

## SECTION 230913 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Control piping, tubing and wiring.
  - 2. Pneumatic control devices.
  - 3. Electric controls devices.
  - 4. Control air compressors, dryers, and pressure regulation stations.
- B. Related Sections include the following:
  - 1. Division 23 Section 230519 "Meters and Gages for HVAC Piping", for measuring equipment that relates to this Section.
  - 2. Division 23 Section 230923 "Direct Digital Controls for HVAC", for building automation controls related to this Section.

#### 1.3 SUBMITTALS

- A. Shop Drawings: Include performance data, components and accessories, wiring diagrams, dimensions, weights and loadings, field connections, and required clearances.
- B. LEED™ Documentation: Submit required documentation showing credit compliance with applicable LEED™ NC 2.2 standards using Submittal Template.
  - 1. Product data showing control devices comply with ASHRAE 90.1-2004.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
  - 2. Interconnection wiring diagrams with identified and numbered system components and devices.

3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

#### 1.4 QUALITY ASSURANCE

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

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

#### 1.6 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  1. Honeywell.
  2. Johnson Controls.
  3. Siemens.

#### 2.2 ELECTRICAL AND INTERLOCKS

- A. Control Contractor shall furnish and mount electrical relays, switches, solenoids, transformers, etc., that are part of the control contract, and Electrical Contractor shall make the electrical interconnections as shown on control drawings. Electrical interconnections between controls and items of equipment shall be made by Electrical Contractor.

## 2.3 RELAYS AND SWITCHES

- A. Accessory pneumatic and electric relays and switches shall be furnished as required to complete the control functions. Relays shall energize control system on equipment start, interface between pneumatic and electrical system, modify control air pressures, or increase system capacity of controllers. Switches shall provide high or low temperature or pressure safety limits or alarms, or change proportional to two position control. Input and output ports shall have suitable pressure gauges. P.E. switches shall be furnished with neon pilot lamps.
- B. Fire alarm and trouble relays shall be wired to a normally closed set of contacts for reporting of status to the Energy Management Control System cabinet where applicable.

## 2.4 THERMOSTATS

- A. Pneumatic Thermostats:
  - 1. Wall mounted, pilot bleed, direct acting, proportional style with pneumatic feedback feature, 55 degree F to 85 degree F range, and an indicating thermometer.
  - 2. Enclose in tamper proof ventilated cases with exposed adjustments in offices only and key operated adjustments in all other areas. Provide additional guards in areas subject to damage such as loading docks, locker rooms, gymnasiums, etc.
  - 3. Dual-Temperature Thermostats: Automatic changeover from normal setting to lower setting for unoccupied cycles, with manual-reset lever to permit return to normal temperatures during unoccupied cycles, with automatic reset to normal during next cycle of operation.
  - 4. Limits: Field adjustable, to limit setting cooling set point below 75 deg F, and heating set point above 72 deg F.

## 2.5 HUMIDISTATS

- A. Pneumatic Room Humidistats:
  - 1. Wall mounted, pilot bleed, reverse acting, proportional style with pneumatic feed back feature, and 25% to 95% RH range.
  - 2. Enclosed in tamper proof ventilated cases with key adjustments.

## 2.6 CONTROL DAMPERS

- A. AMCA-rated, multiple opposed blade style constructed of either extruded aluminum or minimum 16 gauge galvanized steel with reinforced, rigid frames. Complete with all necessary mounting hardware, linkage, jackshafts and supports. Integral damper/operator assemblies are not acceptable. Damper operators shall be accessible from the exterior of the unit when possible.
- B. Blade edge and end gasketing: Closed cell neoprene or stainless steel wiper style with optional blade end overlap on frame, oilite bronze bearings.

- C. Leakage: No more than one half of one percent (0.5%), measured at 4 inches W.G. differential pressure.

## 2.7 ACTUATORS

- A. Pneumatic Valve Operators: Rolling neoprene diaphragm style, either normally open or normally closed as required.
- B. Pneumatic Damper Operators:
  - 1. Damper operators shall have flexible rolling diaphragms and capacity to handle the required load under all conditions. The operators shall be provided with suitable brackets rigidly mounted and adequate means for field adjustment to provide proper operation. The operator shall not require lubrication. Flexible rolling diaphragms shall be replaceable type. Multiple operators shall be installed if deemed necessary for proper operation.
  - 2. For 100% outdoor air units 2 position, spring return, electronic actuators shall be used, unless noted otherwise, Siemens GCA Series or approved equal. Multiple operators shall be installed if required for proper operation.
- C. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
- D. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
  - 1. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:
    - a. Belimo Aircontrols (USA), Inc.
    - b. Siemens
  - 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
  - 3. Coupling: V-bolt and V-shaped, toothed cradle.
  - 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  - 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.

## 2.8 CONTROL VALVES

- A. Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Fluid control valves shall be single seated, straight through, globe with renewable hardened seats and high lift contoured stainless steel plugs and seats, allowing tight shutoff. Valves shall have modified linear control characteristic for steam valve service, and equal percentage characteristic for water service. Valves 2 inches and smaller shall have threaded bronze bodies,

and valves 2-1/2 inches and larger in size shall have flanged cast iron bodies. Stem packing shall be spring loaded, self adjusting Teflon cones. Valve operators shall be rolling neoprene diaphragm style, either normally open or normally closed as required. Electronic valve operators will be allowed.

- C. Valves shall have metal actuators rather than plastic, and copper tubing pneumatic connections.
- D. Hydronic system globe valves shall have the following characteristics:
  - 1. NPS 2 and Smaller: Single seated, straight through, Class 125 threaded bronze body.
  - 2. NPS 2-1/2 and Larger: Single seated, straight through, globe, Class 125 flanged bronze body.
  - 3. Internal Construction: Renewable hardened seats and high lift contoured stainless steel plugs and seats allowing tight shutoff, spring loaded stem packing with self adjusting Teflon cones.
  - 4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
  - 5. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- E. Steam system globe valves shall have the following characteristics:
  - 1. NPS 2 and Smaller: Single seated, straight through, Class 125 threaded bronze body.
  - 2. NPS 2-1/2 and Larger: Single seated, straight through, globe, Class 125 flanged bronze body.
  - 3. Internal Construction: Renewable hardened seats and high lift contoured stainless steel plugs and seats allowing tight shutoff, spring loaded stem packing with self adjusting Teflon cones.
  - 4. Flow Characteristics: Modified linear characteristics.
  - 5. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of operating (inlet) pressure.
- F. Butterfly Valves:
  - 1. Butterfly valves used as automatic isolation valves on heating hot water and chilled water systems shall be of lug style with cast iron body, ANSI Class 125, 316 stainless steel shaft and disc, and EPDM seat; and be provided with 120 VAC or 24 VAC electric actuator, with 2 limit switches for valve position feedback, and operator wheel for manual override of valve position in NEMA 4 enclosure.

## 2.9 TIME CLOCKS

- A. When DDC control is not utilized or an existing pneumatic system within a building is to be extended a time clock shall be furnished and installed to start and stop the controlled equipment.
- B. Clock shall have a 7-day, 365-day programming capability with a minimum of 18 setpoints and momentary feature, 15A SPDT contact, manual override, and battery carry-over.

- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Paragon model EC71/18S, for 120V, 60 Hz, 1 Ph.

## 2.10 DUCT SMOKE DETECTORS

- A. Duct smoke detectors shall be National Time and Signal DDP-2 or Simplex 2098-9649 photoelectric type. Sampling tubes shall extend the full width of the duct. The exact length shall be determined in field. Duct smoke detectors shall have two sets of SPDT contacts rated at 10 Amps, 125 VAC to provide additional switching capabilities and one set of SPDT contacts rated at 5 amps for trouble alarm. Manual reset shall be connected into the motor control circuit in a manner that will not permit the motor to run when the device is activated. This applies to hand as well as automatic position of the selector switch.
- B. Refer to Division 26 for power supply and reset station.

## 2.11 FREEZESTATS

- A. A 20' capillary tube sensing element shall be serpentine from side to side and from top to bottom in the fan housing. The capillary tube shall sense the coldest one foot section and open the fan motor control circuit and stop the fan when the sensed temperature falls below 35 °F. The sensing element shall be installed with chafe protection at attachment points. Provide manual reset button. Multiple freezestats shall be used in large outdoor air ducts as necessary for adequate coverage.

## 2.12 FLOW MEASURING STATIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. EBTRON, Inc.
- B. Sensors: Vortex shedding or thermal mass flow, temperature and pressure compensating type.
- C. Accessories: Include probe mounted transmitter junction box, transmitter and system electronic enclosure with a velocity profiler with digital display.

## 2.13 AIR SUPPLY

- A. Control and Instrumentation Tubing:
  - 1. Hard drawn, type "L" copper tubing, ASTM B16, with solder joint fittings. Compression type fittings may be used for control device connections and shut-off valves only.
  - 2. Polyethylene: Refer to "Pneumatic Piping Installation" for acceptable application.

B. Control Air Compressors

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Saylor-Beall's.
  - b. Quincy.
  - c. Ingersoll-Rand
2. Control air compressor shall be two-stage, duplex, belt driven, completely factory assembled and tested. Each compressor shall have ample capacity to supply the entire system capacity when run twenty minutes per hour, and shall have its own feeder from the motor center or power panel.
3. Compressors shall be mounted on a common air tank and shall be furnished with automatic controls, belt guards, vibration isolators, service valves, pressure switch, discharge check valves, tank safety pressure relief valves, and automatic pressure differential type drain piped to nearest floor drain. Tank shall be ASME approved, and rated for 200 psi working pressure.
4. Motor shall be U frame, open drip-proof type, 1800 rpm maximum, multiple belts and V-drive sheaves.
5. Compressor pump shall be two cylinder and pressure lubricated type, and shall include cast iron cylinder head, oil sight gauge, flywheel with V-grooves, and low-resistance intake filter/silencer.
6. Control for each compressor shall include combination magnetic motor starter with fused disconnect switch, hand-off-automatic switch, and overload protection. Automatic alternators with OHIO or equal electric control relay, 120 V fused control transformer, red and green pilot lights, and red indicating running condition shall be provided and mounted on backboard on wall or on unit-strut.
7. Tank: ASME storage tank with drain test cock, automatic moisture removal trap, tank relief valve, and rubber-cork vibration isolation mounting pads.
8. Size compressor and tank to operate compressor not more than 30 minutes during a 60-minute period.

C. Refrigerated Air Dryer:

1. A refrigerated air dryer shall be installed to remove moisture from the Control Air System. Unit shall be equal to the Hankison Series 80, sized to deliver full air requirements at 100 psi pressure dewpoint of 35 degree F. Dryer shall be provided with a mechanically activated condensate drain trap Hankison "Trip-L-Trap" or approved equal piped to the nearest floor drain. Hankison dryer voltage shall be 120/60/1.

D. Desiccant Dryer:

1. If any pneumatic control piping is required to be installed out of doors or otherwise in areas of outside ambient temperature, a desiccant air dryer shall be installed in lieu of a refrigerated air dryer.
2. A desiccant air dryer shall be installed to remove moisture from the Control Air System. Unit shall be equal to the Puregas HF-200 Series, sized to deliver full air requirements at a 100 psi pressure dewpoint of 0 degree F. Dryer shall be provided with mufflers and shall have 120/60/1 voltage requirement.

E. Pressure Regulating Station:

1. Duplex with Spence, Fisher, or Norgren pressure reducing valve, a King "Ultra-C" filter, a safety pressure relief valve, and inlet and outlet pressure gauges.
2. Provide filters with a mechanically activated condensate drain trap Hankison "Trip-L-Trap" or approved equal piped to the nearest floor drains.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. No pneumatic control line will be run through a control cabinet unless it is connected to a control device within that cabinet.
2. Only copper control tubing shall be used to connect to steam or hot water control valves.
3. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation.

B. Control Devices:

1. Low temperature freeze protection thermostats shall be installed downstream of the heating coils in HVAC units.
2. All thermostats shall be field calibrated and verified.
3. Outdoor air sensors shall be installed on the north or west walls/equipment, and provided with sun and damage guards.
4. Immersion sensors shall be provided with immersion wells.
5. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
6. Installer shall validate correct duct area is programmed into Air Flow Station prior to Air Balance.

C. Control Air:

1. A PE switch for low pressure alarm shall be installed after air dryer, PRV and gauges, and connected to the local or Central Control.
2. Install valved bypass line around the compressed air dryer to allow servicing the dryer without system interruption.
3. Install valved bypass line around the compressor automatic drain to allow repair or replacement without system interruption.
4. Pipe manual and automatic drains to nearest floor drain.
5. Mount compressor and tank unit on vibration isolators as specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment." Isolate air supply with wire-braid-reinforced rubber hose. Secure and anchor according to manufacturer's written instructions and seismic-control requirements.
6. Supply instrument air from compressor units through filter, pressure-reducing valve, and pressure relief valve, with pressure gages and shutoff and bypass valves.



- D. Special Equipment: Install in accordance with manufacturer's instructions and recommendations. All control instruments, valves, etc., shall be carefully adjusted and set for proper operating of the equipment served as noted herein or as required by the equipment manufacturer's instructions and recommendations.
- E. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
- F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- G. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- H. Install steam and condensate instrument wells, valves, and other accessories according to Division 23 Section "Steam and Condensate Heating Piping."
- I. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- J. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

### 3.2 PNEUMATIC PIPING INSTALLATION

- A. Copper Tubing: Pipe shall be securely installed without dents and other imperfections, and it shall be capable of withstanding a rigid test against leakage. Piping shall be installed during the construction of the building, and it shall be protected from damage and placed in concealed positions where possible. Piping installed in plastered walls shall be recessed into the wall so that it will be covered by a full thickness of plaster. No plastic caps shall be allowed. Gauge taps, etc., shall use barbed plugs.
- B. Polyethylene may be used as follows:
  - 1. Exposed installations (Equipment Rooms, etc.): Single polyethylene tubing may be run exposed for lengths 18 inch or less. For lengths which exceed 18 inches, the lines shall be run within enclosed trough or conduit, and this tube carrier system shall be installed in a workmanlike manner, parallel to building lines, and adequately supported. All connections, except for terminal connection to valves, damper operators, etc., shall be made inside trough, junction boxes, or control cabinets. Exposed polyethylene tubing is acceptable only in control cabinets and, in a maximum 18" length, when connecting control devices which require a flexible connection to allow movement.
  - 2. Factory manufactured bundles of polyethylene tubing, which are of the semi-rigid design with outer sheaths of aluminum and polyethylene, may be installed without additional trough or conduit envelope, provided that the bundled tube system is installed in the same workmanlike manner as specified for trough and conduit systems. Single or bundled tubing will not be allowed in concealed locations such as pipe chases, suspended ceilings, within walls, etc., unless run in conduit.
  - 3. Concealed installations: Single polyethylene tubes and standard bundles of polyethylene tubing shall be run within enclosed trough or EMT conduit. Fitting connections shall not be made within an inaccessible area.

- C. Number-code or color-code control air piping for future identification and service of control system, except local individual room control tubing.
- D. Pressure Gages or Test Plugs: Install on branch lines at each receiver controller and on signal lines at each transmitter, except individual room controllers.

### 3.3 FIELD QUALITY CONTROL

- A. Provide field supervision, and calibration and start up service.
- B. Upon completion of the work, the Contractor shall instruct the Owner's Operating Engineer and acquaint him with all of the operating characteristics of all equipment installed by him including the TCS and all other systems, at the same time operating each and every system individually for a period of two days, unless otherwise specified. During this two day period the building's Operations Manual shall be used for reference.

### 3.4 ADJUSTING

- A. Calibrating and Adjusting:
  - 1. Provide diagnostic and test instruments for calibration and adjustment of system.
  - 2. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature and humidity set points.

END OF SECTION 230913