

**NEW FACILITY BID  
203 SOUTH MAIN ST.  
ELLENVILLE, NY 12428**

**PREPARED FOR:**

**ELLENVILLE FIRE DISTRICT  
PO Box 268  
ELLENVILLE, NY 12428**

**ARCHITECT:**

**SENDLEWSKI ARCHITECTS PC  
215 ROANOKE AVENUE  
RIVERHEAD, NEW YORK 11901  
(631) 727-5352**

**Mechanical Specifications**

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**Issued for bid  
September 17, 2026**

## HVAC

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PART 1 - GENERAL

**THE PROJECT IS BEING AWARDED AS A SINGLE PRIME GENERAL CONSTRUCTION CONTRACT. ALL MECHANICAL WORK SHALL BE BID AS A SUBCONTRACT TO THE GENERAL CONTRACTOR.**

1.01 WORK INCLUDED

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. HVAC contractor to supply and install all mechanical HVAC systems for the new firehouse facility in accordance with the mechanical systems drawings. All systems shall be installed complete and in working order.
- C. Supply and install intake and venting, for boiler and domestic hot water heater and include condensate drains, neutralization kits and piping to plumbing system for boiler, domestic hot water heater and air handling units.
- D. Contractors shall furnish all tools, machinery, equipment, scaffolding, appurtenances and appliances necessary for the satisfactory handling and execution of their work.
- E. Provide and install kitchen hood and ansul systems including preparation and filing of all permit documents with the village of Ellenville fire marshal office..
- F. The work under these contracts shall include all labor, materials and incidentals necessary to execute a complete workmanlike job in accordance with the requirements of the Code and all local authorities having jurisdiction.
- G. All work shall be done in such locations and at such times as directed.
- H. The contractors shall place and store his materials as directed.
- I. The contractor shall at all times keep the premises free from accumulations of waste material or rubbish caused by his machines, materials, employees, or work and shall pile in neat piles outside of each building as directed. He shall cooperate with all other trades appurtenant to his work. At the completion of the work, he shall remove all his tools, scaffolding and surplus materials.
- J. Contractors shall be responsible for initiating, maintaining and supervising all safety precautions in accordance with O.S.H.A. requirements.
- K. In the event that part of the building will be occupied during construction, the interior of the building will be separated and the Contractor will schedule his work accordingly.
- L. Supply and install interior radiant slab heating system as add alternate. Coordinate

installations with concrete contractor.

## **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section General Conditions - Temporary facilities and controls, including temporary heat, light, power and water. Cooperate in ensuring adequate protection.
- B. Section General Conditions - General material, equipment and workmanship standards.
- C. Section 03100 - Concrete.

## **1.02 DRAWINGS AND COORDINATION**

- A. It is not the intention of the drawings to show every item, piece of equipment and detail but rather to show systems to be installed. Provide systems with all appurtenant equipment to make a complete operating system.
- B. Inspect the work area prior to commencing the job. Install work as closely as possible to layouts shown on drawings. Modify work as necessary to meet job conditions and to clear other equipment. Consult Architect before making changes which affect the function or appearance of systems.
- C. Dimensions, elevations and locations are shown approximately. Verify measurements in field and coordinate with other trades.

- D. Architect reserves the right to order changes in layout of such items as piping, ducts and equipment if such changes do not substantially affect costs and if affected items have not been fabricated or installed.
- E. In some cases, drawings are based on products of one manufacturer, as listed in the specifications. Be responsible for modifications made necessary by substitution of products of other manufacturers.
- F. Do not install part of a system until all critical components of the system and related systems have been approved. Coordinate parts of system.
- G. Coordinate work with work specified in other sections. Relocate work if required for proper installation and functioning of other systems.
- H. Install products in accordance with manufacturers' instructions. Notify Architect if contract documents conflict with manufacturers' instructions. Comply with Architect's interpretations.
- I. Provide and install all brackets, supports, anchors and frames required for installation of work specified in this division. Provide all required pitch pockets for both mechanical and electrical needs of work herein.
- J. Provide all cutting and patching, excavation and backfilling required for installation of work specified in this Division.
- K. Provide and install a motor starter as required.

#### **1.03 PROJECT RECORD DRAWINGS**

- A. Submit shop drawings in accordance with Section 15011H.
- B. Note that the General Conditions specify that project record drawings be prepared.

#### **1.04 EQUIPMENT CLEARANCES**

- A. Deliver equipment knocked down if necessary.
- B. Install equipment with adequate clearances for maintenance and operation both of the equipment and of adjacent equipment.

#### **1.05 PRELIMINARY OPERATION**

- A. Provide start-up lubrication in accordance with manufacturer's recommendations. Operate mechanical systems with required supervision for at least 2 full days prior to substantial completion. Make necessary adjustments and check proper operation.

#### 1.06 TESTS PRIOR TO SUBSTANTIAL COMPLETION

- A. Tests shall be attended by representatives of mechanical subcontractors, equipped with instruments required to demonstrate proper functioning of systems, as specified. Demonstrate the following:
  - 1. Equipment installed and operating in accordance with manufacturer's specifications and instructions and with these specifications.
  - 2. Safety and temperature controls operating as specified.
  - 3. Systems properly flushed, cleaned and free of contaminants.
  - 4. Systems properly balanced.
  - 5. Motors equipped with proper overload protection and not operating under overload. Obtain ammeter readings.
  - 6. Instruments recording properly.

#### 1.07 WARRANTY

- A. Submit written warranty or warranties covering work specified in this division. Period: 1 year from the date of substantial completion of the building or of the equipment being warranted, whichever is later. Owner is to receive full use of equipment for period of warranty.

#### 1.08 MAINTENANCE AND OPERATING INSTRUCTIONS

- A. Submit three (3) typed copies of maintenance and operating instructions for equipment having moving parts and parts which may reasonably be anticipated to require replacement.
  - 1. List replacement parts and order procedure.
  - 2. Include lubrication instructions and schedule, with types of lubricant to be used.
  - 3. Include maintenance and service procedures.
- B. Instruct Owner's personnel in use of equipment specified in this Division.
- C. Submit three (3) typed copies of maintenance and operating manuals for equipment specified in this Division.
- D. Provide complete demonstration and training of systems operations to designated fire district personnel upon completion.

#### 1.09 MECHANICAL SYSTEMS IDENTIFICATION

- A. See Section 15190H - Mechanical Identification.

#### **1.10 FIELD QUALITY CONTROL**

- A. Test piping systems hydrostatically at 150% of expected working pressure unless otherwise specified.
- B. Reports shall list system tested, date, results, description of correction of faults, and witnesses.
- C. Maintain tests 4 hours, unless otherwise specified.
- D. Perform preliminary tests before witnessed tests.
- E. Give Architect 48 hours notice of tests. Architect will observe tests.

#### **1.11 CODES AND ORDINANCES**

- A. Conform to the requirements of codes and ordinances of authorities having jurisdiction, as specified in the General Conditions. In particular, conform to the requirements of the State of New York Building Code.
- B. Conform to the State of New York Building Code energy conservation requirements, including certification, labelling and maintenance instructions for equipment.
- C. If Contract Documents conflict with codes and ordinances, notify Architect. If requirements of Contract Documents exceed requirements of codes and ordinances, comply with requirements of Contract Documents.

#### **1.12 REMOVAL AND DISPOSAL OF WASTE MATERIALS**

- A. Take down and remove existing mechanical equipment indicated to be removed. Turn over all equipment to owner or dispose of by direction of the owner's authorized representative.
- B. Remove and dispose of all debris and waste materials from the site in a safe and legal manner.

**END OF SECTION**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. Pipe, duct, and equipment hangers, supports, and associated anchors.
- C. Equipment bases and supports.
- D. Sleeves and seals.
- E. Flashing and sealing equipment and pipe stacks.

**1.02 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS**

- A. Furnish hanger and support inserts and sleeves to Section 3A for placement into formwork.

**1.03 RELATED WORK**

- A. Section 03100: Concrete equipment bases.
- B. Section 15242H - Vibration Isolation.
- C. Section 15260H - Piping Insulation.
- D. Section 15280H - Equipment Insulation.
- E. Section 15671H - HVAC system.

**1.04 REFERENCES**

- A. ANSI/ASME B31.1 - Power Piping.

**1.05 SUBMITTALS**

- A. Submit shop drawings in accordance with Section 15011H.
- B. Indicate hanger and support framing and attachment methods.

## PART 2 PRODUCTS

### 2.01 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 to 4 Inches and Cold Pipe Sizes 6 Inches and Over: Carbon steel, adjustable, clevis.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
- E. Vertical Support: Steel riser clamp.
- F. Floor Support for Pipe Sizes to 4 Inches and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, lock nut nipple, floor flange, and concrete pier or steel support.
- G. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- H. Shield for Insulated Piping 2 Inches and Smaller: 18 gage galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support.
- I. Shield for Insulated Piping 2-1/2 Inches and Larger (Except Cold Water Piping): Pipe covering protective saddles.
- J. Shields for Insulated Cold Water Piping 2-1/2 Inches and Larger: Hard block non-conducting saddles in 90 degree segments, 12 inch minimum length, block thickness same as insulation thickness.
- K. Shields for Vertical Copper Pipe Risers: Sheet lead.

### 2.02 HANGER RODS

- A. Steel Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

### 2.03 INSERTS

- A. 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.

### 2.04 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.

- B. Lead Flashing: 5 lb./sq. ft. sheet lead for waterproofing; one lb./sq. ft. sheet lead for soundproofing.
- C. Flexible Flashing: 47 mil. thick sheet butyl; compatible with roofing.
- D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

## **2.05 EQUIPMENT CURBS**

- A. By equipment manufacturer, when available or fabricate curbs of manufacturer approved material. All curbs shall be insulated.

## **2.06 SLEEVES**

- A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gage galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with steel pipe or 18 gage steel. All pipe sleeves shall be 2 standard sizes larger than the pipe passing through.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Sleeves for Round Ductwork: Form with galvanized steel.
- E. Sleeves for Rectangular Ductwork: Form with galvanized steel.
- F. Stuffing Insulation: Glass fiber type, non- combustible.
- G. Calk: Acrylic sealant.

## **2.07 FABRICATION**

- A. Size sleeves large enough to allow for movement due to expansion and contraction, two standard sizes larger than the pipe passing through. Provide for continuous insulation wrapping.
- B. Design hangers without disengagement of supported pipe.
- C. Provide copper plated hangers and supports for copper piping.

## **2.08 FINISH**

- A. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

### PART 3 EXECUTION

#### 3.01 INSERTS

- A. Provide inserts to Section 03100 for placement in concrete formwork.
- B. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

#### 3.02 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

| PIPE SIZE                 | MAX. HANGER SPACING | HANGER DIAMETER |
|---------------------------|---------------------|-----------------|
| 1/2 to 1-1/4 inch         | 6'-0"               | 3/8"            |
| 1-1/2 to 2 inch           | 6'-0"               | 3/8"            |
| 2-1/2 to 3 inch           | 10'-0"              | 1/2"            |
| Copper 2 inch and smaller | 6'-0"               | 3/8"            |
| Copper 2 inch and larger  | 10'-0"              | 3/8"            |

- B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- C. Place a hanger within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- 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.

#### 3.03 EQUIPMENT BASES AND SUPPORTS

- A. Provide equipment bases of concrete type specified in Section 03100.

- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

### 3.04 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- C. Provide manufacturers curbs for mechanical roof installations. Flexible sheet flash and counterflash with sheet metal; seal watertight.

### 3.05 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Extend sleeves through floors one inch above finished floor level. Calk sleeves full depth and provide floor plate.
- C. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and calk seal. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

END OF SECTION

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. Identification of mechanical products installed under Division 15.

**1.02 RELATED WORK**

- A. Section 09900 - Painting: Identification painting.

**1.03 REFERENCES**

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

**1.04 SUBMITTALS**

- A. Submit product data in accordance with Section 15011H.
- B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Submit typed valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Submit manufacturer's installation instructions.

**PART 2 PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

- A. Seton.
- B. Emed.
- C. W. H. Brady - Signmark

**2.02 MATERIALS**

- A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.
- B. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background color. Seton Setonply Style 2060.

D. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges. Seton Style 250-BL.

E. Stencils: With clean cut symbols and letters of following size:

| OUTSIDE DIAMETER OF<br>INSULATION OR PIPE | LENGTH OF<br>COLOR FIELD | SIZE OF<br>LETTERS |
|-------------------------------------------|--------------------------|--------------------|
| 3/4" - 1-1/4"                             | 8"                       | 1/2"               |
| 1-1/2" - 2"                               | 8"                       | 3/4"               |
| 2-1/2" - 6"                               | 12"                      | 1-1/4"             |
| 8" - 10"                                  | 24"                      | 2-1/2"             |
| Over 10"                                  | 32"                      | 3-1/2"             |
| Ductwork and Equipment                    | ---                      | 2-1/2"             |

F. Stencil Paint: In accordance with Section 09900, semi-gloss enamel. Seton Coverall Pipe Paint Style CPP.

G. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed. Seton Setmark pipe markers.

H. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inch wide by 4 mil. thick, manufactured for direct burial service. Seton Underground Warning Tapes.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09900 for stencil painting.

### 3.02 INSTALLATION

A. Plastic Nameplates: Install with corrosive-resistant mechanical fasteners, or adhesive.

B. Metal Tags: Install with corrosive-resistant chain.

C. Stencil Painting: Apply in accordance with Section 09900.

D. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.

- E. Plastic Tape Pipe Markers: Install complete around pipe in accordance with manufacturer's instructions.
- F. Underground Plastic Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.
- G. Equipment: Identify air handling units, pumps, and, tanks, plastic nameplates. Small devices, such as in-line pumps, may be identified with metal tags.
- H. Controls: Identify control panels and major control components outside panels with plastic nameplates.
- I. Valves: Identify valves in main and branch piping with tags.
- J. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Tags may be used on small diameter piping (under 1 1/2 inches). 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 "T", at each side of penetration of structure or enclosure, and at each obstruction.
- K. Ductwork: Identify ductwork with stenciled painting. Identify as to air handling unit number, and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

### **3.03 VALVE CHART AND SCHEDULE**

- A. Provide typed valve chart and schedule in aluminum frame with clear plastic shield. Install at location as directed. Seton Valve Chart Frame #A11P.

**END OF SECTION**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. Inertia bases.
- C. Vibration isolation.

**1.02 RELATED WORK**

- A. Section 15010H - HVAC system.

**1.03 REFERENCES**

- A. ASHRAE - Guide to Average Noise Criteria Curves.

**1.04 QUALITY ASSURANCE**

- A. Maintain ASHRAE criteria for average noise criteria curves for all equipment at full load condition.

**1.05 SUBMITTALS**

- A. Submit shop drawings and product data under provisions of Section 15011H.
- B. Indicate inertia bases on shop drawings.
- C. Indicate vibration isolator locations, with static and dynamic load on each, on shop drawings and described on product data.
- D. Submit manufacturer's installation instructions under provisions of Section 15011H.

**1.06 CERTIFICATES**

- A. Submit manufacturer's certificate under provisions of Section 15011H that isolators are properly installed and properly adjusted to meet or exceed specified requirements.

**PART 2 PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

- A. Mason Industries.

## 2.02 INERTIA BASES

- A. Type A: Integral structural steel fan and motor base with motor slide rails.

## 2.03 VIBRATION ISOLATORS

- A. Type 1: Elastomer mount with threaded insert and hold down holes.
- B. Type 2: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.

## 2.04 FABRICATION

- A. Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.
- B. Color code spring mounts.
- C. Select springs to operate at 2/3 maximum compression strain, with 1/4 inch ribbed neoprene pads.

# PART 3 EXECUTION

## 3.01 INSTALLATION

- A. Install vibration isolators for motor driven equipment.
- B. Set steel bases for one inch clearance between housekeeping pad and base. Set concrete inertia bases for 2 inch clearance. Adjust equipment level.
- C. Provide spring isolators on piping connected to isolated equipment as follows: Up to 4 inch diameter, first three points of support; 5 to 8 inch diameter, first four points of support; 10 inch diameter and over, first six points of support. Static deflection of first point shall be twice deflection of isolated equipment.

## 3.02 SCHEDULE

### ISOLATED EQUIPMENT

### ISOLATOR Type Thickness

|                  |        |
|------------------|--------|
| Condensing Units | Type 1 |
| Air Handlers     | Type 2 |
| Fans             | Type 2 |

END OF SECTION

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. Piping insulation.
- C. Jackets and accessories.

**1.02 RELATED WORK**

- A. Section 09900 - Painting: Painting insulation jacket.
- B. Section 15190H - Mechanical Identification.

**1.03 REFERENCES**

- A. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.
- C. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.
- D. ANSI/ASTM C578 - Preformed, Block Type Cellular Polystyrene Thermal Insulation.
- E. ASTM B209 - Aluminum and Aluminum-alloy Sheet and Plate.
- F. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- G. ASTM E84 - Surface Burning Characteristics of Building Materials.
- H. NFPA 255 - Surface Burning Characteristics of Building Materials.
- I. UL 723 - Surface Burning Characteristics of Building Materials.

**1.04 QUALITY ASSURANCE**

- A. Applicator: Company specializing in piping insulation application with three years minimum experience.
- B. Materials: Flame spread/fuel contributed/smoke developed rating of 25/-/50 in accordance with NFPA 255, UL 723.

**1.05 SUBMITTALS**

- A. Submit product data in accordance with Section 15011H.
- B. Include product description, list of materials and thickness for each service, and locations.
- C. Submit manufacturer's installation instructions.

## **PART 2 PRODUCTS**

### **2.01 ACCEPTABLE MANUFACTURERS**

- A. Manville.
- B. Dow Corning.
- C. Certainteed.

### **2.02 INSULATION**

- A. Type A: Glass fiber insulation; ANSI/ASTM C547; 'k' value of 0.24 at 75 degrees F; noncombustible. Manville Micro-Loc.
- B. Type B: Closed cell insulation; ASTM C0534; 'k' value of 0.255 at 75 degrees F; noncombustible. Halstead Insul-Tube.
- C. Type C: Calcium silicate; ASTM C533; 'k' value of 0.44 at 300 degrees F. Manville Thermo-12.

### **2.03 JACKETS**

- A. Interior Applications:
  - 1. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.
  - 2. Canvas Jackets: UL listed treated cotton fabric, 6 oz/sq. yd.

### **2.04 ACCESSORIES**

- A. Insulation Bands: 3/4 inch wide; 0.015 inch thick galvanized steel.
- B. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum. 0.010 inch thick stainless steel.

- C. Insulating Cement: ANSI/ASTM C195; hydraulic setting mineral wool.
- D. Finishing Cement: ASTM C449.
- E. Fibrous Glass Cloth: Untreated; 9 oz/sq. yd. weight.
- F. Adhesives: Compatible with insulation.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Install materials after piping has been tested and approved.

### 3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Continue insulation with vapor barrier through penetrations.
- C. In exposed piping, locate insulation and cover seams in least visible locations.
- D. On insulated piping with vapor barrier, insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- E. On insulated piping without vapor barrier and piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.
- F. Provide an insert, not less than 6 inches long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2 inches diameter or larger, to prevent insulation from sagging at support points. Inserts shall be cork or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.
- G. Neatly finish insulation at supports, protrusions, and interruptions.
- H. Jackets:
  - 1. Indoor, Concealed Applications: Insulated pipes conveying fluids above ambient temperature shall have standard jackets, with vapor barrier, factory-applied. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass cloth and adhesive.
  - 2. Indoor, Concealed Applications: Insulated dual-temperature pipes or pipes

conveying fluids below ambient temperature shall have vapor barrier jackets, factory-applied. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe, and finish with glass cloth and vapor barrier adhesive.

3. Indoor, Exposed Applications: For pipe exposed in mechanical equipment rooms or in finished spaces, insulate as for concealed applications. Finish with PVC jacket; size for finish painting.

### 3.03 SCHEDULE

| PIPING                          | TYPE | INSULATION        |                   |
|---------------------------------|------|-------------------|-------------------|
|                                 |      | PIPE SIZE<br>Inch | THICKNESS<br>Inch |
| Domestic Cold Water             | A    | All               | 1-1/2             |
| Heating Water Supply and Return | A    | All               | 1-1/2             |
| Refrigerant Suction             | B    | All               | 1/2               |
| Refrigerant Hot Gas             | B    | All               | 1/2               |
| Cooling Coil Condensate         | A    | All               | 1-1/2             |

END OF SECTION

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. Ductwork insulation.
- C. Insulation jackets.

**1.02 RELATED WORK**

- A. Section 09900 - Painting: Painting insulation jackets.
- B. Section 15190H - Mechanical Identification.

**1.03 REFERENCES**

- A. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
- B. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- C. ASTM E84 - Surface Burning Characteristics of Building Materials.
- D. NFPA 255 - Surface Burning Characteristics of Building Materials.
- E. UL 723 - Surface Burning Characteristics of Building Materials.

**1.04 QUALITY ASSURANCE**

- A. Applicator: Company specializing in ductwork insulation application with three years minimum experience.
- B. Materials: UL listed; flame spread/fuel contributed/smoke developed rating of 25/-/50 in accordance with NFPA 255, UL 723.

**1.05 SUBMITTALS**

- A. Submit product data in accordance with Section 15011H.
- B. Include product description, list of materials and thickness for each service, and locations.
- C. Submit manufacturer's installation instructions.

## **PART 2 PRODUCTS**

### **2.01 ACCEPTABLE MANUFACTURERS - INSULATION**

- A. Knauf.
- B. Johns Manville.
- C. Certainteed.

### **2.02 MATERIALS**

- A. Type A: Flexible glass fiber; ANSI/ASTM C612; commercial grade; 'k' value of 0.29 at 75 degrees F; foil scrim facing for air conditioning ducts. Knauf Duct Wrap with Commercial Foil Skrim (FCK) .75 PCF.
- B. Type B: Rigid glass fiber; ANSI/ASTM C612, Class 1; 'k' value of 0.24 at 75 degrees F; 0.002 inch foil scrim facing for air conditioning ducts. Knauf Air Duct.
- C. Type C: Flexible glass fiber; ANSI/ASTM C553; 'k' value of 0.24 at 75 degrees F; 1.5 lb./cu. ft.; coated air side for maximum 4,000 ft./min. air velocity Knauf Duct Liner.
- D. Adhesives: Waterproof fire-retardant type.
- E. Indoor Jacket: 6 oz./sq. yd. canvas. Presized glass cloth, minimum 7.8 oz./sq. yd.
- F. Outdoor Jacket: Coated glass fiber sheet, 30 lb./sq. yd.
- G. Lagging Adhesive: Fire resistive to NFPA 255, UL 723.
- H. Impale Anchors: Galvanized steel, 12 gage, self- adhesive pad.
- I. Joint Tape: Glass fiber cloth, open mesh.
- J. Tie Wire: Annealed steel, 16 gage.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Install materials after ductwork has been tested and approved.
- B. Clean surfaces for adhesives.

### 3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.
- C. Exterior Insulation (Type A or Type B) 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. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- D. Liner (Type C) Application:
  - 1. Adhere insulation with adhesive for 100 percent coverage. Secure insulation with mechanical fasteners on 15-inch centers maximum on top and side of ductwork with dimension exceeding 20 inches. Seal and smooth joints. Do not use nail-type fasteners. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
  - 2. Ductwork dimensions indicated are net inside dimensions required for air flow. Increase ductwork to allow for insulation thickness.
- E. Walk-in Plenum Application:
  - 1. Adhere insulation on interior surface of plenum with adhesive for 100 percent coverage. Secure insulation with mechanical fasteners. Seal and smooth joints. Do not use nail-type fasteners.
- F. Continue insulation with vapor barrier through penetrations.

### 3.03 SCHEDULE

- A. Insulation shall be as per below schedule unless specifically stated otherwise in the contract drawings.

| DUCTWORK                                                              | INSULATION |                   |        |
|-----------------------------------------------------------------------|------------|-------------------|--------|
|                                                                       | TYPE       | THICKNESS<br>Inch | FINISH |
| Exhaust Ducts Within 10 ft. of<br>Exterior Openings and Exhaust Ducts | A          | 1"                | Foil   |

**ELLENVILLE FIRE DISTRICT  
NEW FACILITY**

**DUCT INSULATION  
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|                                  |   |        |      |
|----------------------------------|---|--------|------|
| Exposed to Outdoor Air           |   |        |      |
| Outside Air Intake Ducts         | A | 1-1/2" | Foil |
| Plenums                          | B | 1"     | Foil |
| Plenums (Cooling System)         | B | 1"     | Foil |
| Supply Ducts                     | A | 1-1/2" | Foil |
| Return Ducts                     | A | 1-1/2" | Foil |
|                                  |   |        |      |
| Internal Acoustic Lining         | C | 1"     | Mat  |
| Internal Lining in Supply Ducts  | C | 1"     | Mat  |
| Relief Ducts in Mechanical Rooms | A | 1"     | Foil |

END OF SECTION

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. Pipe and pipe fittings.
- C. Valves.
- D. Heating water piping system.

**1.02 RELATED WORK**

- A. Section 08305 - Access Doors.
- B. Section 09900 - Painting.
- C. Section 15121H - Expansion Compensation.
- D. Section 15140H - Supports and Anchors.
- E. Section 15190H - Mechanical Identification.
- F. Section 15260H - Piping Insulation.

**1.03 REFERENCES**

- A. ANSI/ASME - Boiler and Pressure Vessel Code.
- B. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- C. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
- D. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
- E. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- F. ANSI/ASME B31.9 - Building Services Piping.
- G. ANSI/AWS A5.8 - Brazing Filler Metal.
- H. ANSI/AWS D1.1 - Structural Welding Code.

- I. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- J. ASTM A1 20 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.
- K. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- L. ASTM B32 - Solder Metal.
- M. ASTM B88 - Seamless Copper Water Tube.

#### 1.04 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME B31.9.

#### 1.05 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9 and applicable state labor regulations.
- C. Welders Certification: In accordance with ANSI/ASME SEC 9.

#### 1.06 SUBMITTALS

- A. Submit product data in accordance with Section 15011H.
- B. Include data on pipe materials, pipe fittings, valves, and accessories.
- C. Include welders certification of compliance with ANSI/ASME SEC 9.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site.
- B. Store and protect products.
- C. Deliver and store valves in shipping containers with labelling in place.

### PART 2 PRODUCTS

#### 2.01 HEATING WATER ABOVE GROUND

- A. Copper Tubing: ASTM B88, Type L, hard drawn.
  - 1. Fittings: ANSI/ASME B16.23 cast brass or ANSI/ASME B16.29 solder wrought copper.
  - 2. Joints: ASTM B32, solder, Grade 95TA.

## 2.02 CONDENSATE WATER PIPING, ABOVE GROUND

- A. Copper Tubing: ASTM B88, Type L, hard drawn.
  - 1. Fittings: ANSI/ASME B16.23 cast brass, or ANSI/ASME B16.29 solder wrought copper.
  - 2. Joints: ASTM B32, solder, Grade 95TA.

## 2.03 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tubing: ASTM B88, Type L, hard drawn.
  - 1. Fittings: ANSI/ASME B16.23 cast brass, or ANSI/ASME B16.29 solder wrought copper.
  - 2. Joints: ASTM B32, solder, Grade 95TA.

## 2.04 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
- B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping.
- C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; C-shape elastomer composition sealing gasket for operating temperature range from -30 degrees F to 230 degrees F; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.

## 2.05 ACCEPTABLE MANUFACTURERS - GATE VALVES

- A. Nibco Model T-113.
- B. American Model 325.
- C. Watts Model GV, GVS.

## 2.06 GATE VALVES

- A. Up to 2 Inches: Bronze body, bronze trim, rising stem, handwheel, inside screw, double wedge or disc, solder or threaded ends.

- B. Over 2 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, single or double wedge, flanged ends.

#### 2.07 ACCEPTABLE MANUFACTURERS - GLOBE VALVES

- A. Watts Model GLV.
- B. American Fig. 13.
- C. Nibco Model T-21.

#### 2.08 GLOBE VALVES

- A. Up to 2 Inches: Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable composition disc, solder or screwed ends, with backseating capacity.
- B. Over 2 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

#### 2.09 ACCEPTABLE MANUFACTURERS - BALL VALVES

- A. Appolo - Conbraco Model 70-100.
- B. Nibco Mode 585.
- C. Watts Model G-6400.

#### 2.10 BALL VALVES

- A. Up to 2 Inches: Bronze Chromium plated ball, teflon seats and stuffing box ring, lever handle, solder or threaded ends.
- B. Over 2 Inches: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

#### 2.11 ACCEPTABLE MANUFACTURERS - SWING CHECK VALVES

- A. Watts Model CV.
- B. Nibco Model T-480.
- C. Jenkins.

#### 2.12 SWING CHECK VALVES

- A. Up to 2 Inches: Bronze 22 degree swing disc, solder or screwed ends.
- B. Over 2 Inches: Iron body, bronze trim, 22 degree swing disc, renewable disc and seat, flanged ends.

#### **2.13 ACCEPTABLE MANUFACTURERS - SPRING LOADED CHECK VALVES**

- A. Watts Model CV.
- B. Nibco Model T-480.

#### **2.14 SPRING LOADED CHECK VALVES**

- A. Iron body, bronze trim, stainless steel spring, renewable composition disc, screwed, wafer or flanged ends.

#### **2.15 ACCEPTABLE MANUFACTURERS - RELIEF VALVES**

- A. Watts.
- B. B & G.

#### **2.16 RELIEF VALVES**

- A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

### **PART 3 EXECUTION**

#### **3.01 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.
- D. After completion, fill, clean, and treat systems.

#### **3.02 INSTALLATION**

- A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.

- B. Install piping to conserve building space, and not interfere with use of space and other work. Run all piping concealed.
- C. Group piping whenever practical at common elevations.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 15121.
- E. Provide clearance for installation of insulation, and access to valves and fittings.
- F. Provide access where valves and fittings are not exposed.
- G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Section 09900.
- J. Install valves with stems upright or horizontal, not inverted.

### 3.03 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. Sweat solder adapters to pipe.
- D. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install ball valves for throttling, bypass, or manual flow control services.
- F. Provide spring loaded check valves on discharge of condenser water pumps.
- G. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- H. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.
- I. Use lug end butterfly valves to isolate equipment.

- J. Provide 3/4 inch gate drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest drain.

END OF SECTION

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. Low pressure ducts.
- C. Dryer ducts and kitchen exhaust hood ductwork.
- D. Duct cleaning.

**1.02 RELATED WORK**

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

**1.03 REFERENCES**

- A. ASHRAE - Handbook 1981 Fundamentals; Chapter 33 - Duct Design.
- B. ASHRAE - Handbook 1983 Equipment; Chapter 1 - Duct Construction.
- C. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- D. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- E. ASTM A 525 - General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process.
- F. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- G. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.
- H. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

- I. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
- J. SMACNA - Low Pressure Duct Construction Standards.
- K. UL 181 - Factory-Made Air Ducts and Connectors.

#### 1.04 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: Three pressure classifications: 1/2 inch WG positive or negative static pressure and velocities less than 2,000 fpm; 1 inch WG positive or negative static pressure and velocities less than 2,500 fpm and 2 inch WG positive or negative static pressure and velocities less than 2,500 fpm.

#### 1.05 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A and NFPA 90B and NFPA 96 standards as applicable.

#### 1.06 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Section 15011H.
- B. Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work.
- C. Submit samples.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site.
- B. Store and protect products.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.
- B. Steel Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz. per sq. ft. for each side in conformance with ASTM A90.
- C. Fasteners: Rivets, bolts, or sheet metal screws.

- D. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
- E. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

## **2.02 LOW PRESSURE DUCTWORK**

- A. Fabricate and support in accordance with SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission of architect/engineer.
- C. 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.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- E. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.
- 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. Provide and install flanges, sleeves, transitions as required for the installation of coils in ductwork, conform to SMACNA for construction.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. 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.

- B. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- C. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- D. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout. Use stainless steel for ductwork exposed to view and stainless steel or galvanized steel for ducts where concealed.
- E. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

### 3.02 DUCTWORK APPLICATION SCHEDULE

| AIR SYSTEM                                         | MATERIAL |
|----------------------------------------------------|----------|
| Low Pressure Supply<br>(Heating Systems)           | Steel    |
| Low Pressure Supply<br>(System with Cooling Coils) | Steel    |
| Return and Relief                                  | Steel    |
| General Exhaust                                    | Steel    |
| Outside Air Intake                                 | Steel    |
| Combustion Air                                     | Steel    |

### 3.03 ADJUSTING AND CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- B. Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

END OF SECTION

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. Volume control dampers.
- C. Fire dampers.
- D. Backdraft dampers.
- E. Air turning devices.
- F. Flexible duct connections.
- G. Duct access doors.
- H. Duct test holes.

**1.02 RELATED WORK**

- A. Section 15890H - Ductwork.

**1.03 REFERENCES**

- A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- B. SMACNA - Low Pressure Duct Construction Standards.
- C. UL 33 - Heat Responsive LINKS for Fire-Protection Service.
- D. UL 555 - Fire Dampers and Ceiling Dampers.

**1.04 SUBMITTALS**

- A. Submit shop drawings and product data in accordance with Section 15011H.
- B. Provide shop drawings for shop fabricated assemblies indicated, including volume control dampers duct access doors, duct test holes.
- C. Submit manufacturer's installation instructions for fire dampers.

**PART 2 PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS - Volume Control Damper**

- A. Air Balance.
- B. Arlan Model OBD

**2.02 VOLUME CONTROL DAMPERS.**

- A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
- B. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
- C. Fabricate splitter dampers of double thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.
- D. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inch.
- E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- G. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
- H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

**2.03 ACCEPTABLE MANUFACTURERS - FIRE DAMPERS**

- A. Air Balance.
- B. Arlan Model UL10.

**2.04 FIRE DAMPERS**

- A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- B. Fabricate ceiling firestop flaps of galvanized steel, 22 gage frame and 16 gage flap, two layers 0.125 inch ceramic fiber on top side, with locking clip.

- C. Fabricate ceiling dampers of galvanized steel, 22 gage frame, stainless steel closure spring, and light weight, heat retardant non-asbestos fabric blanket closure.
- D. Fabricate curtain type dampers of galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for low pressure ducts up to 12 inches in height.
- E. Fabricate multiple blade fire dampers with 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.
- F. Fusible links, UL 33, shall separate at 160 degrees F. Provide adjustable link straps for combination fire/balancing dampers.

**2.05 BACKDRAFT DAMPERS - Arlan Model BDD or equal.**

- A. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction.
- B. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of 16 gage galvanized steel, 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.

**2.06 AIR TURNING DEVICES**

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

**2.07 FLEXIBLE DUCT CONNECTIONS**

- A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
- B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 36 oz. per sq. yd., approximately 2 inches, crimped into metal edging strip.

**2.08 DUCT ACCESS DOORS - Arlan Fire Limit Model 50A insulated or equal.**

- A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards and as indicated.

- B. Review locations prior to fabrication.
- C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
- D. Access doors smaller than 12 inches square may be secured with sash locks.
- E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.
- F. Access doors with sheet metal screw fasteners are not acceptable.

## 2.09 DUCT TEST HOLES

- A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions.
- B. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.
- C. Provide balancing dampers on medium and high pressure systems where indicated.
- D. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- E. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative.
- F. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- G. Provide flexible connections immediately adjacent to equipment in ducts associated

with fans and motorized equipment.

- H. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, 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.
- I. Provide duct test holes where indicated and required for testing and balancing purposes.

END OF SECTION

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. Diffusers.
- C. Grilles.
- D. Louvers.

**1.02 RELATED WORK**

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

**1.03 REFERENCES**

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

**1.04 QUALITY ASSURANCE**

- A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Test and rate performance of louvers in accordance with AMCA 500.

**1.05 REGULATORY REQUIREMENTS**

- A. Conform to ANSI/NFPA 90A.

**1.06 SUBMITTALS**

- A. Submit product data in accordance with Section 15011H.
- B. Provide product data for items required for this project.
- C. Submit schedule of outlets and inlets indicating type, size, location, application, and noise level.
- D. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.
- E. Submit manufacturer's installation instructions.

## **PART 2 PRODUCTS**

### **2.01 ACCEPTABLE MANUFACTURERS - CEILING DIFFUSERS**

- A. Titus.
- B. Tuttle & Bailey.
- C. Carnes.

### **2.02 SQUARE CEILING DIFFUSERS**

- A. Square, adjustable pattern, stamped, multicore type diffuser to discharge air in 360 degree pattern with sectorizing baffles where indicated.
- B. Provide snap-in inverted T-bar type frame as required by ceiling construction.
- C. Fabricate of steel with baked enamel finish. Color by Architect.

### **2.03 ACCEPTABLE MANUFACTURERS - GRILLES**

- A. Titus.
- B. Tuttle & Bailey.
- C. Carnes.

### **2.04 CEILING SUPPLY REGISTERS/GRILLES**

- A. Streamlined and individually adjustable curved blades to discharge air along face of grille. Paint finish to be baked enamel. Color by Architect.

**2.05 CEILING EXHAUST AND RETURN REGISTERS/GRILLES**

- A. Streamlined blades, depth of which exceeds 3/4 inch spacing, with spring or other device to set blades. Finish to be baked enamel. Color by Architect.

**2.06 ACCEPTABLE MANUFACTURERS - LOUVERS**

- A. Titus.
- B. Carnes.
- C. Grillmaster.

**2.07 LOUVERS**

- A. Provide 6-inch-deep louvers with blades on 45-degree slope with center baffle and return bend, heavy channel frame, birdscreen with 1/2-inch square mesh for exhaust and 3/4 inch for intake.
- B. Fabricate of 12 gage extruded aluminum, welded assembly, with factory prime coat Kaynar 500 fluoro-polymer finish. Color by Architect.
- C. Furnish with interior angle flange jambs and exterior flat flange for installation.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Install items in accordance with manufacturers' instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Refer to Section 09900.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of 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 Section 9A.

**END OF SECTION**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. Complete system of automatic controls.
- C. Electric control system.
- D. Electronic control system.
- E. Control devices, components, wiring and material.
- F. Instructions for Owners.
- G. Comply with requirements of electrical specifications.

**1.02 RELATED WORK**

- A. Section 15910H - Ductwork Accessories.
- B. Section 16010E - General Provisions Electrical.

**1.03 REFERENCES**

- A. Not used.

**1.04 SUBMITTALS**

- A. Submit shop drawings and product data in accordance with Section 15011H.
- B. Provide damper shop drawings which show data such as arrangement, velocities, and static pressure drops for each system.
- C. Provide complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences, and description and engineering data on each control system component. Include sizing as requested.
- D. At completion of work, submit report of check-out of automatic control system.
- E. Provide control diagrams for each system, framed under glass for wall mounting.
- F. Submit manufacturer's installation instructions.

## **PART 2 PRODUCTS**

### **2.01 ACCEPTABLE MANUFACTURERS**

- A. Honeywell.
- B. Johnson.
- C. Lennox.

### **2.02 SYSTEM REQUIREMENTS**

- A. Provide control systems consisting of thermostats, control valves, dampers, operators, indicating devices, interface equipment, and other apparatus required to operate mechanical systems and to perform functions specified. Refer to drawings for control requirements.
- B. Provide necessary materials and fieldwork necessary to connect control components factory supplied as part of equipment controlled, unless specified otherwise. Generally, self-contained valves, filter gauges, liquid level controllers and similar instruments are not to be installed under this Section.
- C. Unless specified otherwise, provide fully proportional components.

### **2.04 CONTROL VALVES**

- A. Provide valves in accordance with general valve specification. Provide position indicators on valves and pilot positions on sequenced valves.
- B. Select valves to fail safe in normally open or closed position as dictated by freeze, humidity, fire, or temperature protection.
- C. Select two-way valves for liquids to have equal percentage characteristics. Select three-way valves to have linear characteristics. Size valve operators to close valves against pump shut off head. Size for maximum 3 psi drop.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats 60 inches above floor.

- B. Interlock alarms with starter switching to bypass alarm when equipment is manually disconnected. Provide all starters and on-off switches.
- C. At completion of installation provide minimum of 27 days instruction period for operating personnel.
- D. Provide for complete service of controls system, including call-backs, for one year running concurrent with connection period.

END OF SECTION

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. Flow meters.
- C. Pressure gages and pressure gage taps.
- D. Thermometers and thermometer wells.
- E. Static pressure and filter gages.

**1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION**

- A. Section 15510H - Hydronic Piping: Installation of thermometer wells, pressure gage tappings.

**1.03 RELATED SECTIONS**

- A. Section 15952H - Controls and Instrumentation.
- B. Section 15985H - Sequence of Operation.
- C. Section 15990H - Testing, Adjusting and Balancing.

**1.04 REFERENCES**

- A. ASME B40.1 - Gages - Pressure Indicating Dial Type - Elastic Element.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.
- C. ASTM D2458 - Method of Flow Measurement by The Venturi Motor Tube.
- D. ASTM E1 - Specification for ASTM Thermometers.
- E. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.
- F. AWWA C706 - Direct Reading Remote Registration Systems for Cold Water Meters.
- G. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
- H. FS-GG-G-76 - Gages, Pressure and Vacuum, Dial Indicating (for Air, Steam, Oil,

Water, Ammonia, Chloro- Fluorhydrocarbon Gases, and Compressed Gases).

- I. ISA RP 3.2 - Flange Mounted Sharp Edged Orifice Plates for Flow Measurement
- J. UL 393 - Indicating Pressure Gages for Fire and Protection Services.
- K. UL 404 - Gages, Indicating Pressure, for Compressed Gas Service.

#### 1.05 SUBMITTALS

- A. Submit under provisions of Section 15011H.
- B. Product Data: Include list which indicates use, operating range, total range and location for manufactured components.
- C. Submit manufacturer's installation instructions under provisions of Section 15011H.

#### 1.06 PROJECT RECORD DOCUMENTS

- A. Submit "as-built" record documents.
- B. Accurately record actual locations of instrumentation.

#### 1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Marshalltown.

#### 2.02 PRESSURE GAGES

- A. ASME B40.1, UL 393, UL 404 2-1/2 inch diameter drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background, one percent mid-scale accuracy, scale calibrated in psi, Fig. 83K manufactured by Marshalltown.

#### 2.03 PRESSURE GAGE TAPS

- A. Gage Cock: Lever handle, brass for maximum 150 psig, Fig. 125 manufactured by Marshalltown.

- B. Needle Valve: Steel for maximum 150 psig, Fig. 200 manufactured by Marshalltown.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections, Fig. 129 manufactured by Marshalltown.
- D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern, Model 126 or 127 manufactured by Marshalltown.

## 2.06 STEM TYPE THERMOMETERS

- A. ASTM E1, 9 inch scale, red appearing mercury, lens front tube, cast aluminum case with enamel finish and clear glass or polycarbonate window, brass stem, 2 percent of scale accuracy to ASTM E77 scale calibrated in degrees F, 91000 Series manufactured by Marshalltown.

## 2.07 DIAL THERMOMETERS

- A. ASTM E1, 3-1/2 inch diameter dial in steel case, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem, one percent of full scale accuracy, calibrated in degrees F, Model SJ Series manufactured by Marshalltown.

## 2.08 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

## 2.09 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.
- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gages, one gage adapter with 1/8 inch probes, two one inch dial thermometers.

# PART 3 EXECUTION

## 3.01 INSTALLATION

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

- B. Provide one pressure gage per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage.
- C. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets.
- E. Install thermometers in air duct systems on flanges.
- F. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to Section 15975. Where thermometers are provided on local panels, duct or pipe mounted thermometers are not required.
- G. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
- I. Coil and conceal excess capillary on remote element instruments.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gages and thermometers in locations where they are easily read from normal operating level.
- L. Locate test plugs adjacent to thermometers and thermometer sockets, adjacent to pressure gages and pressure gage taps, adjacent to control device sockets.

END OF SECTION

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this Section.
- B. Testing, adjustment, and balancing of air systems.
- C. Testing, adjustment, and balancing of hydronic systems.
- D. Measurement of final operating condition of HVAC systems.

**1.02 RELATED SECTIONS**

- A. Section 15556H - Cast Iron Boilers.
- B. Section 15671H - Air Cooled Condensing Units.
- C. Section 15855H - Air Handling Units with Coils.
- D. Section 15870H - Power Ventilators.
- E. Section 15890H - Ductwork.
- F. Section 15910H - Ductwork Accessories.
- G. Section 15952H - Controls and Instrumentation: Controls, compressors, and sequence of operation.

**1.03 REFERENCES**

- A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. ASHRAE - 1984 Systems Handbook: Chapter 37, Testing, Adjusting and Balancing.
- C. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

**1.04 SUBMITTALS**

- A. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

- B. Submit test reports as a submittal in accordance with Section 15011H.
- C. Prior to commencing work, submit draft reports indicating adjusting, balancing, and equipment data required.
- D. 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.
- E. 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.
- F. Include detailed procedures, agenda, sample report forms, prior to commencing system balance.

#### 1.06 REPORT FORMS

- A. Submit reports on AABC National Standards for Total System Balance.
- B. Forms shall include the following information:
  - 1. Title Page:
    - a. Company name
    - b. Company address
    - c. Company telephone number
    - d. Project name
    - e. Project location
    - f. Project Architect
    - g. Project Engineer
    - h. Project Contractor
    - i. Project altitude
  - 2. Instrument List:
    - a. Instrument
    - b. Manufacturer
    - c. Model
    - d. Serial number
    - e. Range
    - f. Calibration date
  - 3. Air Moving Equipment:
    - a. Location
    - b. Manufacturer
    - c. Model
    - d. Air flow, specified and actual
    - e. Return air flow, specified and actual

- f. Outside air flow, specified and actual
  - g. Total static pressure (total external), specified and actual
  - h. Inlet pressure
  - i. Discharge pressure
  - j. Fan RPM
- 4. Exhaust Fan Data:
  - a. Location
  - b. Manufacturer
  - c. Model
  - d. Air flow, specified and actual
  - e. Total static pressure (total external), specified and actual
  - f. Inlet pressure
  - g. Discharge pressure
  - h. Fan RPM
- 5. 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
- 6. Electric Motors:
  - a. Manufacturer
  - b. HP/BHP
  - c. Phase, voltage, amperage; nameplate, actual, no load.
  - d. RPM
  - e. Service factor
  - f. Starter size, rating, heater elements
- 7. 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
- 8. 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
- 9. Air Monitoring Station Data:
  - a. Identification/location
  - b. System
  - c. Size
  - d. Area
  - e. Design velocity
  - f. Design air flow
  - g. Test velocity
  - h. Test air flow
- 10. Pump Data:
  - a. Identification/number
  - b. Manufacturer
  - c. Size/model
  - d. Impeller
  - e. Service
  - f. Design flow rate, pressure drop, BHP
  - g. Actual flow rate, pressure drop, BHP
  - h. Discharge pressure
  - i. Suction pressure
  - j. Total operating head pressure
  - k. Shut off, discharge and suction pressures
  - l. Shut off, total head pressure
- 11. 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. Water flow, design and actual
  - k. Water pressure drop, design and actual
  - l. Entering water temperature, design and actual
  - m. Leaving water temperature, design and actual
  - n. Air pressure drop, design and actual

12. Flow Measuring Station:
  - a. Identification/station
  - b. Location
  - c. Size
  - d. Manufacturer
  - e. Model
  - f. Design flow rate
  - g. Design pressure drop
  - h. Actual/final pressure drop
  - i. Actual/final flow rate
  - j. Station calibrated setting
13. Duct Leak Test:
  - a. Description of ductwork under test
  - b. Duct design operating pressure
  - c. Duct design test static pressure
  - d. Duct capacity, air flow
  - e. Maximum allowable leakage duct capacity times leak factor
  - f. Test apparatus
    - 1) Blower
    - 2) Orifice, tube size
    - 3) Orifice size
    - 4) Calibrated
  - g. Test static pressure
  - h. Test orifice differential pressure
  - i. Leakage
14. Combustion Test:
  - a. Boiler manufacturer
  - b. Model
  - c. Firing rate
  - d. Overfire draft
  - e. Gas meter timing dial size
  - f. Gas meter time per revolution
  - g. Gas pressure at meter outlet
  - h. Gas flow rate
  - i. Heat input
  - j. Burner manifold gas pressure
  - k. Percent carbon monoxide (CO)
  - l. Percent carbon dioxide (CO<sub>2</sub>)
  - m. Percent oxygen (O<sub>2</sub>)
  - n. Percent excess air
  - o. Flue gas temperature at outlet
  - p. Ambient temperature
  - q. Net stack temperature
  - r. Percent stack loss
  - s. Percent combustion efficiency

- t. Heat output

#### 1.07 PROJECT RECORD DOCUMENTS

- A. Submit record documents.
- B. Accurately record actual locations of flow measuring stations, balancing valves and rough setting.

#### 1.08 QUALITY ASSURANCE

- A. Agency shall be company specializing in the adjusting and balancing of systems specified in this Section with minimum three years experience. Perform Work under supervision of Balancing and Adjusting Supervisor.
- B. Total system balance shall be performed in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance. ASHRAE - 1984 Systems Handbook.

#### 1.09 SEQUENCING AND SCHEDULING

- A. Sequence work.
- B. Schedule work.
- C. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.
- D. Schedule and provide assistance in final adjustment and test of life safety system with Fire Authority.

#### PART 2 PRODUCTS Not Used

#### PART 3 EXECUTION

##### 3.01 EXAMINATION

- A. Before commencing work, verify that systems are complete and operable. Ensure the following:
  - 1. Equipment is operable and 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. Correct fan rotation.
7. Fire and volume dampers are in place and open.
8. Coil fins have been 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 has been minimized.
12. Hydronic systems have been flushed, filled, and vented.
13. Correct pump rotation.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

- B. Report any defects or deficiencies noted during performance of services to Architect/Engineer.
- C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- E. Beginning of work means acceptance of existing conditions.

### 3.02 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.

### 3.03 INSTALLATION TOLERANCES

- A. Adjust air handling systems to plus or minus 5 percent for supply systems and plus or minus 10 percent for return and exhaust systems from figures indicated.
- B. Adjust hydronic systems to plus or minus 10 percent of design conditions indicated.

### 3.04 ADJUSTING

- A. Adjust work.
- B. Recorded data shall represent actually measured, or observed condition.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing

settings to be restored. Set and lock memory stops.

- D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- G. Check and adjust systems approximately six months after final acceptance and submit report.

### 3.05 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 extent 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. Where modulating dampers are provided, take measurements and balance at extreme conditions.
- L. 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.

### 3.06 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

END OF SECTION