submittal final Approval is granted for the study, these materials shall be considered at best "Approved, pending Approval of the study" and not released for order.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Features and operating sequences, both automatic and manual.
 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Contactor Transfer Switches:
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. Caterpillar.
 - b. GE Zenith Controls.
 - c. Kohler Power Systems.
 - d. Onan/Cummins Power Generation.
 - e. Russelectric, Inc.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- H. Battery Charger: For generator starting batteries.
 - 1. Ammeter to display charging current.
 - 2. Fused ac inputs and dc outputs.
- I. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- J. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Section 260553 "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- K. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- G. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.
- H. Automatic Transfer-Switch Features:
 - 1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 - 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 - 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 - 4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 - 5. Test Switch: Simulate normal-source failure.
 - 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 - 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 - 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is not available.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- B. Identify components according to Section 260553 "Identification for Electrical Systems."
- C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.3 FIELD QUALITY CONTROL

- A. Test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
 - 1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 - 4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 - 5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- C. Coordinate tests with tests of generator and run them concurrently.
- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- E. Remove and replace malfunctioning units and retest as specified above.
- F. Prepare test and inspection reports.
- G. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Section 017900 "Demonstration and Training."
- B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

(blank)

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes lightning protection for structures.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminals and mounting accessories.
 - 1. Layout of the lightning protection system, along with details of the components to be used in the installation.
 - 2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.
 - 3. Details included in the drawings are for reference only as an aid to bidding. The contractor shall design and submit a full UL Master label system.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.
- B. Field quality-control reports.
- C. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.
- D. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:
 - 1. Ground rods.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by UL, trained and approved for installation of units required for this Project.
- B. System Certificate:
 - 1. UL Master Label.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

- A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.
- C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96 and NFPA 780.
- B. Roof-Mounted Air Terminals: NFPA 780
 - 1. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.
- C. Main and Bonding Conductors: Aluminum.
- D. Ground Rods: Copper-clad steel , sectional type; 3/4 inch in diameter by 10 feet long.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.
- C. Conceal the following conductors:
 - 1. Down conductors (behind downspouts and other building structures)
- D. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.
- E. Bond extremities of vertical metal bodies exceeding 60 feet in length to lightning protection components.
- F. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot intervals.

3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.3 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 cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

- A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
- B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF SECTION 264113

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Comply with UL 1449.
- D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE SUPPRESSOR

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Advanced Protection Technologies Inc. (APT).
 - 2. Current Technology Inc.
 - 3. LEA International.
 - 4. Liebert; a brand of Emerson Electric Co.
- B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449
 - 1. SPDs with the following features and accessories:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- a. Integral disconnect switch.
 - b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 - c. Indicator light display for protection status.
 - d. Surge counter.
- C. Comply with UL 1283.
- D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 320 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 1200 V for 480Y/277 V.
 - 2. Line to Ground: 1200 V for 480Y/277 V.
 - 3. Line to Line: 2000 V for 480Y/277 V.
- F. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
 - 1. Line to Neutral: 700 V.
 - 2. Line to Ground: 700 V.
 - 3. Line to Line: 1000 V.
- G. SCCR: Equal or exceed 200 kA.

2.3 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:
 - 1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - 2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior solid-state luminaires that use LED technology.
 - 2. Exit Signs
 - 3. Lighting fixture supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 - 6. [03*] Confirmation of compliance with Design Lighting Consortium (DLC) or ENERGY STAR product requirements."

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

7. Photometric data and adjustment factors based on laboratory tests.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation
- B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.
- C. [02*]Photometric Plots
 1. For all area in which the Basis of design fixtures are not provided, provide a photometric point by point plot with statics indicating the lighting levels are equivalent to the levels indicated on the light calculation drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Product Certificates: For each type of luminaire.
- C. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 [02*]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 other manufacturers. Substitution will be subject to post-bid submittal review and approval.

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. Bulb shape complying with ANSI C79.1.
- F. CRI of minimum 70. CCT of 4100 K Insert value.
- G. Rated lamp life of 35,000 hours.
- H. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- I. Internal driver:
 - 1. Minimum efficiency: 85% at full load.
 - 2. Minimum Operating Ambient Temperature: -20° C. (-4° F.).
 - 3. Input Voltage: 120 - 277V (±10%) at 60 Hz.
 - 4. Integral short circuit, open circuit, and overload protection.
 - 5. Power Factor: ≥ 0.95.
 - 6. Total Harmonic Distortion: ≤ 20%.
 - 7. Comply with FCC 47 CFR Part 15.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- J. LED Modules:
 - 1. Comply with IES LM-79 and LM-80 requirements.
 - 2. Minimum CRI 80 and color temperature 4200° K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 - 3. Minimum Rated Life: 50,000 hours per IES L70.
 - 4. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.
- K. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- L. Housings:
 - 1. Extruded-aluminum housing and heat sink.
- M. [03*]All interior LED lighting fixtures shall be compliant with current product requirements of Design Lighting Consortium (DLC) or ENERGY STAR program."

2.3 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
- C. Provide Five (5) extra exits signs for installation as directed by the Architect. Installation costs for these shall be included in the bid. Unused exit signs shall be turned over to the owner.

2.4 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
 - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

- a. "USE ONLY" and include specific lamp type.
- b. Lamp diameter, shape, size, wattage, and coating.
- c. CCT and CRI for all luminaires.

2.5 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:
 - 1. Ceiling mount with two 5/32-inch-Insert value diameter aircraft cable supports adjustable to 120 inches in length.
- H. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 265119

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Communications equipment coordination and installation.
 - 2. Sleeves for pathways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common communications installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 1. Manufacturers: Subject to compliance with requirements,:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
 - 3. Pressure Plates: Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: of length required to secure pressure plates to sealing elements. Include one for each sealing element.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 270500

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 271500 - COMMUNICATIONS CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Pathways.
2. UTP cabling.
3. 50/125 -micrometer, optical fiber cabling.
4. Coaxial cable.
5. Multiuser telecommunications outlet assemblies.
6. Cable connecting hardware, patch panels, and cross-connects.
7. Telecommunications outlet/connectors.
8. Cabling system identification products.
9. Cable management system.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. LAN: Local area network.
- E. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- F. Outlet/Connectors: A connecting device in the work area on which cable or outlet cable terminates.
- G. RCDD: Registered Communications Distribution Designer.
- H. UTP: Unshielded twisted pair.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.4 CABLING DESCRIPTION

- A. Cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
 - 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
 - 2. cabling shall contain no more than one transition point or consolidation point between the cross-connect and the telecommunications outlet/connector.
 - 3. Bridged taps and splice shall not be installed in the cabling.
 - 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. The maximum allowable cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the cross-connect.

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. Cabling administration drawings and printouts.
 - 3. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 4. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Patch-Panel Units: 20% of project total of each type.
 2. Connecting Blocks: 20% of project total of each type.
 3. Device Plates: 20% of project total of each type.

PART 2 - PRODUCTS

2.1 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Belden CDT Inc.; Electronics Division.
 2. Berk-Tek; a Nexans company.
 3. CommScope, Inc.
 4. Draka USA.
 5. Genesis Cable Products; Honeywell International, Inc.
 6. KRONE Incorporated.
 7. Mohawk; a division of Belden CDT.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

8. Nordex/CDT; a subsidiary of Cable Design Technologies.
 9. Superior Essex Inc.
 10. SYSTIMAX Solutions; a CommScope, Inc. brand.
 11. 3M.
 12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. Description: 100-ohm, 4-pair UTP, formed into 25-pair, binder groups covered with a thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 6.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

2.2 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Technology Systems Industries, Inc.
 2. Dynacom Corporation.
 3. Hubbell Premise Wiring.
 4. KRONE Incorporated.
 5. Leviton Voice & Data Division.
 6. Molex Premise Networks; a division of Molex, Inc.
 7. Nordex/CDT; a subsidiary of Cable Design Technologies.
 8. Panduit Corp.
 9. Siemon Co. (The).
 10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair UTP cable installed plus 20% spares and blank positions.
- D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.3 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Berk-Tek; a Nexans company.
 2. CommScope, Inc.
 3. Corning Cable Systems.
 4. General Cable Technologies Corporation.
 5. Mohawk; a division of Belden CDT.
 6. Nordex/CDT; a subsidiary of Cable Design Technologies.
 7. Optical Connectivity Solutions Division; Emerson Network Power.
 8. Superior Essex Inc.
 9. SYSTIMAX Solutions; a CommScope, Inc. brand.
 10. 3M.
 11. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. Description: Singlemode, 50/125-micrometer, 12-fiber, tight buffer, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
 2. Comply with TIA/EIA-568-B.3 for performance specifications.
 3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - b. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
 4. Conductive cable shall be armored type.
 5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
 6. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- C. Jacket:
1. Jacket Color: Orange.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.4 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. ADC.
 2. American Technology Systems Industries, Inc.
 3. Berk-Tek; a Nexans company.
 4. Corning Cable Systems.
 5. Dynacom Corporation.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

6. Hubbell Premise Wiring.
7. Molex Premise Networks; a division of Molex, Inc.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Optical Connectivity Solutions Division; Emerson Network Power.
10. Siemon Co. (The).

B. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

C. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex and duplex, connectors. Insertion loss not more than 0.75 dB.
3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.

1. Faceplate: Four port Stainless Steel.
2. For use with snap-in jacks accommodating any combination of UTP jacks.
3. Legend: Clear-labels.
4. Provide blank in un-used openings.

2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.7 SOURCE QUALITY CONTROL

A. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

B. Factory test UTP cables according to TIA/EIA-568-B.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in all spaces whether plenum or not.
 - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Do not use consolidation point as a cross-connect point,.
 - 4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
3. Cable jacket color code should be as follows:
 - a. VoIP shall be Blue
 - b. Data shall be Black
 - c. Security shall be Yellow
 - d. Access Control shall be Purple
 - e. Intercom Speakers shall be Gray
 - f. Consult the owner for color of other systems not covered.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
- a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
- a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- E. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

mounted device shall be identified with name and number of particular device as shown.

- b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 - 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
- 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

- 1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
- 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
- 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
- 4. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- 5. UTP Performance Tests:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
- 6. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
- 7. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 271500

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Electronic safety and security equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electronic safety and security installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2. Sealing Elements: interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Include two for each sealing element.
4. Connecting Bolts and Nuts of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

- A. Electronic safety and security penetrations occur when raceways, pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 280500

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Magnetic door holders.
 - 7. Remote annunciator.
 - 8. Addressable interface device.
 - 9. Digital alarm communicator transmitter.

1.3 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. HLI: High Level Interface.
- D. NICET: National Institute for Certification in Engineering Technologies.
- E. PC: Personal computer.
- F. VESDA: Very Early Smoke-Detection Apparatus.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring required for HVAC unit shutdown on alarm.
 - c. Locate detectors according to manufacturer's written recommendations.
12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by the architect prior to submission to authorities having jurisdiction.
2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. Licensed or certified by authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1.6 Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Record copy of site-specific software.
 - g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - h. Manufacturer's required maintenance related to system warranty requirements.
 - i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.

1.9 PROJECT CONDITIONS

- A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
- B. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- B. Automatic sensitivity control of certain smoke detectors.
- C. All components provided shall be listed for use with the selected system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 1. Manual stations.
 2. Heat detectors.
 3. Flame detectors.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

4. Smoke detectors.
5. Duct smoke detectors.
6. Automatic sprinkler system water flow.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances
2. Identify alarm and specific initiating device at fire-alarm control unit, connected network panels, and remote textual annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Release fire and smoke doors held open by magnetic door holders.
5. Activate audio/alarm communication system.
6. Record events in the system memory.
7. Indicate device in alarm on the annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. User disabling of zones or individual devices.
2. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit, connected network panels, and remote annunciators.
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
4. Transmit system status to building management system.
5. Display system status on annunciator.

2.3 FIRE-ALARM CONTROL UNIT

- 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:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Gamewell - FCI by Honeywell.
2. Notifier.
3. SimplexGrinnell LP.
4. Siemens

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
 - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder
 - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
 - d. The FACP shall be listed for connection to a central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B .
2. Install no more than 200 addressable devices on each signaling-line circuit.
3. Serial Interfaces:
 - a. One dedicated RS 485 port for central-station operation using point ID DACT.
 - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module
 - c. One USB port for PC configuration.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

E. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters and digital alarm radio transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, breaking-glass or plastic-rod pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS:

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

4. Each sensor shall have multiple levels of detection sensitivity.
5. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
 1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
 1. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "ALERT" is engraved in minimum 1-inch- high letters on the lens.
 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 2. Mounting: Wall mounted unless otherwise indicated.
 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 4. Flashing shall be in a temporal pattern, synchronized with other units.
 5. Strobe Leads: Factory connected to screw terminals.
 6. Mounting Faceplate: Factory finished, red.
- C. Tone Notification Appliances:
 1. Comply with UL 1480.
 2. High-Range Units: Rated 2 to 15 W.
 3. Low-Range Units: Rated 1 to 2 W.
 4. Mounting: Flush or semirecessed bidirectional.
 5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2.8 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
 - 1. Electromagnets: Require no more than 3 W to develop 25-lbf holding force.
 - 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
 - 3. Rating: 24-V ac or dc.
- B. Material and Finish: Match door hardware.

2.9 ADDRESSABLE INTERFACE DEVICE

- A. General:
 - 1. Include address-setting means on the module.
 - 2. Store an internal identifying code for control panel use to identify the module type.
 - 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.
 - 2. Programming device.
 - 3. LED display.
 - 4. Manual test report function and manual transmission clear indication.
 - 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.11 FIRE ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Comtran Corp.
 2. Draka USA.
 3. Genesis Cable Products; Honeywell International, Inc.
 4. Rockbestos-Suprenant Cable Corporation.
 5. West Penn Wire/CDT; a division of Cable Design Technologies.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG or size as recommended by system manufacturer.
1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
1. Low-Voltage Circuits: No. 16 AWG, minimum.
 2. Line-Voltage Circuits: No. 12 AWG, minimum.
 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NRTL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Equipment Mounting: Install fire-alarm control unit on finished floor.
- C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
- D. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
 - 2. Mount manual fire-alarm box on a background of a contrasting color.
 - 3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- E. Smoke- or Heat-Detector Spacing:
 - 1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 3. Smooth ceiling spacing shall not exceed 30 feet.
 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
 5. HVAC: Locate detectors not closer than 60 inches from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
- F. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- H. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- I. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- J. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install devices on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- K. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- 3.3 PATHWAYS
- A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.
1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.
- B. Pathways shall be installed in EMT.
- C. Exposed EMT shall be painted red enamel.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

3.4 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated HVAC duct systems.
 - 2. Magnetically held-open doors.
- C. Connect two dedicated active telephone lines to the DACT; coordinate with communications system installer.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Perform the following tests and inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

DOBO HALL RENOVATION
PACKAGE A – RENOVATION
UNC WILMINGTON
Architect's Project No. 580999

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

