

SECTION 15010

BASIC MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Basic Mechanical Requirements specifically applicable to Division 15 Sections, in addition to Division 1 - General Requirements.

1.2 REFERENCES

- | | |
|--|--------|
| A. American National Standards Institute | ANSI |
| B. American Society of Mechanical Engineers | ASME |
| C. American Water Work Association | AWWA |
| D. American Society of Heating, Refrigeration and Air Conditioning Engineers | ASHRAE |
| E. American Refrigeration Institute | ARI |
| F. American Society for Testing and Materials | ASTM |
| G. National Fire Protection Association | NFPA |
| H. Sheet Metal and Air Conditioning Contractors National Association | SMACNA |
| I. National Electrical Manufacturer's Association | NEMA |
| J. Underwriters Laboratories | UL |
| K. Manufacturers Standardization Society of the Valve and Fitting Industry | MSS |
| L. American Gas Association | AGA |
| M. Factory Mutual | FM |
| N. Industrial Risk Insurers | IRI |
| O. Insurers Service Organization | ISO |
| P. Plumbing and Drainage Institute | PDI |

1.3 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Proposed Products List: Include Products specified in Division 15.
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
- D. Mark dimensions and values in units to match those specified.

1.4 REGULATORY REQUIREMENTS

- A. Conform to International Building Code for 2006.
- B. Plumbing: Conform to International Plumbing Code for 2006.
- C. Mechanical: Conform to International Mechanical Code for 2006.
- D. Fire Protection: Conform to National Fire Protection Association documents currently in effect.
- E. Obtain permits, and request inspections from authority having jurisdiction.

1.5 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Architect/Engineer before proceeding.

1.6 TRANSPORTATION AND HANDLING

- A. Transport and handle Products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.
- C. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.7 STORAGE AND PROTECTION

- A. Store and protect Products in accordance with manufacturers' instructions, with seals and labels intact and legible.
- B. Store sensitive Products in weather tight, climate controlled enclosures.
- C. For exterior storage of fabricated Products, place on sloped supports, above ground.
- D. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

1.8 SUBSTITUTIONS AND PRODUCT OPTIONS

A. See Section 01630.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 15140
SUPPORTS AND ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and equipment hangers and supports.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment and pipe stacks.

1.2 RELATED SECTIONS

- A. Section 03300 - Cast-In-Place Concrete: Equipment bases.
- B. Section 07270 - Firestopping: Joint seals for piping and duct penetration of fire rated assemblies.
- C. Section 07850 - Prefabricated Roof Curbs.
- D. Section 07920 - Caulking and Sealants.
- E. Section 09900 - Painting.
- F. Section 15245 - Vibration Isolation.
- G. Section 15260 - Piping Insulation.
- H. Section 15310 - Fire Protection Piping.
- I. Section 15410 - Plumbing Piping.
- J. Section 15535 - Refrigerant Piping and Specialties.

1.3 REFERENCES

- A. ASME B31.1 - Power Piping.
- B. ASME B31.5 - Refrigeration Piping.

- C. ASME B31.9 - Building Services Piping.
- D. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- E. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- F. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- G. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- H. NFPA 13 - Installation of Sprinkler Systems.
- I. UL 203 - Pipe Hanger Equipment for Fire Protection Service.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data: Provide manufacturers catalog data including load capacity.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 REGULATORY REQUIREMENTS

- A. Conform to Standard Plumbing and Mechanical codes for support of plumbing piping.
- B. Supports for Sprinkler Piping: In conformance with NFPA 13.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. I.T.T. Grinnel.

2. Other acceptable manufacturers offering equivalent products.
 - a) Fee and Mason.
 - b) PHD.
 - c) Elcen.
- B. Fire Protection Piping:
1. Conform to NFPA 13.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- C. Plumbing Piping - DWV:
1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
 2. Hangers for Pipe Sizes up to 1-1/2 Inch: Carbon steel, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- D. Plumbing Piping - Water:
1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
 2. Hangers for Pipe Sizes up to 1-1/2 Inch: Carbon steel, adjustable swivel, split ring, copper plated or plastic coated.

3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
7. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
8. Vertical Support: Steel riser clamp, plastic coated.
9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

E. Refrigerant Piping:

1. Conform to ASME B31.5, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes up to 1-1/2 Inch: Carbon steel, adjustable swivel, split ring, copper plated or plastic coated.
3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Metal Counterflashing: 22 gage galvanized steel.

- C. Lead Flashing:
 - 1. Waterproofing: 5 lb/sq ft sheet lead.
 - 2. Soundproofing: 1 lb/sq ft sheet lead.
- D. Flexible Flashing: 45 mil thick sheet compatible with roofing.
- E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.4 EQUIPMENT CURBS

- A. Manufacturers:
 - 1. Custom Curbs Model CRC-3 and CES-3.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Thy Curb Model TC-3 and EMS-3.
 - b) Creative Metals Model CSS and ESSF.
- B. Fabrication: Welded 18 gage galvanized steel shell and base, 1-1/2 inch thick insulation, factory installed wood nailer.

2.5 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed. Refer to Section 07270.
- D. Sleeves for Round Ductwork: Galvanized steel.
- E. Sleeves for Rectangular Ductwork: Galvanized steel or wood.
- F. Stuffing or Firestopping Insulation: Glass fiber type, non-combustible; refer to Section 07270.
- G. Sealant: Refer to Section 07900.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.2 PIPE HANGERS AND SUPPORTS

- A. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- B. Place hangers within 12 inches of each horizontal elbow.
- C. Use hangers with 1-1/2 inch minimum vertical adjustment.
- D. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- E. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Support riser piping independently of connected horizontal piping.
- H. Provide copper plated hangers and supports for copper piping.
- I. Design hangers for pipe movement without disengagement of supported pipe.
- J. Prime coat exposed steel hangers and supports. Refer to Section 09900. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.3 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members and Steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.4 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor, shower and mop sink drains watertight to adjacent materials.
- E. Provide curbs for mechanical roof installations 12 inches minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- F. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.5 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.
- D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- E. Install chrome plated steel escutcheons at finished surfaces.

END OF SECTION

SECTION 15190

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.2 RELATED SECTIONS

- A. Section 09900 - Painting: Identification painting.

1.3 REFERENCES

- A. ANSI A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS AT PROJECT CLOSEOUT

- A. Submit under provisions of Section 01700.
- B. Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. Seton Name Plate Company.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Brady U.S.A., Inc.
 - b) EMED Company, Inc.
- B. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Manufacturers:
 - 1. Seton Name Plate Company Model M45.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Brady U.S.A., Inc.
 - b) EMED Company, Inc.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- C. Chart: Typewritten letter size list in anodized aluminum frame.

2.3 STENCILS

- A. Manufacturers:
 - 1. Seton Name Plate Company Model 44.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Brady U.S.A., Inc.
 - b) EMED Company, Inc.
- B. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
 - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
 - 6. Ductwork and Equipment: 2-1/2 inch high letters.
- C. Stencil Paint: As specified in Section 09900, semi-gloss enamel, colors conforming to ANSI A13.1.

2.4 PIPE MARKERS

- A. Manufacturers:
 - 1. Seton Name Plate Company Model M39 and M40.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Brady U.S.A., Inc.
 - b) EMED Company, Inc.

- B. Color: Conform to ANSI A13.1.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Plastic Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS

- A. Manufacturers:
 - 1. Seton Name Plate Company Model BCM.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Brady U.S.A., Inc.
 - b) EMED Company, Inc.
- B. Description: Steel with 3/4 inch diameter color coded head.
- C. Color code as follows:
 - 1. Yellow - HVAC equipment
 - 2. Red - Fire dampers/smoke dampers
 - 3. Green - Plumbing valves

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09900 for stencil painting.

3.2 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install labels with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

- D. Install tags using corrosion resistant chain. Number tags consecutively by location.
- E. Apply stencil painting in accordance with Section 09900.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify valves in main and branch piping with tags.
- J. Tag automatic controls, instruments, and relays. Key to control schematic.
- K. Identify piping, concealed or exposed, with plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- L. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 15245

VIBRATION ISOLATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vibration isolation.

1.2 RELATED SECTIONS

- A. Section 03300 - Cast-in-Place Concrete.
- B. Section 15140 - Supports and Anchors.
- C. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation on motor driven equipment over .25 HP, plus connected piping and ductwork.
- B. Provide minimum static deflection of isolators for equipment as indicated.
 - 1. Slab on Grade, Under 20 hp
 - a) Under 400 rpm: 1 inch
 - b) 400 - 600 rpm: 1 inch
 - c) 600 - 800 rpm: 0.5 inch
 - d) 800 - 900 rpm: 0.2 inch
 - e) 1100 - 1500 rpm: 0.14 inch
 - f) Over 1500 rpm: 0.1 inch
 - 2. Upper Floors Above Ceiling, Normal
 - a) Under 400 rpm: 3.5 inch
 - b) 400 - 600 rpm: 3.5 inch
 - c) 600 - 800 rpm: 2 inch
 - d) 800 - 900 rpm: 1 inch
 - e) 1100 - 1500 rpm: 0.5 inch
 - f) Over 1500 rpm: 0.2 inch

3. Upper Floors Above Ceiling, Critical
 - a) Under 400 rpm: 3.5 inch
 - b) 400 - 600 rpm: 3.5 inch
 - c) 600 - 800 rpm: 3.5 inch
 - d) 800 - 900 rpm: 2 inch
 - e) 1100 - 1500 rpm: 1 inch
 - f) Over 1500 rpm: 0.5 inch

C. Upper floor locations shall be considered critical unless otherwise indicated.

D. Use bases and isolator types as indicated in schedule.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings: Indicate and locate vibration isolators, with static and dynamic load on each.

C. Product Data: Provide schedule of vibration isolator type with location and load on each.

D. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

E. Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Section 01700.

B. Record actual locations of hangers including attachment points.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Vibration Elimination Company, Inc.

B. Kinetics Noise Control.

C. Vibration Mounting and Control, Inc.

2.2 BASES

- A. Direct Isolation: (Type A)
 - 1. Direct isolation shall be used when equipment is unitary and requires no additional support. Confirm with equipment manufacturer.
- B. Structural Bases and Rails: (Type B)
 - 1. Bases and rails shall be rigid to prevent misalignment or undue stress on isolated equipment, and to transmit loads to isolator and snubbers.
 - 2. Bases and rails shall be of welded structural steel with gusseted brackets, supporting equipment and motor with motor slide rails.
- C. Concrete Bases: (Type C)
 - 1. Concrete base shall have mass of 1.5 times weight of isolated equipment.
 - 2. Concrete bases shall be constructed of structural steel channel perimeter frame with gusseted brackets and anchor bolts, welded in reinforcing bars, with provision for hold down and isolator brackets.
 - 3. Connection points shall be reinforced to connect isolators and snubbers to base.
 - 4. Concrete: Reinforced 3,000 psi concrete.
- D. Curb Isolation System: (Type D)
 - 1. Roof curb isolator system shall be specifically designed to support rooftop equipment and house master spring isolators in a water tight and airtight assembly.
 - 2. Small diameter spring isolators shall be provided with 1-3" static deflection as indicated and shall meet design criteria specified for Type 3 isolators.

2.3 VIBRATION ISOLATORS

- A. Glass Fiber Pads (Type 1):
 - 1. Neoprene jacketed pre-compressed molded glass fiber.
- B. Neoprene Pad Isolators (Type 1):
 - 1. Rubber or neoprene waffle pads.
 - a) 30 durometer.
 - b) Minimum 1/2 inch thick.
 - c) Maximum loading 40 psi.
 - d) Height of ribs shall not exceed 0.7 times width.
 - 2. Configuration: 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.
- C. Rubber Mount or Hanger (Type 2):
 - 1. Molded rubber designed for 0.5 inches deflection with threaded insert.

- D. Spring Hanger (Type 3):
 - 1. Spring Isolators:
 - a) For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b) Code: Color code springs for load carrying capacity.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
 - 4. Misalignment: Capable of 20 degree hanger rod misalignment.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install isolation for motor driven equipment.
- C. Install spring hangers without binding.
- D. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- E. Support piping connections to isolated equipment resiliently as follows:
 - 1. Up to 4 Inch Diameter: First three points of support.
 - 2. 5 to 8 Inch Diameter: First four points of support.
 - 3. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.
- F. Connect wiring to isolated equipment with flexible hanging loop.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

3.3 PIPE ISOLATION SCHEDULE

Pipe Size Inch	Isolated Distance from Equipment
1	120 diameters
2	90 diameters
3	80 diameters
4	75 diameters
6	60 diameters
8	60 diameters

3.4 EQUIPMENT ISOLATION SCHEDULE

Equipment Type	Slab on grade Base/Isolation/Defl	20Ft. B/I/D	Equipment Location Floor Span		
			30Ft. B/I/D	40Ft. B/I/D	50Ft. B/I/D
Refrigeration Machines					
Reciprocating compressors	C/3/.75	C/3/.75	C/3/1.5	C/3/1.5	C/3/2.5
Reciprocating condensing units and chilling units	A/2/.25	A/4/.75	A/4/1.5	A/4/2.5	A/4/2.5
Packaged Roof Air-Conditioning Units	N/A	D/3/.75	A-B/3/1.5	A-B/3/2.5	A-B/3/3.5
Fans and Air Handling Equipment Axial Tubular and Fan Heads					
Up to 22 in. wheel dia.	A-B/2/.25	A-B/3/.75	A-B/3/.75	A-C/3/.75	A-C/3/1.5
301 to 500 rpm	B-C/3/.75	C/3/1.5	C/3/2.5	C/3/2.5	C/3/2.5
501 rpm and over	B-C/3/.75	C/3/1.5	C/3/1.5	C/3/1.5	C/3/2.5
Centrifugal Fans and Vent Sets					
Up to 22 in. wheel dia.	A-B/2/.25	A-B/3/.75	A-B/3/.75	A-C/3/.75	A-C/3/.75
301 to 500 rpm	B/3/1.5	B/3/1.5	B/3/1.5	B/3/2.5	B/3/2.5
501 rpm and over	B/3/.75	B/3/.75	B/3/.75	B/3/1.5	B/3/2.5

END OF SECTION

SECTION 15260
PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.2 RELATED SECTIONS

- A. Section 07270 - Firestopping.
- B. Section 09900 - Painting: Painting insulation jacket.
- C. Section 15140 - Supports and Anchors.
- D. Section 15190 - Mechanical Identification.
- E. Section 15410 - Plumbing Piping: Placement of hangers and hanger inserts.
- F. Section 15535 - Refrigerant Piping: Placement of inserts.

1.3 REFERENCES

- A. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- B. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- D. ASTM C195 - Mineral Fiber Thermal Insulation Cement.
- E. ASTM C240 - Standard Test Methods of Testing Cellular Glass Insulation Block.
- F. ASTM C449/C449M - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

- G. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- H. ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- I. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- J. ASTM C547 - Mineral Fiber Preformed Pipe Insulation.
- K. ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.
- L. ASTM C578 - Preformed, Block Type Cellular Polystyrene Thermal Insulation.
- M. ASTM C591 - Unfaced Preformed Rigid Preformed Cellular Urethane Thermal Insulation.
- N. ASTM C610 - Expanded Perlite Block and Pipe Thermal Insulation.
- O. ASTM C795 - Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- P. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- Q. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
- R. ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).
- S. ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- T. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
- U. ASTM E84 - Surface Burning Characteristics of Building Materials.
- V. ASTM E96 - Water Vapor Transmission of Materials.
- W. NAIMA - National Insulation Standards.
- X. NFPA 255 - Surface Burning Characteristics of Building Materials.
- Y. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience, approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

- A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 15010.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 GLASS FIBER

- A. Manufacturers:
 - 1. Schuller Micro-Lok.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Knauf.
 - b) Owens-Corning.
 - c) CertainTeed.
- B. Insulation: ASTM C547; rigid molded, noncombustible.
 - 1. 'K' value: ASTM C335, 0.24 at 75 degrees F.
 - 2. Minimum Service Temperature: -20 degrees F.
 - 3. Maximum Service Temperature: 850 degrees F.
 - 4. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket
 - 1. ASTM C921, White kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
 - 3. Secure with self sealing longitudinal laps and butt strips.
 - 4. Secure with outward clinch expanding staples and vapor barrier mastic.
- D. Tie Wire: 18 gage stainless steel with twisted ends on maximum 12 inch centers.
- E. Vapor Barrier Adhesive: Install vapor barrier adhesive of type recommended by insulation manufacturer.

2.2 CELLULAR FOAM

- A. Manufacturers:
 - 1. Armstrong Armaflex.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Schuller Rubatex.
 - b) Imcoa-Imcolock.
- B. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 - 1. 'K' Value: ASTM C177 or C518; 0.28 at 75 degrees F.
 - 2. Minimum Service Temperature: -40 degrees F.
 - 3. Maximum Service Temperature: 220 degrees F.
 - 4. Maximum Moisture Absorption: ASTM D1056; 1.0 percent by volume.
 - 5. Moisture Vapor Transmission: ASTM E96; 0.17 perm inches.
 - 6. Maximum Flame Spread: ASTM E84; 25.

7. Maximum Smoke Developed: ASTM E84; 50 (pipe), 100 (sheet).
8. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Install adhesive as recommended by insulation manufacturer.

2.3 JACKETS

A. PVC Plastic

1. Manufacturers:
 - a) Zeston.
 - b) Prato.
 - c) Foster Products.
2. Jacket: ASTM C921, One piece molded type fitting covers and sheet material, off white color.
 - a) Minimum Service Temperature: 0 degrees F.
 - b) Maximum Service Temperature: 150 degrees F.
 - c) Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.
 - d) Maximum Flame Spread: ASTM E84; 25.
 - e) Maximum Smoke Developed: ASTM E84; 50.
 - f) Thickness: 20 mil.
 - g) Connections: Brush on welding adhesive and pressure sensitive color matching vinyl tape.
3. Covering Adhesive Mastic: Install mastic as recommended by covering manufacturer.

B. Aluminum Jacket: ASTM B209.

1. Thickness: 0.020 inch.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.

- B. On exposed piping, locate insulation and cover seams in least visible locations.
- C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory applied or field applied.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
 - 3. Finish with glass cloth and vapor barrier adhesive.
 - 4. PVC fitting covers may be used.
 - 5. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
 - 6. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- D. For insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 - 3. Finish with glass cloth and adhesive.
 - 4. PVC fitting covers may be used.
 - 5. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
 - 6. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- E. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert Location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- F. Finish insulation at supports, protrusions, and interruptions.
- G. For pipe exposed in mechanical equipment rooms or in finished spaces, finish with PVC jacket and fitting covers.

- H. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 TOLERANCE

- A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 GLASS FIBER INSULATION SCHEDULE

PIPING SYSTEMS	PIPE SIZE Inch	THICKNESS Inch
A. Plumbing Systems		
Domestic Cold Water	all sizes	1/2"
Domestic Hot Water and Hot Water Recirculation	all sizes	1"
Roof Drain Bodies	all sizes	1/2"
Roof Drainage run Horizontal Above Grade	all sizes	1/2"
Floor Drains Above Grade Mechanical Rooms Drains, Traps and Horizontal Piping	all sizes	1/2"
Condensate Drains	all sizes	1/2"

3.5 CELLULAR FOAM INSULATION

Plumbing System	PIPE SIZE Inch	THICKNESS Inch
A. Plumbing System		
Domestic Water Piping under Slab	all sizes	1/2"
Condensate Drains	all sizes	1/2"

B. Heating and Cooling Systems

Condensate Drains	all sizes	1/2"
Refrigerant Suction Piping (inside)	all sizes	1/2"
Refrigerant Suction Piping (outside)	all sizes	3/4"
Refrigerant Hot Gas	all sizes	1/2"

END OF SECTION

SECTION 15290
DUCTWORK INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Ductwork insulation.
- B. Insulation jackets.

1.2 RELATED SECTIONS

- A. Section 09900 - Painting: Painting insulation jackets.
- B. Section 15190 - Mechanical Identification.
- C. Section 15890 - Ductwork.

1.3 REFERENCES

- A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- C. ASTM C553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- D. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- E. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- F. ASTM E84 - Surface Burning Characteristics of Building Materials.
- G. ASTM E96 - Water Vapor Transmission of Materials.
- H. ASTM E162 - Surface Flammability of Materials Using a Radiant Heat Energy Source.
- I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

- J. NAIMA National Insulation Standards.
- K. NFPA 255 - Surface Burning Characteristics of Building Materials.
- L. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- M. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

- A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 15010.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. Schuller.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Knauf Micrilite.
 - b) Owens Corning.
 - c) CertainTeed.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' value: ASTM C518, 0.29 at 75 degrees F.
 - 2. Maximum service temperature: 250 degrees F.
 - 3. Maximum moisture absorption: 0.20 percent by volume.
 - 4. Density: 1.0 lb/cu ft.
- C. Vapor Barrier Jacket
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture vapor transmission: ASTM E96; 0.04 perm.
 - 3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape
 - 1. Install vapor barrier tape as recommended by the insulation manufacturer.
 - 2. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Tie Wire: Annealed steel, 16 gage.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that ductwork has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with NAIMA National Insulation Standards.
- B. Insulated ductwork conveying air below ambient temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Insulated ductwork conveying air above ambient temperature:
 - 1. Provide with or without standard vapor barrier jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- D. For exterior applications, provide insulation with vapor barrier jacket. Cover with outdoor jacket finished with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
- E. External Duct Insulation Application:
 - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - 2. Secure insulation without vapor barrier with staples, tape, or wires.
 - 3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
 - 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.3 TOLERANCE

- A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 FLEXIBLE GLASS FIBER DUCTWORK INSULATION SCHEDULE

DUCTWORK	THICKNESS	FINISH
Low Pressure Supply, Return And Outside Air Ductwork	1-1/2"	FSK
Flexible Duct Connections	1-1/2"	FSK
Fire Damper Sleeves	1-1/2"	FSK
Flex at A.H.U.	1-1/2"	FSK

END OF SECTION

SECTION 15310

FIRE PROTECTION PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe, fittings, valves, and connections for sprinkler systems.

1.2 RELATED SECTIONS

- A. Section 09900 - Painting.
- B. Section 15140 - Supports and Anchors.
- C. Section 15190 - Mechanical Identification.
- D. Section 15245 - Vibration Isolation.
- E. Section 15325 - Sprinkler Systems.

1.3 REFERENCES

- A. ASME Boiler and Pressure Vessel Code Section IX - Welding and Brazing Qualifications.
- B. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
- C. ASME B16.3 - Malleable Iron Threaded Fittings, Class 150 and 300.
- D. ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.
- E. ASME B16.5 - Pipe Flanges and Flanged Fittings.
- F. ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings.
- G. ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded.
- H. ASME B16.25 - Buttwelding Ends.
- I. ASME B36.10 - Welded and Seamless Wrought Steel Pipe.

- J. ASTM A135 - Electric-Resistance-Welded Steel Pipe.
 - K. ASTM A47 - Malleable Iron Castings.
 - L. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
 - M. ASTM A120 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated (Galvanized) Welded and Seamless, for Ordinary Uses.
 - N. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - O. ASTM A795 - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 - P. ASTM B32 - Solder Metal.
 - Q. AWS D10.9 - Specifications for Qualification of Welding Procedures and Welders for Piping and Tubing.
 - R. AWWA C110 - Ductile Iron and Gray Iron Fittings.
 - S. AWWA C151 - Ductile Iron Pipe, Centrifugally Cast.
 - T. NFPA 13 - Installation of Sprinkler Systems.
 - U. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances.
 - V. UL 262 - Gate Valves for Fire-Protection Service.
 - W. UL 312 - Check Valves for Fire-Protection Service.
 - X. UL 405 - Fire Department Connections.
- 1.4 SUBMITTALS
- A. Submit under provisions of Section 01300.
 - B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections. Documents shall be prepared under the supervision of and approved by a licensed fire sprinkler engineer in the State of Illinois.

- C. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Submit under provisions of Section 01700.
- B. Maintenance Instructions: Include installation instructions, spare parts lists, procedures, and treatment programs.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this Section with minimum three (3) years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Sprinkler Systems: Perform work to NFPA 13.
- B. Welding Materials and Procedures: Perform to ASME Code.
- C. Valves: Bear UL or FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- D. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.
- E. Maintain one (1) copy of each document on site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 15010.
- B. Deliver and store valves in shipping containers, with labeling in place.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 PRODUCTS

2.1 SPRINKLER PIPING, BURIED

- A. Cast Iron Pipe: AWWA C151.
 - 1. Fittings: AWWA C110, standard thickness.
 - 2. Joints: AWWA C111, rubber gasket.
 - 3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

2.2 SPRINKLER PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A53; ASTM A120; ASTM A795; ASTM A135 or ASME B36.10; Schedule 10 and 40 black.
 - 1. Steel Fittings: ASME B16.9, wrought steel, buttwelded; ASME B16.25, buttweld ends; ASTM A234, wrought carbon steel and alloy steel; ASME B16.5, steel flanges and fittings; ASME B16.11, forged steel socket welded and threaded.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and fittings; ASME B16.4, screwed fittings.
 - 3. Malleable Iron Fittings: ASME B16.3, screwed type. ASTM A47.
 - 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers.
 - 5. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

2.3 PIPE HANGERS AND SUPPORTS

- A. Refer to Section 15140.
- B. Conform to NFPA 13.
- C. Hangers for Pipe Sizes ½ to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- D. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- E. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- F. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.

- G. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- H. Vertical Support: Steel riser clamp.
- I. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.4 GATE VALVES

- A. Screwed - Up To and Including 2 Inches:
 - 1. Manufacturers:
 - a) Nibco Model T-104-0.
 - b) Stockham B133.
 - c) Fairbanks 0222.
 - 2. Bronze body, bronze trim, screw over bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc, threaded ends, UL listed, FM approved.
- B. Flanged - Over 2 Inches:
 - 1. Manufacturers:
 - a) Nibco Model F-607-0TS.
 - b) Stockham G634.
 - c) Fairbanks 0411.
 - 2. Iron body, bronze trim, bolted bonnet, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends, UL listed, and FM approved.

2.5 BALL VALVES

- A. Screwed Ends - Up To and Including 2 Inches:
 - 1. Manufacturers:
 - a) Nibco Model T-505-4.
 - b) Milwaukee Model BB-SC.
 - c) Victaulic 727.
 - 2. Bronze three piece full port body, chrome plated brass ball, Teflon seats and stuffing box ring, indicator operator, threaded ends, UL listed, FM approved.

2.6 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. Nibco Model WD3510-4.
 - 2. Mueller WG8282-3FP.
 - 3. Stockham Model LG527F.

- B. Ductile iron body with BUNA-N seat, wafer ends, extended neck, ductile iron disc, UL listed and FM approved.
- C. Operator: Gear operator with tamper switches.

2.7 CHECK VALVES

- A. Manufacturers:
 - 1. Nibco Model W-900-W.
 - 2. Kennedy 706.
- B. Cast iron wafer style spring actuated check with BUNA-N seat, aluminum bronze plates, UL listed and FM approved.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems and NFPA 24 for service mains.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, and not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

- G. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09900.
- H. Do not penetrate building structural members unless indicated.
- I. Provide sleeves when penetrating footings, floors and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required. Refer to Section 07270.
- J. Sleeve pipes passing through partitions, walls, and floors.
- K. Pipe Hangers and Supports:
 - 1. Install in accordance with NFPA 13.
 - 2. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 7. Prime coat exposed steel hangers and supports. Refer to Section 09900. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- M. Die cut screw joints with full cut standard taper pipe threads with Teflon or other non-toxic joint compound applied to male threads only.
- N. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.
- O. Provide gate, ball or butterfly valves for shut-off or isolating service.
 - 1. Provide tamper switches at all required locations. Coordinate tamper switch electrical connections with electrician.

P. Provide drain valves at main shut-off valves, low points of piping and apparatus.

END OF SECTION

SECTION 15325
SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.
- C. Fire department connections.

1.2 RELATED SECTIONS

- A. Section 02225 - Trenching.
- B. Section 15190 - Mechanical Identification.
- C. Section 15245 - Vibration Isolation.
- D. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. NFPA 13 - Installation of Sprinkler Systems.
- B. NFPA 24 - Private Service Mains and Their Appurtenances.
- C. NFPA 25 - Inspection, Testing and Maintenance of Water Based Fire Protection Systems.
- D. FM - Factory Mutual Approval Guide.
- E. NFPA 70 - National Electrical Code.
- F. UL - Fire Resistance Directory.
- G. UL 199 - Automatic Sprinklers.

1.4 SYSTEM DESCRIPTION

- A. System to provide coverage for entire building.

- B. Provide system to NFPA 13 light hazard occupancy requirements.
- C. Determine volume and pressure of incoming water supply from water flow test data. When new test data is available, revise design prior to submittals.
- D. Interface system with building fire and smoke alarm system.
- E. Provide fire department connections where indicated.

1.5 SUBMITTALS

- A. Section 01300 - Submittals: Procedures for submittals.
- B. The required documents have been submitted to the local building officials for review and approval.
- C. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- D. Shop Drawings:
 - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
 - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
- E. Submit shop drawings, product data and hydraulic calculations to Architect/Engineer for review and approval. Submit approved shop drawings, product data and hydraulic calculations by Architect/Engineer to State Fire Marshal for review and approval. Submit proof of that approval to Architect/Engineer and keep one (1) approved copy on site during construction.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

- A. Section 01700 - Contract Closeout: Procedures for submittals.
- B. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- C. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.

- D. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 13. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years experience and licensed for fire service piping installation in the State of Georgia.
- D. Design system by a fire sprinkler designer experienced in design of this Work, certified and licensed in the State of Georgia.

1.8 REGULATORY REQUIREMENTS

- A. Conform to UL or FM.
- B. Perform Work in accordance with NFPA 13.
- C. Equipment and Components: Bear UL or FM label or marking.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver, store, protect and handle products to site under provisions of Section 15010.
- B. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.10 EXTRA MATERIALS

- A. Provide extra sprinklers under provisions of NFPA 13.
- B. Provide suitable wrenches for each sprinkler type.
- C. Provide metal storage cabinet in location designated or located adjacent to alarm valve.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Section 01600 - Material and Equipment: Product options and substitutions. Substitutions: Permitted.

2.2 SPRINKLERS

- A. Manufacturers:
 - 1. Tyco Fire Products.
 - 2. Viking.
 - 3. Reliable.
- B. Upright: Quick response glass bulb type temperature rated for specific area hazard.
 - 1. Head Finish: Brass.
 - 2. Model: "TY-FRB" manufactured by Tyco.
- C. Quick Response Pendent: Recessed quick response type with matching escutcheon plate, glass bulb type rated for 155 degrees F.
 - 1. Head Finish: White.
 - 2. Escutcheon Finish: White.
 - 3. Escutcheon Type: Recessed.
 - 4. Model: "TY-FRB" manufactured by Tyco.

2.3 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm, with pressure retard chamber and variable pressure trim; with test and drain valve.
 - 1. Model: F or G manufactured by Tyco.
- B. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy red enameled gong motor housing, nylon bearings, and inlet strainer.
- C. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
- D. Fire Department Connections:
 - 1. Type: Flush mounted wall type with brass finish.
 - 2. Outlets: Two-way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish with breakable caps.

3. Drain: ½ inch automatic drip, outside.
4. Label: "Sprinkler - Fire Department Connection".

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NFPA 13.
- B. Install equipment in accordance with manufacturers instructions.
- C. Install buried shut-off valves in valve box. Provide post indicator.
- D. Provide approved double detector check valve assembly at sprinkler system water source connection.
- E. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent Siamese connectors to allow full swing of fire department wrench handle.
- F. Locate outside alarm gong on building wall as indicated.
- G. Place pipe runs to minimize obstruction to other work.
- H. Place piping in concealed spaces above finished ceilings.
- I. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- J. Drop nipples supplying pendent sprinklers shall be trimmed as required to ensure a consistent distance between the deflection and the ceiling for all heads within a space.
- K. Flush entire piping system of foreign matter.
- L. Install guards on sprinklers in mechanical rooms, electrical rooms or storage rooms without ceilings.
- M. Hydrostatically test entire system.
- N. Sprinkler contractor shall install all fire protection service from point of service which begins immediately after the tap of the service main where water is used exclusively for fire protection purposes.
- O. Require test be witnessed by authority having jurisdiction.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

END OF SECTION

SECTION 15410
PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for piping systems.
 - 1. Sanitary sewer.
 - 2. Domestic water.
 - 3. Storm water.
 - 4. Equipment drains and overflows.
 - 5. Natural gas.

1.2 RELATED SECTIONS

- A. Section 02675 - Disinfection of Water Distribution System.
- B. Section 08305 - Access Doors.
- C. Section 09900 - Painting.
- D. Section 15190 - Mechanical Identification.
- E. Section 15245 - Vibration Isolation.
- F. Section 15260 - Piping Insulation.
- G. Section 15430 - Plumbing Specialties.
- H. Section 15440 - Plumbing Fixtures.
- I. Section 15450 - Plumbing Equipment.
- J. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. AGA Z21.22 - Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.
- B. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.

- C. ASME B16.3 - Malleable Iron Threaded Fittings.
- D. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- F. ASME B16.22 - Wrought Copper and Bronze Solder Joint Pressure Fittings.
- G. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes.
- H. ASME B31.9 - Building Service Piping.
- I. ASME SEC IX - Welding and Brazing Qualifications.
- J. ASTM A47 - Ferritic Malleable Iron Castings.
- K. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- L. ASTM A74 - Cast Iron Soil Pipe and Fittings.
- M. ASTM A234/A234M - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- N. ASTM B32 - Solder Metal.
- O. ASTM B42 - Seamless Copper Pipe.
- P. ASTM B43 - Seamless Red Brass Pipe.
- Q. ASTM B68 - Seamless Copper Tube.
- R. ASTM B75 - Seamless Copper Tube.
- S. ASTM B88 - Seamless Copper Water Tube.
- T. ASTM B251 - Wrought Seamless Copper and Copper-Alloy Tube.
- U. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- V. ASTM B302 - Threadless Copper Pipe (TP).
- W. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

- X. ASTM D1785 - Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- Y. ASTM D2241 - Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- Z. ASTM D2466 - Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- AA. ASTM D2564 - Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- BB. ASTM D2665 - Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
- CC. ASTM D2729 - Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- DD. ASTM D2855 - Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
- EE. ASTM D4160 - Reinforced Thermosetting Resin Pipe (RTRP) Fittings for Non-Pressure Applications.
- FF. ASTM E814 - Fire Tests of Through-Penetration Fire Stops.
- GG. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- HH. ASTM F679 - Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- II. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- JJ. AWS A5.8 - Brazing Filler Metal.
- KK. AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids.
- LL. AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.
- MM. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- NN. AWWA C651 - Disinfecting Water Mains.
- OO. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in. for Water Distribution.

- PP. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- QQ. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
- RR. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- SS. MSS SP-67 - Butterfly Valves.
- TT. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- UU. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
- VV. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
- WW. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
- XX. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.
- YY. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends.
- ZZ. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- AAA. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- BBB. NCPWB - Procedure Specifications for Pipe Welding.
- CCC. UL 1479 - Fire Tests of Through-Penetration Firestops.

1.4 SUBMITTALS FOR REVIEW

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.5 SUBMITTALS

- A. Section 01700 - Contract Closeout.

- B. Project Record Documents: Record actual locations of valves.

1.6 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME SEC IX.
- C. Welders Certification: In accordance with ASME SEC IX NCPWB Standard Procedure Specifications.
- D. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.7 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with local plumbing code.
- B. Conform to applicable code for installation of backflow prevention devices.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver, store, protect and handle products to site under provisions of Section 15010.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53, Schedule 40 black.
 - 1. Fittings: ASTM A234, forged steel welding pipe.
 - 2. Joints: ASME B31.2, ASME SEC 9, welded.
 - 3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2.2 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53, Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, forged steel welding type.
 - 2. Joints: NFPA 54, threaded or welded to ASME B31.2, ASME SEC. 1.

2.3 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
- B. PVC Pipe: ASTM D2665.
 - 1. Fittings: PVC.
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.4 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: ASTM C564, neoprene gasket system or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.5 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Tubing: ASTM B42, Type K, annealed.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 - 2. Joints: AWS A5.8, BCuP silver braze.

- B. Ductile Iron Pipe: AWWA C151.
 - 1. Fittings: Ductile or Gray iron, standard thickness.
 - 2. Joints: AWWA C111, rubber gasket with 3/4 inch diameter rods.

2.6 WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L, hard drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, solder, Grade 95TA.

2.7 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: ASTM C564, neoprene gasket system or lead and oakum.
- B. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.8 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: ASTM C564, neoprene gasket system or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.9 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53, Schedule 40 galvanized.
 - 1. Fittings: Galvanized cast iron or ASME B16.3, malleable iron.
 - 2. Joints: Threaded or grooved mechanical couplings.
- B. Copper Tubing: ASTM B88, Type M, hard drawn.
 - 1. Fittings: ASME B16.18 cast brass or ASTM B16.22 solder wrought copper.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver with melting range of 430 to 535 degrees F.

2.10 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 3 Inches and Under:
 - 1. Ferrous pipe: Class 150 malleable iron threaded unions.
 - 2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

- B. Pipe Size Over 1 Inch:
 - 1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 - 2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

- C. Grooved and Shouldered Pipe End Couplings:
 - 1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - 2. Sealing gasket: "C" shape composition sealing gasket.

- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.11 BALL VALVES

- A. Screwed - Up To and Including 2 Inches:
 - 1. Manufacturers:
 - a. Nibco Model T585-70.
 - b. Milwaukee Model BA300.
 - c. Hammond Model 8300.
 - d. Kitz Model 68.
 - 2. Bronze two piece full port body, chrome plated brass ball, Teflon seats and stuffing box ring, lever handle, threaded ends.

- B. Soldered - Up to and Including 2 Inches:
 - 1. Manufacturers:
 - a. Nibco Model S-585-70.
 - b. Milwaukee Model BA-150.
 - c. Hammond Model 8311.
 - d. Kitz Model 69.
 - 2. Bronze two piece full port body, chrome plated brass ball, Teflon seats and stuffing box ring, lever handle, solder ends.

- C. Flanged - Over 2 Inches:
 - 1. Manufacturers:
 - a. Nibco Model F-510.
 - b. Milwaukee Model F90CC.
 - c. Hammond Model 941TRE.
 - d. Kitz Model K150.
 - 2. Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle.

2.12 SWING CHECK VALVES

- A. Screwed - Up To and Including 2 Inches:
 - 1. Manufacturers:
 - a. Nibco Model T413.
 - b. Milwaukee Model 554.
 - c. Hammond Model IB940.
 - d. Kitz Model 04.
 - 2. Bronze body, bronze trim, bronze rotating swing check with composite disc, threaded ends.
- B. Soldered - Up to and Including 2 Inches:
 - 1. Manufacturers:
 - a. Nibco Model S413.
 - b. Milwaukee Model 1509.
 - c. Hammond Model IB-912.
 - d. Kitz Model 14.
 - 2. Bronze body, bronze trim, bronze rotating swing check with composite disc, solder ends.
- C. Flanged - Over 2 Inches:
 - 1. Manufacturers:
 - a. Nibco Model F-918B.
 - b. Milwaukee Model F-2974.
 - c. Hammond Model IR1140.
 - d. Kitz Model 78.
 - 2. Iron body, bronze trim, bronze on bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.13 WATER PRESSURE REDUCING VALVES

- A. Manufacturers:
 - 1. Watts.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. Mueller.
 - b. Wilkins.

- B. Up to 2 Inches: Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded and single union ends.
- C. Over 2 Inches: Cast iron body, bronze fitted, elastomeric diaphragm, stainless steel seat and seat disc, flanged.

2.14 RELIEF VALVES

- A. Manufacturers:
 - 1. Watts Model Series 174A.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. Mueller.
 - b. Wilkins.
- B. Bronze body, Teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

2.15 STRAINERS

- A. Manufacturers:
 - 1. Watts.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. Mueller.
 - b. Wilkins.
- B. Size 2 inch and Under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. Size 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 15260.

H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08305.

I. Establish elevations of buried piping outside the building to ensure not less than 2.5 ft. of cover.

J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

L. Provide support for utility meters in accordance with requirements of utility companies.

M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09900.

N. Install bell and spigot pipe with bell end upstream.

O. Install valves with stems upright or horizontal, not inverted.

- P. Install water piping to ASME B31.9.
- Q. Sleeve pipes passing through partitions, walls and floors.

3.4 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install gate, ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install ball or butterfly valves for throttling, bypass, or manual flow control services.
- F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
- G. Provide spring loaded check valves on discharge of water pumps.

3.5 ERECTION TOLERANCES

- A. Establish invert elevations for horizontal drainage piping within the building and install at a uniform slope throughout.
 - 1. Drainage piping of 2-1/2 inch diameter or less shall be installed at a slope of 1/4 inch per foot minimum.
 - 2. Drainage piping of 3 inch diameter or larger shall be installed at a slope of 1/8 inch per foot minimum.
 - 3. All underslab drainage piping within the building shall be minimum 3 inch diameter, except for shower drains or as noted on the plans.
 - 4. All horizontal vent piping shall be installed at 1/4 inch per foot slope.
- B. Slope water piping minimum 0.25 percent and arrange to drain at low points.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed and clean.

- B. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.7 SERVICE CONNECTIONS

- A. Provide new sanitary and storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves pressure reducing valve, and sand strainer.
 - 1. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch above floor and 6 inch minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.
- C. Provide new gas service complete with gas meter and regulator. Gas service distribution piping to have initial pressure of 11" w.c.. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

END OF SECTION

SECTION 15430
PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cleanouts.
- B. Backflow preventers.
- C. Water hammer arresters.

1.2 RELATED SECTIONS

- A. Section 15410 - Plumbing Piping.
- B. Section 15440 - Plumbing Fixtures.
- C. Section 15450 - Plumbing Equipment.
- D. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. ASME A112.26.1 - Water Hammer Arresters.
- B. ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent.
- C. ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
- D. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
- E. PDI WH-201 Water Hammer Arresters.

1.4 SUBMITTALS FOR REVIEW

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Section 01700 - Contract Closeout: Procedures for submittals.
- B. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers and water hammer arresters.
- C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver, store, protect and handle products to site under provisions of Section 15010.
- B. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 CLEANOUTS

- A. Manufacturers:
 - 1. J. R. Smith.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Josam.
 - b) Wade.
 - c) Zurn.
- B. Exterior Surfaced Area: Round cast nickel bronze access frame and non-skid cover; Model 4225 manufactured by J. R. Smith.
- C. Exterior Unsurfaced Areas: Line type with lacquered cast iron body and round epoxy coated gasketed cover; Model 4285 manufactured by J. R. Smith.

- D. Interior Finished Floor Areas: Cast iron, two piece body with double drainage flange, weep holes and adjustable nickel-bronze strainer, round with scoriated cover in service areas and with depressed cover to accept floor finish in finished floor area.
 - 1. Finished Concrete Floor: J. R. Smith 4025.
 - 2. Carpeted Floors: J. R. Smith 4025-Y.
 - 3. Ceramic or Quarry Tile Floors: J. R. Smith 4045.
 - 4. Vinyl Tile Floor: J. R. Smith 4145.

- E. Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw; Model 4530 manufactured by J. R. Smith.

2.2 BACKFLOW PREVENTERS

- A. Manufacturers:
 - 1. Watts Model 909.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Febco Model 825.
 - b) Wilkins Model 975.
 - c) Hersey Model FRP2/GLM.

- B. Reduced Pressure Backflow Preventers: ANSI/ASSE 1013, AWWA C506; bronze body with bronze and plastic internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks; Model 909 manufactured by Watts.

- C. Double Check Valve Assemblies: ANSI/ASSE 1012, AWWA C506; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent; Model 709 manufactured by Watts.

2.3 WATER HAMMER ARRESTERS

- A. Manufacturers:
 - 1. J. R. Smith.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Sioux Chief.
 - b) Zurn.
 - c) Josam.

- B. ANSI A112.26.1; sized in accordance with PDI WH-201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psig working pressure; J. R. Smith Figure 5000.

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- F. Pipe relief from backflow preventer to nearest drain.
- G. Install water hammer arresters complete with accessible isolation valve on supply piping to flush valves, washing machines, dishwashers, and as indicated.
- H. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch minimum, and minimum 18 inches long.

END OF SECTION

SECTION 15440
PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Floor drains.
- B. Trap primers.

1.2 RELATED SECTIONS

- A. Section 07900 - Joint Sealers: Seal fixtures to walls and floors.
- B. Section 15140 - Supports and Anchors.
- C. Section 15410 - Plumbing Piping.
- D. Section 15430 - Plumbing Specialties.
- E. Section 15450 - Plumbing Equipment.

1.3 REFERENCES

- A. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Installation Instructions.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01700.
- B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 15010.
- B. Accept fixtures on site in factory packaging. Inspect for damage.
- C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.7 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MANUFACTURERS OFFERING EQUIVALENT PRODUCTS

- A. Floor Drains, Roof Drains or Wall Hydrants:
 - 1. J.R. Smith.
 - 2. Zurn.
 - 3. Josam.
 - 4. Wade.
- B. Trap Primers:
 - 1. Precision Plumbing Products, Inc.
 - 2. MiFab.

2.2 (P-1) NOT USED

2.3 (P-2) NOT USED

2.4 (P-3) NOT USED

2.5 (P-4) NOT USED

2.6 WALL HYDRANTS (P-5)

- A. Manufacturer: Zurn Model Z-1321; non-freeze, self-draining type, all bronze nickel plated with 3/4 inch hose connection, removable key, and integral vacuum breaker.

2.7 FLOOR DRAINS - FINISHED AREA (P-6)

- A. Manufacturer: Zurn Model ZN-415-P-Y-B; cast iron body with nickel bronze full grate, round top, sediment bucket and trap primer connection.
- B. Note: Provide deep seal P-Trap.

2.8 TRAP PRIMER VALVE w/V.B. (P-7)

- A. Manufacturer: Precision Plumbing Products, Inc. Model "Prime-Rite" trap primer valve with integral vacuum breaker.
- B. Distribution Unit: P.P.P. Inc., Model P-1.

2.9 ROOF DRAINS (P-8)

- A. Manufacturer: Zurn Model ZA-100-EA-R-C; cast iron body with sump and adjustable extension, removable cast aluminum dome strainer, under deck clamp, sump receiver, reversible collar and combined flashing clamp and gravel stop. Reference plans for size.

2.10 AUXILIARY ROOF DRAIN (P-9)

- A. Manufacturer: Zurn Model ZA-100-C-EA-R-W2; cast iron body with sump and adjustable extension, removable cast aluminum dome strainer, under deck clamp, sump receiver, reversible collar and combined flashing clamp and gravel stop. Reference plans for size.

2.11 ROOF HYDRANT (P-10)

- A. Manufacturer: Woodford Model RHY1-MS; freeze resistant roof hydrant with mounting system.
- B. Note: Coordinate location with general contractor and roofing contractor.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components level and plumb.
- C. Install and secure fixtures in place with wall supports, wall carriers and bolts.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

- A. Adjust work under provisions of Section 01700.
- B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

- A. Clean work under provisions of 01700.
- B. At completion clean plumbing fixtures and equipment.

3.7 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01500.
- B. Do not permit use of fixtures.

END OF SECTION

SECTION 15450
PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pumps.
 - 1. Sump Pumps.

1.2 RELATED SECTIONS

- A. Section 15140 - Supports and Anchors.
- B. Section 15245 - Vibration Isolation.
- C. Section 15410 - Plumbing Piping.
- D. Section 15430 - Plumbing Specialties.
- E. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.
- B. NFPA 70 - National Electrical Code.
- C. NEMA 250 - Enclosure for Electrical Equipment (1000 Volts Maximum).

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data:
 - 1. Indicate pump type, capacity, power requirements, and affected adjacent construction.
 - 2. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 - 3. Provide electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Submit under provisions of Section 01700.
- B. Project Record Documents: Record actual locations of components.
- C. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years experience.
- B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.
- C. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
 - 1. National Electrical Manufacturers Association (NEMA).
 - 2. Underwriters Laboratories (UL).
- D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.7 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 15010.
- B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 WARRANTY

- A. Provide three (3) year warranty under provisions of Section 01700.
- B. Warranty: Include coverage of submersible sump pumps.

PART 2 PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

- A. Manufacturers:
 - 1. Zoeller.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Weinman.
 - b) Weil.
 - c) Myers.
 - d) Grundfos.
- B. Type: Completely submersible vertical centrifugal.
- C. Casing: Cast iron pump body and oil filled motor chamber.
- D. Impeller: Bronze open non-clog with stainless steel shaft.
- E. Bearings: Ball bearings.
- F. Accessories: Oil resistant 10 foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector.
- G. Controls: Integral diaphragm type level controls with separate liquid level control high level alarm.

PART 3 EXECUTION

3.1 PUMP INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
- C. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- D. Align and verify alignment of base mounted pumps prior to start-up.

END OF SECTION

SECTION 15535

REFRIGERANT PIPING AND SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure relief valves.
- H. Filter-driers.
- I. Solenoid valves.
- J. Expansion valves.
- K. Receivers.
- L. Flexible connections.

1.2 RELATED SECTIONS

- A. Section 08305 - Access Doors.
- B. Section 09900 - Painting.
- C. Section 15260 - Piping Insulation.
- D. Section 15671 - Air Cooled Condensing Units.
- E. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. ARI 495 - Refrigerant Liquid Receivers.
- B. ARI 710 - Liquid Line Dryers.
- C. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter-Driers
- D. ARI 750 - Thermostatic Refrigerant Expansion Valves.
- E. ARI 760 - Solenoid Valves for Use With Volatile Refrigerants.
- F. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- G. ASHRAE 34 - Number Designation of Refrigerants.
- H. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
- I. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- J. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes.
- K. ASME B31.5 - Refrigeration Piping.
- L. ASME B31.9 - Building Services Piping.
- M. ASME SEC 8D - Boilers and Pressure Vessels Code, Rules for Construction of Pressure Vessels.
- N. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- O. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- P. ASTM B88 - Seamless Copper Water Tube.
- Q. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- R. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

- S. AWS A5.8 - Brazing Filler Metal.
- T. AWS D1.1 - Structural Welding Code, Steel.
- U. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- V. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- W. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- X. UL 429 - Electrically Operated Valves.

1.4 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASTM B31.5 and MSS SP69 unless indicated otherwise.
- C. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
 - 2. If receiver is provided, install in liquid line leaving receiver.
 - 3. Use line size on leaving side of liquid solenoid valves.
- D. Valves
 - 1. Use service valves on suction and discharge of compressors.
 - 2. Use gage taps at compressor inlet and outlet.
 - 3. Use gage taps at hot gas bypass regulators, inlet and outlet.
 - 4. Use check valves on compressor discharge.
 - 5. Use check valves on condenser liquid lines on multiple condenser systems.
- E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- F. Strainers:
 - 1. Use line size strainer upstream of each automatic valve.
 - 2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
 - 3. On steel piping systems, use strainer in suction line.
 - 4. Use shut-off valve on each side of strainer.

- G. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.
- H. Permanent Filter-Driers:
 - 1. Use in low temperature systems.
 - 2. Use in systems utilizing hermetic compressors.
 - 3. Use filter-driers for each solenoid valve.
- I. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.
- C. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.
- D. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Test Reports: Indicate results of leak test, acid test.
- F. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

- A. Submit under provisions of Section 01700.
- B. Record exact locations of equipment and refrigeration accessories on record drawings.
- C. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing the work of this section with minimum three (3) years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 15010.
- B. Deliver and store piping and specialties in shipping containers with labeling in place.
- C. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- D. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.1 REFRIGERANT PIPING

- A. Copper Tubing: ASTM B280, Type ACR hard drawn or annealed.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
- B. Copper Tubing to 7/8 inch OD: ASTM B88, Type K, annealed.
 - 1. Fittings: ASME B16.26 cast copper.
 - 2. Joints: Flared.
- C. Pipe Supports and Anchors:
 - 1. Conform to ASME B31.5, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 - 6. Wall support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 - 10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

11. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.2 MOISTURE AND LIQUID INDICATORS

- A. Manufacturers:
 1. Sporlan Model SA.
- B. Indicators: Double port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator and plastic cap; for maximum working pressure of 500 psig, and maximum temperature of 200 degrees F.

2.3 VALVES

- A. Diaphragm Packless Valves:
 1. Manufacturers:
 - a) Mueller Model A155 or A-148
 2. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psig and maximum temperature of 275 degrees F.
- B. Packed Angle Valves:
 1. Manufacturers:
 - a) Mueller Model A51.
 2. Forged brass, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 425 psig and maximum temperature of 275 degrees F.
- C. Service Valves:
 1. Manufacturers:
 - a) Mueller Model A157 or A153.
 2. Forged brass body with copper stubs, brass caps, removable valve core, flared or solder ends, for maximum pressure of 500 psig.

2.4 CHECK VALVES

- A. Globe Type:
 1. Manufacturers:
 - a) Mueller Model A137.

2. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum working pressure of 425 psig and maximum temperature of 300 degrees F.

B. Straight Through Type:

1. Manufacturers:
 - a) Mueller Model A156.
2. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psig and maximum temperature of 200 degrees.

2.5 PRESSURE RELIEF VALVES

A. Manufacturers:

1. Mueller Model 155.

B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; for standard 300 psig setting; selected to ASHRAE 15.

2.6 FILTER-DRIERS

A. Replaceable Cartridge Angle Type:

1. Manufacturers:
 - a) Sporlan Catch-All C.
 - b) Parker.
2. Shell: ARI 710, UL listed, steel, removable cap, for maximum working pressure of 500 psig.
3. Filter Cartridge: Pleated media with integral end rings, stainless steel support.
4. Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumina.
5. Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets.

B. Permanent Straight Through Type:

1. Manufacturers:
 - a) Sporlan Model C.
 - b) Parker.
2. ARI 710, UL listed, steel shell with molded desiccant filter core, for maximum working pressure of 500 psig.

2.7 SOLENOID VALVES

- A. Manufacturers:
 - 1. Sporlan.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Parker.
- B. Valve: ARI 760, pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly with flared, solder, or threaded ends; for maximum working pressure of 300 psig. Stem shall permit manual operation in case of coil failure.
- C. Coil Assembly: UL 429, UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and colour coded lead wires, integral junction box.

2.8 EXPANSION VALVES

- A. Manufacturers:
 - 1. Sporlan.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a) Parker.
- B. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, mechanical pressure limit (maximum operating pressure MOP feature), adjustable superheat setting, with capillary tube and remote sensing bulb.
- C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.9 FLEXIBLE CONNECTORS

- A. Corrugated bronze hose with single layer of exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 500 psig.

2.10 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tubing: ASTM B88, Type M, hard drawn.
 - 1. Fittings: ASME B16.18 cast brass or ASTM B16.22 solder wrought copper.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver with melting range of 430 to 535 degrees F.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Pipe Hangers and Supports:
 - 1. Install in accordance with ASTM B31.5, ASTM F708 and MSS SP89.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 7. Provide copper plated hangers and supports for copper piping.
- G. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- H. Provide clearance for installation of insulation and access to valves and fittings.
- I. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Section 08305.

- J. Flood piping system with nitrogen when brazing.
- K. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- L. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09900.
- M. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
- N. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- O. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- P. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- Q. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- R. Fully charge completed system with refrigerant after testing.
- S. Provide electrical connection to solenoid valves. Refer to Section 16180.

3.3 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test system with dry nitrogen to 200 psig. Perform final tests at 27 inches vacuum and 200 psig using electronic leak detector. Test to no leakage.

3.4 SCHEDULES

A. Pipe Hanger Spacing

PIPE SIZE Inches	MAX. HANGER SPACING Feet	HANGER ROD DIAMETER Inches
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8
8 to 12	14	7/8

END OF SECTION

SECTION 15671

AIR COOLED CONDENSING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Condensing unit package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Refrigerant piping connections.
- E. Motor starters.
- F. Electrical power connections.

1.2 RELATED SECTIONS

- A. Section 03300 - Cast-in-Place Concrete: Concrete bases.
- B. Section 15245 - Vibration Isolation: Placement of vibration isolators.
- C. Section 15535 - Refrigerant Piping and Specialties.
- D. Section 15835 - Terminal Heat Transfer Units: Fan-coil units.
- E. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- C. ARI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.
- D. ASHRAE 14 - Methods of Testing for Rating Positive Displacement Condensing Units.
- E. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

- F. ASHRAE 90A - Energy Conservation in new Building Design.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. NEMA MG 1 - Motors and Generators.
- I. UL 207 - Refrigerant-Containing Components and Accessories, Non-Electrical.
- J. UL 303 - Refrigeration and Air-Conditioning Condensing, and Air-Source Heat Pump Equipment.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.
- C. Product Data: Provide rated capacities, weights specialties and accessories, electrical nameplate data, and wiring diagrams. Make submission with fan-coil units, refer to Section 15835 ensure capacities are complementary.
- D. Design Data: Indicate pipe and equipment sizing.
- E. Submit manufacturer's installation instructions.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Submit under provisions of Section 01700.
- B. Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

1.6 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver, store, protect and handle products to site under provisions of Section 15010.

- B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- C. Protect units on site from physical damage. Protect coils.

1.8 WARRANTY

- A. Section 01700 - Contract Closeout.
- B. Provide a five year warranty to include coverage for refrigerant compressors.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Trane.
- B. Other Acceptable Manufacturers:
 - 1. Lennox.
 - 2. Carrier.
- C. Section 01600 - Materials and Equipment: Product options and substitutions. Substitutions: Permitted.

2.2 MANUFACTURED UNITS

- A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, wind deflector, and screens.
- B. Construction and Ratings: In accordance with ARI 210/240 and UL 303. Testing shall be in accordance with ASHRAE 14.
- C. Performance Ratings: Energy Efficiency Rating (EER) not less than prescribed by ASHRAE 90A.

2.3 CASING

- A. House components in welded steel frame with steel panels with weather resistant, baked enamel finish.
- B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

- C. Provide removable access doors or panels with quick fasteners.

2.4 CONDENSER COILS

- A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 425 psig (2900 kPa), and dehydrate. Seal with holding charge of refrigerant.
- B. Coil Guard: PVC coat steel wire.

2.5 FANS AND MOTORS

- A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge.
- B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built in current and thermal overload protection.

2.6 COMPRESSORS

- A. Compressor: Hermetic scroll type.
- B. Mounting: Statically and dynamically balance rotating parts and mount on rubber-in-shear vibration isolators.
- C. Lubrication System: Reversible, positive displacement oil pump with oil charging valve, oil level sight glass, and magnetic plug or strainer.
- D. Motor: Constant speed 3600 rpm suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting. Furnish with starter.
- E. Sump Oil Heater: Evaporates refrigerant returning to sump during shut down. Energize heater thermostatically.

2.7 REFRIGERANT CIRCUIT

- A. Provide each unit with one refrigerant circuit, factory supplied and piped.
- B. For each refrigerant circuit, provide:
 1. Filter dryer.
 2. Liquid line sight glass and moisture indicator.
 3. Thermal expansion valve for maximum operating pressure.
 4. Insulated suction line.

5. Suction and liquid line service valves.
6. Liquid line solenoid valve.
7. Charging valve.
8. Discharge line check valve.
9. Compressor discharge service valve.
10. Condenser pressure relief valve.

2.8 CONTROLS

- A. On unit, mount weatherproof steel control panel, NEMA 250, containing power and control wiring, factory wired with single point power connection.
- B. For each compressor, provide across-the-line starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset current overload protection. For each condenser fan, provide across-the-line starter with starter relay.
- C. Provide safety controls arranged so any one will shut down machine:
 1. High discharge pressure switch (manual reset).
 2. Low suction pressure switch (automatic reset).
 3. Oil Pressure switch (manual reset).
- D. Provide controls to permit operation down to 0 degrees F ambient temperature.
 1. Thermostat to cycle fan motors in response to outdoor ambient temperature.
 2. Head pressure switch to cycle fan motors in response to refrigerant condensing pressure.
 3. Solid state control to vary speed of one condenser fan motor in response to refrigerant condensing pressure.
 4. Electronic control consisting of mixing damper assembly, controlled to maintain constant refrigerant condensing pressure.
- E. Provide electric solid state microcomputer based room thermostat, located as indicated.
 1. Incorporate:
 - a) Automatic switching from heating to cooling.
 - b) Preferential rate control to minimize overshoot and deviation from set point.
 - c) Set-up for four separate temperatures per day.
 - d) Instant override of setpoint for continuous or timed period from one hour to 31 days.
 - e) Short cycle protection.
 - f) Programming based on weekdays, Saturday and Sunday.
 - g) Switch selection features including imperial or metric display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

2. Display shall include:
 - a) Time of Day.
 - b) Actual room temperature.
 - c) Programmed temperature.
 - d) Programmed time.
 - e) Duration of timed override.
 - f) Day of week.
 - g) System mode indication: Heating, cooling, auto, off, fan auto, fan on.
 - h) Stage (heating or cooling) operation.
3. Model T7300 manufactured by Honeywell.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. Complete structural, mechanical, and electrical connections in accordance with manufacturer's installation instructions.
- C. Provide for connection to electrical service. Refer to Section 16180.
- D. Install units on vibration isolation. Refer to Section 15245.
- E. Provide connection to refrigeration piping system and evaporators. Refer to Section 15535. Comply with ASHRAE 15.
- F. Furnish charge of refrigerant and oil.

3.2 DEMONSTRATION AND INSTRUCTIONS

- A. Section 01700 - Contract Closeout: Demonstrating installed work.
- B. Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil or refrigerant prior to end of correction period.
- C. Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.

END OF SECTION

SECTION 15781

PACKAGED ROOF TOP AIR CONDITIONING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Packaged roof top unit.
- B. Unit controls.
- C. Roof mounting curb and base.

1.2 RELATED SECTIONS

- A. Section 15245 - Vibration Isolation.
- B. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. ARI 210 - Unitary Air-Conditioning Equipment.
- B. ARI 240 - Air Source Unitary Heat Pump Equipment.
- C. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- D. NFPA 70 - National Electrical Code.
- E. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- C. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

- D. Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Submit under provisions of Section 01700.
- B. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instruction, maintenance and repair data, and parts listing.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years experience.

1.7 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver, store, protect and handle products to site under provisions of Section 15010.
- B. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

1.9 WARRANTY

- A. Section 01700 - Contract Closeout.
- B. Provide a five year warranty to include coverage for refrigeration compressors.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. AAON.
- B. Addison.
- C. Trane.

- D. Section 01600 - Materials and Equipment: Product options and substitutions. Substitutions: Permitted.

2.2 AIR CONDITIONING UNITS

- A. General: 100% outside air roof mounted units having electric refrigeration.
- B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, electric heating elements, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.
- C. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 16180.

2.3 FABRICATION

- A. Cabinet: Galvanized steel, access doors or removable access panels with quick fasteners. Structural members shall be minimum 16 gage, with access doors or removable panels of minimum 18 gage.
- B. Insulation: One inch thick neoprene coated glass fiber with edges protected from erosion.
- C. Supply Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch motor pulley, and rubber isolated hinge mounted motor. Isolate complete fan assembly.
- D. Air Filters: One inch thick permanent washable.
- E. Roof Mounting Curb: 14 inches high galvanized steel, channel frame with gaskets, nailer strips.

2.4 ELECTRIC HEATING COIL

- A. Helical nickel-chrome resistance wire coil heating elements with refractory ceramic support bushings easily accessible with automatic reset thermal cut-out, built-in magnetic contactors, galvanized steel frame, control circuit transformer and fuse, manual reset thermal cut-out, and airflow proving device.
- B. Controls: Start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with switch for continuous fan operation.

2.5 EVAPORATOR COIL

- A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.
- B. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

2.6 COMPRESSOR

- A. Provide semi-hermetic compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gage ports, and filter drier.
- B. Five minute timed off circuit to delay compressor start.
- C. Outdoor thermostat to energize compressor above 65 degrees F ambient.
- D. Provide step capacity control by hot gas by-pass and cylinder unloading.

2.7 CONDENSER COIL

- A. Provide copper tube aluminum fin coil assembly with subcooling rows and coil guard.
- B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor.

2.8 OPERATING CONTROLS - SINGLE ZONE UNITS

- A. Electric solid state microcomputer based room thermostat, located as indicated.
- B. Room thermostat shall incorporate:
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from set point.
 - 3. Set-up for four separate temperatures per day.
 - 4. Instant override of set point for continuous or timed period from one hour to 31 days.
 - 5. Short cycle protection.
 - 6. Programming based on weekdays, Saturday and Sunday.

7. Switch selection features including imperial or metric display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.
- C. Room thermostat display shall include:
1. Time of day.
 2. Actual room temperature.
 3. Programmed temperature.
 4. Programmed time.
 5. Duration of timed override.
 6. Day of week.
 7. System model indication: heating, cooling, auto, off, fan auto, fan on.
 8. Stage (heating or cooling) operation.
- D. Provide low limit thermostat in supply air to close outside air dampers and stop supply fan.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 90A.
- C. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems.

END OF SECTION

SECTION 15835

TERMINAL HEAT TRANSFER UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fan-coil units.

1.2 RELATED SECTIONS

- A. Section 16180 - Equipment Wiring Systems: Electrical supply to units.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTAL

- A. Submit shop drawings under provisions of Section 01300.
- B. Submit product data indicating typical catalog of information including arrangements.
- C. Indicate mechanical and electrical service locations and requirements, specifically indicating deviations from indicated products.
- D. Submit manufacturer's installation instructions under provisions of Section 01300.

1.5 SUBMITTAL AT PROJECT CLOSEOUT

- A. Submit record documents under provisions of Section 01700.
- B. Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five (5) years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70 code for internal wiring of factory wired equipment.

1.8 WARRANTY

- A. Provide five (5) year manufacturer's warranty under provisions of Section 01700.

PART 2 PRODUCTS

2.1 FAN-COIL UNITS

- A. Manufacturers:
 - 1. Trane.
 - 2. Carrier.
 - 3. York.
- B. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 200 psi and 220 degrees F.
- C. Cabinet: 16 gage steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation.
- D. Finish: Factory apply baked enamel.
- E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- F. Motor: Sleeve bearings, resiliently mounted.
- G. Control: Multiple speed switch, factory wired, located in cabinet.
- H. Filter: Easily removed one inch thick glass fiber throw-away type, located to filter air before coil.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Protection: Provide finished cabinet units with protective covers during balance of construction.

- C. Install fan-coil units as indicated.
- D. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Verify that electrical wiring installation is in accordance with manufacturer's submittals and installation requirements of Division 16 sections.

3.2 CLEANING

- A. Clean work under provisions of 01700.
- B. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- C. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- D. Install new filters.

END OF SECTION

SECTION 15870
POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Roof exhausters.

1.2 RELATED SECTIONS

- A. Section 15245 - Vibration Isolators.
- B. Section 15890 - Ductwork.
- C. Section 15910 - Duct Accessories: Backdraft dampers.
- D. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. AMCA 99 - Standards Handbook.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 261 - Directory of Products Licensed to Bear the AMCA Certified Ratings Seal.
- D. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- E. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- F. NEMA MG1 - Motors and Generators.
- G. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Vapors from Commercial cooking Equipment.
- H. UL 705 - Power Ventilators.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.

B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate installation instructions.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Section 01700.

B. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years experience.

1.7 REGULATORY REQUIREMENTS

A. Kitchen Range Hood Exhaust Fans: Comply with requirements of NFPA 96.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 ROOF VENTILATORS

A. Manufacturers:

1. Cook.
2. Greenheck.
3. ACME.
4. Substitutions: Refer to Section 01600 - Material and Equipment.

B. Product Requirements:

1. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
2. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
3. Fabrication: Conform to AMCA 99.
4. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

- C. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- D. Roof Curb: 12 inch high of galvanized steel with continuously welded seams, one inch insulation and curb bottom, and factory installed nailer strip.
- E. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.
- F. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.
- G. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Provide sheaves required for final air balance.
- E. Install backdraft dampers on inlet to roof and wall exhausters.
- F. Do not operate fans until ductwork is clean, filters are in place, and bearings are lubricated.

END OF SECTION

SECTION 15890

DUCTWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal ductwork.
- B. Duct cleaning.

1.2 RELATED SECTIONS

- A. Section 09900 - Painting: Weld priming, weather resistant, paint or coating.
- B. Section 15140 - Supports and Anchors: Sleeves.
- C. Section 15290 - Duct Insulation: External insulation.
- D. Section 15910 - Ductwork Accessories.
- E. Section 15940 - Air Outlets and Inlets.
- F. Section 15990 - Testing, Adjusting and Balancing.

1.3 REFERENCES

- A. ASTM A 36 - Structural Steel.
- B. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- C. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- D. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.
- E. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- F. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

- G. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
 - H. ASTM A 653 - Steel Sheet, Zinc-Coated (galvanized) or Zinc-Iron Alloy coated (galvanized) by the hot dipped process.
 - I. AWS D9.1 - Welding of Sheet Metal.
 - J. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
 - K. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
 - L. SMACNA - HVAC Air Duct Leakage Test Manual.
 - M. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- 1.4 PERFORMANCE REQUIREMENTS
- A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.
- 1.5 SUBMITTALS
- A. Submit under provisions of Section 01300.
 - B. Shop Drawings: Indicate dimensions, sizes, material thickness, and location and sizes of field connections.
 - C. Product Data: Provide manufacturers literature and data sheets indicating rated capacities, dimensions and accessories.
- 1.6 SUBMITTALS AT PROJECT CLOSEOUT
- A. Submit under provisions of Section 01700.
 - B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.
- 1.7 QUALITY ASSURANCE
- A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
 - B. Maintain one copy of document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum three (3) years experience.

1.9 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A and NFPA 90B standards.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel Ducts: All interior ducts shall be constructed of galvanized steel in accordance with ASTM A653 galvanized steel sheet, lock-forming quality, having G60 zinc coating in conformance with ASTM A90.
- B. All exterior ductwork and ductwork exposed to high humidities shall have G90 zinc coating.
- C. Insulated Flexible Ducts:
 - 1. Manufacturers:
 - a) Thermaflex M-KE.
 - b) Flexmaster Type 3M.
 - c) OmniAir Series 1200.
 - 2. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire; fiberglass insulation; aluminized vapor barrier film.
 - 3. Pressure Rating: 4 inches WG positive and 1.0 inches WG negative.
 - 4. Maximum Velocity: 4000 fpm.
 - 5. Temperature Range: -20 degrees F to 180 degrees F.
- D. Fasteners: Rivets, bolts, or sheet metal screws.

- E. Sealant:
 - 1. Manufacturers:
 - a) Hardcast DT5300 Tape with FTA-20 adhesive.
 - b) United MDT-300 with MTA-20 adhesive.
 - 2. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used with tape.

- F. Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages and reinforcing for operating pressures indicated.

- B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

- D. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

- E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

- F. Pittsburgh Lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.

- G. Flanged duct systems shall be Ductmate or W.D.C.I. proprietary duct connection systems will be accepted. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

- H. Formed - on flanges will be accepted. Formed on flanges will be constructed as SMACNA T-25 flanges, as defined in 1995 SMACNA Manual. No other construction pertaining to formed - on flanges will be accepted. Formed on flanges shall be accepted for use on ductwork 42" wide or less and must include the use of corners, bolts and cleat.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Seal all ductwork with specified sealant.
- C. Duct Sizes are inside clear dimensions.
- D. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- F. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- G. Use double nuts and lock washers on threaded rod supports.
- H. Connect diffusers to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.
- I. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- J. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.2 SCHEDULES

A. DUCTWORK MATERIAL SCHEDULE

AIR SYSTEM	MATERIAL
Low Pressure Supply	Steel
Return and Relief	Steel
General Exhaust	Steel
Outside Air Intake	Steel

B. DUCTWORK PRESSURE CLASS SCHEDULE

AIR SYSTEM	PRESSURE CLASS
Low Pressure Supply	1 inch
Return and Relief	1 inch
General Exhaust	½ inch

END OF SECTION

SECTION 15910
DUCTWORK ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers.
- C. Duct access doors.
- D. Duct test holes.
- E. Fire dampers.
- F. Flexible duct connections.
- G. Volume control dampers.

1.2 RELATED SECTIONS

- A. Section 15245 - Vibration Isolation.
- B. Section 15890 - Ductwork.
- C. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- B. NFPA 70 - National Electrical Code.
- C. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- D. UL 33 - Heat Responsive Links for Fire-Protection Service.
- E. UL 555 - Fire Dampers and Ceiling Dampers.
- F. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.
- C. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors and hardware used. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Indicate for fire dampers.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Submit under provisions of Section 01700.
- B. Record actual locations of access doors and test holes.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 15010.
- B. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.2 BACKDRAFT DAMPERS

- A. Gravity Backdraft Dampers, Size 18 x 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturers standard construction.
- B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 16 gage thick galvanized steel or extruded aluminum, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
 - 1. Less Than 12 Inches Square: Secure with sash locks.
 - 2. Up to 18 Inches Square: Provide two hinges and two sash locks.
 - 3. Up to 24 x 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - 4. Larger Sizes: Provide an additional hinge.
- C. Access doors with sheet metal screw fasteners are not acceptable.

2.4 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.5 FIRE DAMPERS

- A. Manufacturers:
 - 1. Ruskin.
 - 2. Prefco.
 - 3. Phillips.
- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- C. Ceiling Dampers: Galvanized steel, 22 gage frame and 16 gage flap, two layers

0.125 inch ceramic fiber on top side, and one layer on bottom side for round flaps, with locking clip.

- D. Horizontal Dampers: Galvanized steel, 22 gage frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- E. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations and closure under air flow conditions. Configure with blades out of air stream.
- F. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- G. Fusible Links: UL 33, separate at 165 degrees F.
- H. Fire dampers shall have UL 555 dynamic rating for use in dynamic and static systems.

2.6 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Connector: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
 - 2. Net Fabric Width: Approximately 6 inches wide.
 - 3. Metal: 3 inch wide, 24 gage galvanized steel.
- C. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.7 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Splitter Dampers:
 - 1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
 - 2. Blade: Fabricate of double thickness sheet metal to streamline shape,

- 3. secured with continuous hinge or rod.
- 3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
- D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- E. End Bearings: Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- F. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches provide regulator at both ends.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 15890 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, at smoke detectors, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing

purposes.

- E. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Demonstrate re-setting of fire dampers to Owner's representative.
- G. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators.
- H. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- I. Use splitter dampers only where indicated.
- J. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 15940

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Diffusers.
- B. Registers/grilles.
- C. Roof hoods.

1.2 RELATED SECTIONS

- A. Section 09900 - Painting: Painting of ductwork visible behind outlets and inlets.

1.3 REFERENCES

- A. ADC 1062 - Certification, Rating and Test Manual.
- B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
- C. ARI 650 - Air Outlets and Inlets.
- D. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- E. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- F. NFPA 70 - National Electrical Code.
- G. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

- C. Samples: Submit one (1) of each required air outlet and inlet type.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Submit under provisions of Section 01700.
- B. Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

PART 2 PRODUCTS

2.1 RECTANGULAR CEILING DIFFUSERS

- A. Manufacturers:
 - 1. MetalAire Model 5800A.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. Titus.
 - b. Anemostat.
- B. Type: Square, adjustable pattern, stamped, multi-core diffuser to discharge air in four way pattern with sectorizing baffles where indicated.
- C. Frame: Surface mount or inverted T-bar type. Reference architectural reflected ceiling schedule for type of frame. Reference mechanical floor plan for size of face and duct.
- D. Fabrication: Steel with baked enamel off-white finish.
- E. Accessories: Radial opposed blade damper with damper adjustable from diffuser face.

2.2 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES

- A. Manufacturers:
 - 1. MetalAire Model CC-5D.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. Titus.
 - b. Anemostat.
 - c. Tuttle and Bailey.
- B. Type: Fixed grilles of 1/2 x 1/2 x 1/2 inch louvers.
- C. Frame: 1-1/4 inch margin with channel lay-in frame for suspended grid ceilings.
- D. Fabrication: Aluminum with factory off-white enamel finish.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.3 ROOF HOODS

- A. Manufacturers:
 - 1. Cook Model IV.
 - 2. Other acceptable manufacturers offering equivalent products.
 - a. Penn.
 - b. ACME.
 - c. Greenheck.
- B. Fabricate air inlet or exhaust hoods in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Fabricate of galvanized steel, minimum 16 gage base and 20 gage hood, or aluminum, minimum 16 gage base and 18 gage hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake, and factory prime coat finish.
- D. Fabricate louver penthouse with mitered corners and reinforce structural angles.
- E. Mount unit on minimum curb base as specified on detail, with insulation between duct and curb.
- F. Make hood outlet area minimum of twice throat area.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Division 9.

END OF SECTION

SECTION 15990

TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of refrigerating systems.
- C. Measurement of final operating condition of HVAC systems.

1.2 REFERENCES

- A. AABC - National Standards for Total System Balance.
- B. ADC - Test Code for Grilles, Registers, and Diffusers.
- C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- C. Field Reports: Submit under provisions of Section 01400.
- D. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- E. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

- F. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.
- G. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- H. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
- I. Test Reports: Indicate data on AABC National Standards for Total System Balance forms.

1.4 QUALITY ASSURANCE

- A. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance.

1.5 QUALIFICATIONS

- A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years documented experience certified by AABC.
- B. Perform Work under supervision of AABC Certified Test and Balance Engineer and NEBB Certified Testing, Balancing and Adjusting Supervisor.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 1. Systems are started and operating in a safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.

B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

C. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of dampers and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

3.6 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

Packaged Roof Top Heating/Cooling Units

Air Coils

Terminal Heat Transfer Units

Fans

Air Inlets and Outlets

B. Report Forms

1. Title Page:

- a. Name of Testing, Adjusting, and Balancing Agency
- b. Address of Testing, Adjusting, and Balancing Agency
- c. Telephone number of Testing, Adjusting, and Balancing Agency
- d. Project name
- e. Project location
- f. Project Architect
- g. Project Engineer
- h. Project Contractor
- i. Project altitude
- j. Report date

2. Summary Comments:

- a. Design versus final performance
- b. Notable characteristics of system
- c. Description of systems operation sequence
- d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
- e. Nomenclature used throughout report
- f. Test conditions

3. Instrument List:

- a. Instrument
- b. Manufacturer
- c. Model number
- d. Serial number
- e. Range
- f. Calibration date

4. Electric Motors:

- a. Manufacturer
- b. Model/Frame
- c. HP/BHP
- d. Phase, voltage, amperage; nameplate, actual, no load
- e. RPM
- f. Service factor

- g. Starter size, rating, heater elements
- h. Sheave Make/Size/Bore
- 5. V-Belt Drive:
 - a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
- 6. Cooling Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air DB temperature, design and actual
 - g. Entering air WB temperature, design and actual
 - h. Leaving air DB temperature, design and actual
 - i. Leaving air WB temperature, design and actual
 - j. Saturated suction temperature, design and actual
 - k. Air pressure drop, design and actual
- 7. Heating Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air temperature, design and actual
 - g. Leaving air temperature, design and actual
 - h. Air pressure drop, design and actual
- 8. Air Moving Equipment:
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Arrangement/Class/Discharge
 - f. Air flow, specified and actual
 - g. Return air flow, specified and actual
 - h. Outside air flow, specified and actual
 - i. Total static pressure (total external), specified and actual
 - j. Inlet pressure
 - k. Discharge pressure
 - l. Sheave Make/Size/Bore
 - m. Number of Belts/Make/Size
 - n. Fan RPM

9. Return Air/Outside Air Data:
 - a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow
 - e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow
 - h. Return air temperature
 - i. Outside air temperature
 - j. Required mixed air temperature
 - k. Actual mixed air temperature
 - l. Design outside/return air ratio
 - m. Actual outside/return air ratio
10. Exhaust Fan Data:
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Air flow, specified and actual
 - f. Total static pressure (total external), specified and actual
 - g. Inlet pressure
 - h. Discharge pressure
 - i. Sheave Make/Size/Bore
 - j. Number of Belts/Make/Size
 - k. Fan RPM
11. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
12. Air Distribution Test Sheet:
 - a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow

- h. Test (final) velocity
- i. Test (final) air flow
- j. Percent of design air flow

END OF SECTION