

SECTION 23 09 13
HVAC CONTROLS, FIELD COMPONENTS, AND INSTRUMENTS

PART 1 GENERAL

1.01 GENERAL

- A. This section is a supplement to Section 23 09 00, Instrumentation and Control Devices for HVAC.
- B. The requirements of this section shall be provided in addition to those listed in Section 23 09 00, Instrumentation and Control Devices for HVAC.

1.02 SUBMITTALS

- A. Action Submittals: Shop Drawings.

1.03 EXTRA MATERIALS

- A. Furnish, tag and box for shipment and storage the following special tools:

Item	Quantity
Special tools required to maintain or dismantle	One complete set for each different size unit
B. HVAC Control Panel (HCP) Spare Lamps: Furnish spare lamps for each type and color of pilot light used, a minimum of one per HCP, stored inside HCP in dummy light sockets secured to back panel surface.	

PART 2 PRODUCTS

2.01 HVAC CONTROL PANELS (HCP)

- A. Provide at locations shown on the Drawings for convenient operator interface with control system.
- B. A single 120-volt, 20-amp feeder shall serve each HCP, unless otherwise indicated.
- C. HCP Contents: Set point adjustment dials, gauges, receiver controllers, manual timers, time clocks, microprocessor control modules, electronic indication relays, control switches, transformers, pilot lights, alarm lights, display screens, keypads, and other devices necessary for particular system.

D. HCP Construction:

1. Construct each HCP to NEMA 250 rating as indicated below:

**HVAC Control Panel (HCP) NEMA 250
Construction Schedule**

Location	NEMA 250 Type
Office Areas	1
Chemical Storage Areas	4X
Membrane Facility	3R
All other Process Areas	12

2. Metal enclosure to accommodate secure conduit fittings and protect against electrical transients.
3. Hinged front door with locking handle.
4. Flush-mount manual switches, pilot lights, and direct-reading gauges on front panel face.
5. Identify front panel mounted devices and HCP with labeling in accordance with Section 23 09 00, Instrumentation and Control Devices for HVAC.

E. Panel Listing: Panels shall bear UL or ETL listing mark stating, "LISTED ENCLOSED INDUSTRIAL CONTROL PANEL."

F. Control Devices:

1. Mount inside HCP.
2. Prewired internally.
3. Terminate wires leaving HCP at separately numbered terminal strips (one terminal pair per circuit).
4. Furnish individual connectors for every item of mechanical equipment, integral and remote pilot lights, and other devices described for each panel.
5. Refer to the Drawings for power and control circuit requirements.
6. Identify wires by color coding or numerical tags at both ends.
7. Wire control devices without splices to the terminal strip.
8. Furnish integral circuit protection for panel mounted control devices.

G. Terminal Blocks:

1. One-piece molded plastic blocks with screw type terminals and barriers rated for 600 volts.
2. Double sided and supplied with removable covers to prevent accidental contact with live circuits.

3. Furnish permanent, legible identification, clearly visible with protective cover removed.
4. Terminate wires at terminal blocks with crimp type, pre-insulated, ring-tongue lugs.
5. Size lugs for terminal block screws and for the number and size of wires terminated.
6. Provide screwdriver access for blade width of a minimum of 3/16 inch or Klein 601 Series screwdrivers. Terminals requiring use of special screwdrivers are not acceptable.

H. Schematic Diagrams:

1. Furnish black and white graphic of smooth or engraved laminated plastic.
2. Mount on front face of HCP showing equipment within respective systems.
3. Show pilot lights, pressure gauges, and temperature-indicating dials on schematic in locations that correspond to actual system location.
4. Locate manual selector switches directly below equipment symbol being controlled.

I. Miscellaneous Accessories:

1. Furnish panel as-built electrical wiring diagrams and schematics, secured to inside of panel door, or enclosed in plastic jackets placed inside each panel.
2. Install plastic or stick-on labels on interior control devices to identify them in conjunction with control schematics.

2.02 CONTROL DAMPERS

A. General:

1. Physical Characteristics:
 - a. Specification applies to control dampers, except those specified to be furnished with equipment.
 - b. Furnish opposed-blade type for proportional action and parallel-blade type for two-position action.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

B. Standard Duty Control Dampers (M):

1. Manufacturers and Products:
 - a. Ruskin; Model CD-35.
 - b. Or equal.

2. Physical Characteristics:
- a. Frame:
 - 1) Nominal 5 inches deep, minimum 16-gauge (127 mm by minimum 1.6 mm) roll formed, hat-shaped channel, reinforced at corners. (Structurally equivalent to 13 gauge (2.3 mm) U-channel.)
 - 2) Material: Galvanized steel and Type 304 stainless steel for Headworks.
 - b. Blades:
 - 1) Style: Single skin with three longitudinal grooves, minimum.
 - 2) Orientation: Horizontal or vertical with thrust washers, as indicated on the Drawings.
 - 3) Minimum 14 gauge (2 mm) equivalent thickness.
 - 4) Material: Galvanized steel and Type 304 stainless steel for Headworks.
 - 5) Width: Nominal 6 inches (152 mm).
 - c. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.
 - d. Seals:
 - 1) Blade Seals: Inflatable PVC-coated fiberglass material and galvanized steel. Mechanically attached to blade edge.
 - 2) Jamb Seals: Flexible metal compression type.
 - e. Linkage: Concealed in frame.
 - f. Axles:
 - 1) Minimum 1/2 inch (13 mm) diameter, hex-shaped, mechanically attached to blade.
 - 2) Material: Plated steel.
 - g. Accessories:
 - 1) As follows:
 - a) Actuator: Refer to Article Control Damper Operators, for requirements.
 - b) Switch Package: Two-position indicator switches linked directly to damper blade to remotely indicate damper blade position.
 - c) Flange: 1-1/2 inch (38 mm), roll formed as part of frame, front or rear configuration.
 - d) T-Flange Frame:
 - (1) Minimum 6-inch by 1-3/8-inch by 0.125-inch (152 mm by 35 mm by 3.2 mm) aluminum, bolt holes in corners.
 - e) Factory Sleeve: Minimum 20-gauge (1 mm) thickness, minimum 12-inch (305-mm) length.
 - f) Duct transition connection: configure to suit ductwork cross-section, as shown on the Drawings.
3. Functional Characteristics: None.

4. Performance Characteristics:
 - a. Performance Data:
 - 1) As follows:
 - a) Temperature Rating: Withstand minus 76 degrees F to 350 degrees F (minus 60 degrees C to 177 degrees C).
 - b) Closed Position: Maximum pressure of 13 inches w.g. (3.2 kPa) at a 12-inch blade length.
 - c) Open Position: Maximum air velocity of 6,000 feet per minute (1,829 meters per minute).
 - d) Leakage: Maximum 2 cubic feet per minute per square foot (0.6 cubic meter per minute per square meter) at 1 inch w.g. (0.25 kPa) for all sizes 24 inches (610 mm) wide and above.
 - e) Pressure Drop: Maximum 0.05 inch w.g. (0.01 kPa) at 1,500 feet per minute (457 meters per minute) across 24-inch by 24-inch (610-mm by 610-mm) damper.

2.03 CONTROL DAMPER OPERATORS

A. General:

1. Drawings and Control Diagrams indicate only one damper motor for each motorized damper (M).
2. Select actual quantity of motors required to operate each damper in accordance with size of damper provided.
3. Coordinate exact quantity of damper motors with electrical work to ensure that necessary wiring and conduit is provided for installation.
4. Provide operators for motorized dampers and motorized louvers.

B. Electric Damper Operators:

1. Manufacturers:
 - a. Siemens Building Technologies.
 - b. Or equal.
2. Physical Characteristics:
 - a. Mounting: External side plate or External sleeve.
 - b. Ample power to overcome friction of damper linkage and air pressure acting on damper blades.
 - c. Furnished with external adjustable stops to limit stroke.
 - d. Operators on modulating dampers that are to be sequenced with other control devices shall have full relay type pilot positioner and interconnecting linkage to provide mechanical feedback that will accurately position and control damper.
 - e. Intake, relief, and exhaust dampers shall close and return dampers shall open on control failure, unless indicated otherwise.
3. Functional Characteristics: None.

4. Performance Characteristics:
 - a. Performance:
 - 1) As follows:
 - a) 24V, 60-Hz, two-position or 24V, 60-Hz, modulating as operating sequence requires.
 - b) Fail Position: Open.
 - b. Operating Torque:
 - 1) Provide multiple independent damper sections, each with separate actuator, as needed to provide minimum of 120 percent of operating torque required by damper(s).
 - 2) Required damper operating torque for actuator sizing calculations shall include friction of damper linkage and 1-inch WC air pressure on damper blades:
 - a) Opposed-Blade Dampers: Minimum 5 inch-pounds per square foot of damper area, unless higher values are recommended by damper manufacturer.
 - b) Parallel-Blade Dampers: Minimum 7 inch-pounds per square foot of damper area, unless higher values are recommended by damper manufacturer.

2.04 ELECTRIC THERMOSTATS

A. Office Area Room Thermostat :

1. Physical Characteristics:
 - a. Modulating electric type, except where two-position action is required.
 - b. Temperature Scale: Furnish 50 degrees F to 90 degrees F dial.
 - c. External adjustments.
 - d. Adjustable sensitivity.
 - e. Nonlocking cover.
 - f. Insulating back, where exterior wall mounting is indicated.
2. Functional Characteristics:
 - a. Temperature Scale: Furnish 50 degrees F to 90 degrees F dial.
3. Performance Characteristics: None.

B. Process Area Room Thermostat:

1. Physical Characteristics:
 - a. Modulating electric type, except where two-position action is required.
 - b. Temperature Scale: Furnish 50 degrees F to 90 degrees F dial.
 - c. External adjustments.
 - d. Adjustable sensitivity.
 - e. Insulating back where exterior wall mounting is indicated.
 - f. Nonlocking wire protective guard.

2. Functional Characteristics:
 - a. Temperature Scale: Furnish 32 degrees F to 104 degrees F dial.
3. Performance Characteristics: None.

2.05 ELECTRONIC SENSORS

A. Temperature:

1. General Requirements:
 - a. Physical Characteristics:
 - 1) Sensors and transmitters shall be provided, as outlined in input/output summary and sequence of operations.
 - 2) Temperature sensor shall be resistance type and shall be either two-wire 1,000-ohm nickel RTD or two-wire 1,000-ohm platinum RTD.
 - b. Functional Characteristics:
 - 1) The following point types (and accuracy of each) are required, and their associated accuracy values include errors associated with sensor, lead wire, and A to D conversion:

<u>Point Type</u>	<u>Accuracy</u>
Room Temperature	$\pm 0.5^{\circ}\text{F}$
Duct Temperature	$\pm 0.5^{\circ}\text{F}$
All Others	$\pm 0.75^{\circ}\text{F}$

- c. Performance Characteristics: None.
2. Room Temperature Sensor:
 - a. Physical Characteristics:
 - 1) Constructed for either surface or wall box mounting.
 - 2) Nonlocking wire protective guards for room temperature sensors installed in process areas.
 - 3) Shall have the following options when specified:
 - a) Set point reset slide switch providing plus or minus 3 degrees F (adjustable) range.
 - b) Individual heating/cooling set point slide switches.
 - c) Momentary override request pushbutton for activation of after-hours operation.
 - d) Analog thermometer.
 - b. Functional Characteristics: None.
 - c. Performance Characteristics: None.
3. Room Temperature Sensors with Integral Display:
 - a. Physical Characteristics:
 - 1) Constructed for either surface or wall box mounting.

- 2) Nonlocking wire protective guards for room temperature sensors installed in process areas.
- 3) Integral LCD display and four button keypad with the following capabilities:
 - a) Display room and outside air temperatures.
 - b) Display and adjust room comfort set point.
 - c) Display and adjust fan operation status.
 - d) Timed override request pushbutton with LED status for activation of after-hours operation.
 - e) Display controller mode.
 - f) Password selectable adjustment of set point and override modes.
- b. Functional Characteristics: None.
- c. Performance Characteristics: None.
4. Duct Temperature:
 - a. Physical Characteristics:
 - 1) Element:
 - a) Rigid insertion, 12 inch length, through sealed opening in center of duct.
 - b) Averaging, for ducts or plenums with any dimension greater than 36 inches. Sealed opening in duct. Sensing element incorporated in copper capillary a minimum of 20 feet long, serpentine across full area of airflow.
 - b. Functional Characteristics:
 - 1) Range:
 - a) Heating: 40 to 140 degrees F.
 - b) Cooling: 30 to 100 degrees F.
 - c. Performance Characteristics: None.
5. Outdoor Temperature:
 - a. Physical Characteristics: None.
 - b. Functional Characteristics: None.
 - c. Performance Characteristics:
 - 1) Accuracy: Plus or minus 1 degree F.
 - 2) Range: Minus 40 to 140 degrees F.
 - 3) Cover: Weathertight, with sealed conduit connection and sun shield.

B. Pressure (P):

1. Air Pressure (P-1):
 - a. Physical Characteristics:
 - 1) Cover: NEMA 250 Type, suitable for area classification; in accordance with NFPA 70.
 - 2) Mount nonvibrating.
 - b. Functional Characteristics: None.

- c. Performance Characteristics:
 - 1) Accuracy: 5 percent of range.
 - 2) Range: 150 percent of measured variable.

C. Differential Pressure (DP):

- 1. General:
 - a. Physical Characteristics: None.
 - b. Function Characteristics: Temperature compensated.
 - c. Performance Characteristics:
 - 1) Vary output voltage with change in differential pressure. Voltage shall vary linearly from 0V dc to 10V dc according to differential pressure between high and low pressure ports.
 - 2) Sensing range shall be suitable for application with linearity of 1.5 percent of full scale and offset of less than 1 percent of full scale.
 - 3) Capable of withstanding up to 150 percent of rated pressure without damage.
 - 4) Compatible with 14V dc to 30V dc supply voltage range.
- 2. Duct Air Static Differential Pressure:
 - a. Manufacturers and Products:
 - 1) Dwyer A302 duct probe.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) MAMAC transmitter.
 - 2) Install static pressure fittings for differential pressure sensors and switches at a right angle to the flow.
 - c. Functional Characteristics: None.
 - d. Performance Characteristics: None.

D. Position Indicator:

- 1. Physical Characteristics:
 - a. 0 percent to 100 percent open, for damper, inlet vane, or similar.
 - b. Potentiometer, 0 ohm to 2,000 ohm equals 0 percent to 100 percent.
- 2. Functional Characteristics: None.
- 3. Performance Characteristics: None.

E. Relative Humidity (RH):

- 1. Physical Characteristics: None.
 - a. Room Relative Humidity.
 - b. Solid state.
- 2. Functional Characteristics: None.

3. Performance Characteristics:
 - a. Accuracy: Plus or minus 2 percent.
 - b. Range: 10 percent to 95 percent.

F. Current Sensors (CS):

1. Fixed Setpoint, Digital Output Current Switch:
 - a. Manufacturers and Products:
 - 1) Veris; Hawkeye 600/800.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Application: Monitoring status of direct drive equipment.
 - 2) Current-operated solid state relay.
 - 3) Split core design.
 - 4) Trip Setpoint: Fixed.
 - 5) Output: Digital switch.
 - 6) Sensor Power: Induced from line.
 - c. Functional Characteristics: None.
 - d. Performance Characteristics: None.
2. Adjustable Setpoint, Digital Output Current Switch:
 - a. Manufacturers and Products:
 - 1) Veris; Hawkeye 708/908.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Application: Monitoring status of belt drive equipment.
 - 2) Current-operated solid state relay.
 - 3) Split core design.
 - 4) Trip Setpoint: Adjustable.
 - 5) Output: Digital switch, with status LED.
 - 6) Sensor Power: Induced from line.
 - c. Functional Characteristics: None.
 - d. Performance Characteristics: None.
3. Adjustable Setpoint, Digital Output, AFD Current Switch:
 - a. Manufacturers and Products:
 - 1) Veris; Hawkeye 904.
 - 2) Or equal.
 - b. Physical Characteristics:
 - 1) Application: Monitoring status of belt-drive or direct-drive equipment controlled by an AFD.
 - 2) Microprocessor-based current-operated solid state relay.
 - 3) Automatic compensation for AFD frequency and current changes.
 - 4) Split core design.
 - 5) Trip Setpoint: Self-calibrating.
 - 6) Output: Digital switch, with normal and alarm status LED.
 - 7) Sensor Power: Induced from line.

- c. Functional Characteristics: None.
- d. Performance Characteristics: None.

2.06 MISCELLANEOUS DEVICES

A. General:

- 1. Physical Characteristics:
 - a. Mounted on the motor stator winding for temperature protection.
 - b. Flat laminated RTDs installed in the slot of the stator.
- 2. Functional Characteristics:
 - a. RTD to voltage (0-volt to 5-volt) converters with zero span adjustments for use with analog inputs.
 - b. Auxiliary contacts in each motor starter, Work of Division 26, Electrical.
 - c. START/STOP relay module for either momentary or maintained switch action as indicated.
 - d. Capable of being remotely reset from existing building automation system.
- 3. Performance Characteristics: Limited range thermistors are acceptable provided they sense expected range for point at specified accuracy with 0-volt to 5-volt output.

B. Manual Timer (MT):

- 1. Manufacturers and Products:
 - a. Nutone.
 - b. Or equal.
- 2. Physical Characteristics:
 - a. Spring wound.
 - b. Install on front cover of HCP.
- 3. Functional Characteristics:
 - a. 12-hour, SPST, 120-volt, 20-amp.
 - b. HOLD feature to override the time clock during off-hour operation.
- 4. Performance Characteristics: None.

C. Time Clock (TC):

- 1. Manufacturers and Products:
 - a. Paragon.
 - b. Or equal.
- 2. Physical Characteristics:
 - a. Electronic 7-day programmable type.
 - b. Mount inside HCP.
- 3. Functional Characteristics: 8-hour battery backup feature.
- 4. Performance Characteristics: None.

D. Electronic Indication:

1. Physical Characteristics:
 - a. Furnish temperature-indicating dials or digital read-outs on HCP.
 - b. 2-1/2-inch minimum rectangular.
 - c. Temperature sensing dc bridge circuit.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

E. Duct Mounted Ionization Detection (I):

1. Manufacturers and Products:
 - a. BRK Electronics; Model DH1851AC.
 - b. Or equal.
2. Physical Characteristics:
 - a. Furnish duct smoke detectors for air handling systems, number and location as shown.
 - b. Type: Duct mounted, suitable for airstream sensing.
 - c. Detector Type: Ionization.
 - d. Furnish with reset button or key switch.
 - e. Include mounting bracket for installation on the ductwork.
 - f. Coordinate with other trades to accomplish specified Automatic Smoke Detection shutoff control sequence.
3. Functional Characteristics:
 - a. Voltage: 120V ac.
4. Performance Characteristics: None.

F. HVAC System Emergency Shutdown Switch (ESS):

1. Manufacturers and Products:
 - a. Simplex; 2099 Series.
 - b. Or equal.
2. Physical Characteristics:
 - a. Wall-mounted, break-glass type manual pull switches for HVAC system emergency shutdown.
 - b. Noncoded, single action, single pole.
 - c. Surface mounting type.
 - d. Provided with red laminated plastic nameplate with engraved white letters 1/2-inch high reading, "VENTILATION SYSTEM EMERGENCY SHUTOFF SWITCH," wall mounted directly above each switch.
3. Functional Characteristics: None.
4. Performance Characteristics: None.

PART 3 EXECUTION

3.01 INSTALLATION

A. Control Dampers:

1. Install at locations indicated on the Drawings and in accordance with manufacturer's instructions.
2. Install square and free from racking with blades running horizontally.
3. Operate opposed blade dampers from a power blade or drive axle.
4. Bracing:
 - a. Install for multiple section assemblies to support assembly weight and to hold against system pressure.
 - b. Install at every horizontal and vertical mullion.

END OF SECTION

