SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

This Section includes end devices normally found in pneumatic, digital, and electric control systems. Input and output devices are specified in this Section and may be used to complement either electronic or digital systems.

Manufacturers found in SpecAgent for this Section were identified as representative and not as an endorsement for meeting the requirements of this Specification.

This Section includes performance, proprietary, and descriptive type specifications. Edit to avoid conflicting requirements.

This Section includes the term "Architect/Engineer." "Architect" is used in AIA contract documents; "Engineer" is used in EJCDC contract documents. Retain appropriate term.

See the Drawing Coordination Considerations for information needed to coordinate this Specification Section with the Drawings.

1. GENERAL
   * + 1. SUMMARY
          1. Section Includes:

Air-supply piping and tubing.

Control panel enclosures.

Humidistats.

Thermostats.

Time clocks.

Alarm system.

Control air dampers.

Electric damper actuators.

Control valves.

Electric valve actuators.

Outside air-measuring and modulation device.

Direct digital control system components.

Duct-mounted smoke detector.

Differential pressure monitor.

* + - * 1. Related Requirements:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

Section 230513 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors.

Section 230553 - Identification for HVAC Piping and Equipment: Nameplates and labeling for control panels specified in this Section.

Section 230993 - Sequence of Operations for HVAC Controls: Sequences of operation implemented using products specified in this Section.

Section 232116 - Hydronic Piping Specialties: Product requirements for thermometer sockets and gage taps for placement by this Section. Installation requirements for piping products furnished in this Section.

Section 233300 - Air Duct Accessories: Product requirements for duct-mounted thermometers. Installation requirements for dampers and other duct-mounted products furnished in this Section.

Section 260503 - Equipment Wiring Connections: Execution requirements for electric connections specified by this Section.

* + - 1. DEFINITION

Limit list of definitions to terms unique to this Section and not provided elsewhere.

* + - * 1. FRP: Fiberglass-reinforced plastic.
      1. REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

LEED requires compliance with specific editions of referenced standards. Section 014000 requires compliance with the latest reference standard edition, except when a specific date is required by code. Consider including publication dates for referenced standards in this Section to ensure the correct standard is used for LEED compliance.

* + - * 1. Air Movement and Control Association International, Inc.:

AMCA 500-D - Laboratory Methods of Testing Dampers for Rating.

* + - * 1. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

* + - * 1. American Society of Mechanical Engineers:

ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

* + - * 1. ASTM International:

ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

ASTM A536 - Standard Specification for Ductile Iron Castings.

ASTM B32 - Standard Specification for Solder Metal.

ASTM B88 - Standard Specification for Seamless Copper Water Tube.

ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

ASTM D2737 - Standard Specification for Polyethylene (PE) Plastic Tubing.

* + - * 1. American Welding Society:

AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

AWS A5.8M - Specification for Filler Metals for Brazing and Braze Welding.

* + - * 1. National Electrical Manufacturers Association:

NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats.

* + - * 1. National Fire Protection Association:

NFPA 72 - National Fire Alarm and Signaling Code.

NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

* + - * 1. Underwriters Laboratories, Inc.:

UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics.

* + - 1. COORDINATION
         1. Section 013000 - Administrative Requirements: Requirements for coordination.
         2. Coordinate installation of control components in piping systems with work of Section 232116 - Hydronic Piping Specialties.
         3. Coordinate installation of control components in duct systems with work of Section 233300 - Air Duct Accessories.
      2. PREINSTALLATION MEETINGS
         1. Section 013000 - Administrative Requirements: Requirements for preinstallation meeting.
         2. Convene minimum [**one week**] [**<\_\_\_\_\_\_\_\_> weeks**] prior to commencing Work of this Section.
      3. SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

* + - * 1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
        2. Manufacturer’s installation instructions shall be provided along with product data.
        3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
        4. Section 013300 - Submittal Procedures: Requirements for submittals.
        5. Product Data:

Submit description and engineering data for each control system component, including sizing as applicable.

Design Data: Submit data for [**sizing of air tubing**] <**\_\_\_\_\_\_\_\_**>.

* + - * 1. Shop Drawings:

Indicate operating data, system drawings, wiring diagrams, and written, detailed operational description of sequences.

Coordinate submittals with information requested in Section 230993 - Sequence of Operations for HVAC Controls.

Include following Paragraph for submission of physical samples for selection of finish, color, texture, and other properties.

* + - * 1. Samples: Submit [**two**] <**\_\_\_\_\_\_\_\_**> [**of each type of room thermostat and cover**] [**thermostat guards**] [**of each exposed control component**].
        2. Manufacturer's Certificate: Certify that [**products**] <**\_\_\_\_\_\_\_\_**> meet or exceed [**specified requirements**] <**\_\_\_\_\_\_\_\_**>.

Include separate Paragraphs for additional certifications.

* + - * 1. Manufacturer's Instructions: Submit installation requirements for each control component.
        2. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
        3. Qualifications Statements:

Coordinate following Subparagraphsubparagraphs with requirements specified in QUALIFICATIONS Article.

Submit qualifications for manufacturer and installer.

Submit manufacturer's approval of installer.

* + - * 1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
        2. Manufacturer’s installation instructions shall be provided along with product data.
        3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
      1. CLOSEOUT SUBMITTALS
         1. Section 017000 - Execution and Closeout Requirements: Requirements for closeout procedures.
         2. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors.
         3. Operation and Maintenance Data: Submit inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
      2. MAINTENANCE MATERIAL SUBMITTALS
         1. Section 017000 - Execution and Closeout Requirements: Requirements for maintenance materials.
         2. Extra Stock Materials:

Furnish <**\_\_\_\_\_\_\_\_**> [**<\_\_\_\_\_\_\_\_> percent of total**] of each type of [**thermostat**] [**humidistat**] [**and**] [**exposed sensor**].

* + - 1. QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

* + - * 1. Provide pneumatic tubing located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested according to UL 1820 “Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics”.
        2. Control Air Damper Performance: According to AMCA 500-D “Laboratory Methods of Testing Dampers for Rating”.
        3. Perform Work according to [**State**] [**Municipality**] of <**\_\_\_\_\_\_\_\_**> [**Highways**] [**Public Work's**] standard.

Include the following Paragraph only when cost of acquiring specified standards is justified.

* + - * 1. Maintain [**one copy**] [**<\_\_\_\_\_\_\_\_> copies**] of [**each**] document on-Site.
      1. QUALIFICATIONS

Coordinate following Paragraphs with requirements specified in SUBMITTALS Article.

* + - * 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [**three**] <**\_\_\_\_\_\_\_\_**> years' [**documented**] experience[**, and with service facilities within 100 miles of Project**] [**, and with service facilities within <\_\_\_\_\_\_\_\_> miles of Project**].
        2. Installer: Company specializing in performing Work of this Section with minimum [**three**] <**\_\_\_\_\_\_\_\_**> years' [**documented**] experience [**and approved by manufacturer**].
      1. DELIVERY, STORAGE, AND HANDLING
         1. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
         2. Inspection: Accept controls on-Site in original factory packaging and inspect for damage.
         3. Store materials according to manufacturer's instructions.
      2. EXISTING CONDITIONS
         1. Field Measurements:

Verify field measurements prior to fabrication.

Indicate field measurements on Shop Drawings.

* + - 1. WARRANTY

This Article extends warranty period beyond one year. Extended warranties may increase construction costs and Owner enforcement responsibilities. Specify warranties with caution.

* + - * 1. Section 017000 - Execution and Closeout Requirements: Requirements for warranties.
        2. Furnish [**five**] <**\_\_\_\_\_\_\_\_**>-year manufacturer's warranty for [**each control-system component**] [**HVAC instrumentation**] <**\_\_\_\_\_\_\_\_**>.

1. PRODUCTS

Manufacturers are listed in following Article. Alternatively, list manufacturers for individual control components in applicable Articles.

* + - 1. CONTROL COMPONENT MANUFACTURERS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=9646) Subject to compliance with requirements, provide products by the following:

[Alerton Inc](http://www.specagent.com/Lookup?uid=123457166053).

[American Auto-Matrix](http://www.specagent.com/Lookup?uid=123457166054).

[Automated Logic Corporation](http://www.specagent.com/Lookup?uid=123457166056).

[Delta Controls Inc](http://www.specagent.com/Lookup?uid=123457166057).

[Distech Controls](http://www.specagent.com/Lookup?uid=123457166066).

[Honeywell International Inc](http://www.specagent.com/Lookup?uid=123457166058).

[Invensys Building Systems](http://www.specagent.com/Lookup?uid=123457166059).

[Johnson Controls, Inc](http://www.specagent.com/Lookup?uid=123457166060).

[KMC Controls (formerly Kreuter Manufacturing Company)](http://www.specagent.com/Lookup?uid=123457166061).

[Reliable Controls Corporation](http://www.specagent.com/Lookup?uid=123457166065).

[Schneider Electric USA, Inc](http://www.specagent.com/Lookup?uid=123457166055).

[Siemens Industry, Inc., Building Technologies Division](http://www.specagent.com/Lookup?uid=123457166062).

[Teletrol Systems Incorporated](http://www.specagent.com/Lookup?uid=123457166063).

[Trane](http://www.specagent.com/Lookup?uid=123457166064).

Approved equivalent.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8129&mf=04&src=wd):

Substitutions: [Section 016000 - Product Requirements] [Not permitted].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Subparagraph insert "State of \_\_\_\_\_\_\_\_ Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to <**\_\_\_\_\_\_\_\_**> standards.

* + - 1. AIR-SUPPLY PIPING AND TUBING
         1. Copper Tubing:

Type: Drawn.

Comply with ASTM B280 “Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service”.

Fittings: ASME B16.22 “Wrought Copper and Copper Alloy Solder Joint Pressure Fittings”, wrought copper.

Joints:

Brazed, AWS A5.8 “Specification for Filler Metals for Brazing and Braze Welding” BCuP silver/phosphorus/copper alloy, with melting range 1,190 to 1,480 degrees F (640 to 805 degrees C).

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Copper Tubing:

Type K, drawn.

Comply with ASTM B88 “Standard Specification for Seamless Copper Water Tube” (B88M).

Fittings: [**ASME B16.18, cast brass**] [**or**] [**ASME B16.22, solder wrought copper**].

ASTM B32 permits up to 0.1 percent lead content in solders not classified as containing lead.

Joints: [**ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, lead free solder**] [**ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, solder**] [**AWS A5.8, Classification BCuP-3 or BCuP-4 silver braze**].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Copper Tubing:

Type K, annealed.

Comply with ASTM B88 “Standard Specification for Seamless Copper Water Tube” (B88M).

Fittings: [**ASME B16.18, cast brass**] [**or**] [**ASME B16.22, solder wrought copper**].

Joints: [**ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, lead free solder**] [**ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, solder**] [**AWS A5.8, Classification BCuP-3 or BCuP-4 silver braze**].

* + - * 1. Virgin Polyethylene (PE) Nonmetallic Tubing:

Comply with ASTM D2737 “Standard Specification for Polyethylene (PE) Plastic Tubing”.

Furnish flame-retardant harness for multiple tubing.

Fittings: PE.

Joints: [**Compression**] [**or**] [**push-on**] type.

* + - 1. CONTROL PANEL ENCLOSURES
         1. Furnish enclosure for each system under automatic control.
         2. Equipment Mounting:

Within Cabinet: Relays and controls.

Flush on Cabinet Panel Face: Temperature indicators, pressure gages, pilot lights, push buttons, and switches.

* + - * 1. Construction:

Comply with NEMA 250 “Enclosures for Electrical Equipment (1000 Volts Maximum)”, Type [**1**] [**3**] [**4**] [**7**] [**9**] <**\_\_\_\_\_\_\_\_**>.

Material: [**Steel**] [**Stainless steel**] [**FRP**] [**Plastic**].

* + - * 1. Covers:

Continuous hinge.

Closure: [**Flush latch operable by screwdriver**] [**Flush latch operable by key**] [**Hasp and staple for padlock**].

* + - * 1. Finish: [**Manufacturer's standard enamel**] [**None**] <**\_\_\_\_\_\_\_\_**>.
      1. HUMIDISTATS
         1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8130&mf=04&src=wd):

Substitutions: [Section 016000 - Product Requirements] [Not permitted].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Subparagraph insert "State of \_\_\_\_\_\_\_\_ Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to <**\_\_\_\_\_\_\_\_**> standards.

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=9825) Subject to compliance with requirements, provide products by the following:

Schneider Electric USA, Inc.

Approved equivalent.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

* + - * 1. Room Humidistats:

Type: Wall mounted; proportioning.

Throttling Range: Adjustable, [**2 to 5**] [**<\_\_\_\_> to <\_\_\_\_>**] percent relative humidity.

Operating Range: [**30 to 80**] [**<\_\_\_\_> to <\_\_\_\_>**] percent.

Maximum Temperature: [**110**] <**\_\_\_\_\_\_\_\_**> degrees F ([**43**] <**\_\_\_\_\_\_\_\_**> degrees C).

Covers: Furnish [**set point indication**] [**concealed set point**].

* + - * 1. Duct Humidistats:

Type: Insertion, proportioning.

Throttling Range: Adjustable, [**2 to 5**] [**<\_\_\_\_> to <\_\_\_\_>**] percent relative humidity.

Operating Range: [**20 to 80**] [**<\_\_\_\_> to <\_\_\_\_>**] percent.

Maximum Temperature: 150 degrees F (65 degrees C).

* + - * 1. High-Limit Duct Humidistats:

Type: Insertion, two-position, reverse acting.

Throttling Range: Adjustable, differential of [**2**] <**\_\_\_\_\_\_\_\_**> percent relative humidity.

Operating Range: [**20 to 80**] [**<\_\_\_\_> to <\_\_\_\_>**] percent.

Maximum Temperature: 150 degrees F (65 degrees C).

* + - 1. THERMOSTATS
         1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8131&mf=04&src=wd):

Substitutions: [Section 016000 - Product Requirements] [Not permitted].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Subparagraph insert "State of \_\_\_\_\_\_\_\_ Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to <**\_\_\_\_\_\_\_\_**> standards.

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=9770) Subject to compliance with requirements, provide products by one of the following:

Honeywell International Inc.

Siemens Industry, Inc., Building Technologies Division.

Approved equivalent.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

* + - * 1. Pneumatic Room Thermostats:

Type: Adjustable proportioning.

Set Point:

[**Single**] [**Dual**].

Adjustment: Minimum 10 degrees F (6 degrees C) [**and adjustable dead band**].

Element: Single bimetallic element for heating or cooling only.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Elements: Dual bimetallic elements for [**heating and cooling**] [**day or night**].

Covers: Locking with [**set point adjustment**] [**set point indication**] [**concealed set point**]; [**with thermometer**] [**without thermometer**].

* + - * 1. Electric Room Thermostats:

Comply with NEMA DC 3 “Residential Controls - Electrical Wall-Mounted Room Thermostats”.

Voltage: 24 V.

[**Furnish setback/setup temperature control**].

Service: Cooling only.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Service: Heating only.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Service: Cooling and heating.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Service: [**One**] [**Two**]-step cooling and [**one**] [**two**]-step heating.

Covers: Locking with [**set point adjustment**] [**set point indication**] [**concealed set point**], [**with thermometer**] [**without thermometer**].

* + - * 1. Line Voltage Thermostats:

Selector Switch:

Integral.

Manual HAND-OFF-AUTO.

[**Single-**] [**or**] [**two-**]pole.

Dead Band: Maximum 2 degrees F (1 degree C).

Cover: Locking with [**set point adjustment**] [**set point indication**] [**concealed set point**], [**with thermometer**] [**without thermometer**].

* + - * 1. Room Thermostat Accessories:

Thermostat Covers: [**Brushed aluminum**] <**\_\_\_\_\_\_\_\_**>.

Furnish insulating bases for thermostats located on exterior walls.

Thermostat Guards:

Material: [**Metal**] [**Locking transparent plastic**] <**\_\_\_\_\_\_\_\_**>.

Mounting: On separate base from thermostat.

Adjusting Key: Manufacturer's standard.

Furnish aspirating boxes for flush-mounted thermostats[**, as indicated on Drawings**].

* + - * 1. Outdoor Reset Thermostat:

Type:

[**Remote bulb**] [**or**] [**bimetal rod and tube**].

Proportioning action, with adjustable throttling range and adjustable set point.

Scale Range: [**Minus 10 to 70**] [**<\_\_\_\_> to <\_\_\_\_>**] degrees F ([**2 to 35**] [**<\_\_\_\_> to <\_\_\_\_>**] degrees C).

* + - * 1. Immersion Thermostat:

Type:

[**Remote bulb**] [**or**] [**bimetal rod and tube**].

Proportioning action, with adjustable throttling range and adjustable set point.

* + - * 1. Airstream Thermostats:

Type:

[**Remote bulb**] [**or**] [**bimetal rod and tube**].

Proportional action, with adjustable set point in middle of range and adjustable throttling range.

Averaging Service Remote Bulb Element Length: [**7.5**] [**20**] <**\_\_\_\_\_\_\_\_**> feet ([**2.3**] [**6**] <**\_\_\_\_\_\_\_\_**> m).

Furnish flange and shield.

* + - * 1. Electric Low-Limit Duct Thermostat:

Type: Snap acting, single pole, single throw.

Reset: [**Manual**] [**Automatic**] switch, tripping when temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.

Bulb Length: Minimum [**20**] <**\_\_\_\_\_\_\_\_**> feet ([**6**] <**\_\_\_\_\_\_\_\_**> m).

Furnish one thermostat for every 20 sq. ft. (1.86 sq m) of coil surface.

* + - * 1. Electric High-Limit Duct Thermostat:

Snap acting, single pole, single throw, [**manual**] [**automatic**] reset switch tripping when temperature sensed across any 12-inch (300-mm) bulb length is equal to or above set point.

Bulb Length: Minimum [**20**] <**\_\_\_\_\_\_\_\_**> feet ([**6**] <**\_\_\_\_\_\_\_\_**> m).

Furnish one thermostat for every 20 sq. ft. (1.86 sq m) of coil surface.

* + - * 1. Fire Thermostats:

UL labeled.

Factory set according to NFPA 90A “Installation of Air-Conditioning and Ventilating Systems”.

Contacts: Normally closed.

Reset: Manual.

* + - * 1. Heating/Cooling Valve-Top Thermostats:

Type: Proportional acting for proportional flow.

Diaphragm: Molded rubber.

Element: [**Remote bulb,**] liquid filled.

Direct and reverse acting at differential pressure of [**25**] <**\_\_\_\_\_\_\_\_**> psi ([**172**] <**\_\_\_\_\_\_\_\_**> kPa).

Housing: Cast, with position indicator and adjusting knob.

* + - 1. TIME CLOCKS
         1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8132&mf=04&src=wd): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

IO HVAC Controls

Intermac

Approved equivalent.

Substitutions: [Section 016000 - Product Requirements] [Not permitted].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Subparagraphsubparagraph insert "State of \_\_\_\_\_\_\_\_ Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to <**\_\_\_\_\_\_\_\_**> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

* + - * 1. Timer: Seven-day programming switch timer, with synchronous timing motor and seven-day dial.
        2. Power Backup:

Continuously charged NiCad battery for power failure backup.

Carryover: Eight hours.

Trippers:

Multiple switch trippers to control systems for minimum of two and maximum of eight signals each day.

Furnish two normally open (NO) and two normally closed (NC) output switches.

Consider programmable clock for applications requiring more than one time clock.

* + - * 1. Control:

Description: Solid-state programmable time control with <**\_\_\_\_\_\_\_\_**> separate programs.

Carryover: 24-hour battery[**, duty cycling**].

Accessories: [**Individual HAND-OFF-AUTO switches for each program**] [**Seven-day programming**] [**365-day calendar with 20 programmable holidays**] [**Choice of failsafe operation for each program**] [**System fault alarm**] [**and**] <**\_\_\_\_\_\_\_\_**>.

* + - 1. ALARM SYSTEM
         1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8133&mf=04&src=wd):

Substitutions: [Section 016000 - Product Requirements] [Not permitted].

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=9748) Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

Honeywell

Johnson Controls

Trane Co.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Subparagraphsubparagraph insert "State of \_\_\_\_\_\_\_\_ Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to <**\_\_\_\_\_\_\_\_**> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

* + - * 1. Enclosure: Comply with NEMA 250 “Enclosures for Electrical Equipment (1000 Volts Maximum)”, Type [**1**] [**3**] [**4**] [**7**] [**9**] <**\_\_\_\_\_\_\_\_**>.
        2. Components:

Alarm Panel:

Individual indication, horn.

SILENCE-ACKNOWLEDGE switch.

TEST switch.

Remote Panels:

Duplicate functions of primary panel.

Alarm SILENCE-ACKNOWLEDGE switch, to acknowledge alarm from each panel.

Main Alarm Panel:

Dry contacts for use with remote alarm monitoring system to indicate [**each**] alarm condition.

* + - * 1. Control Sequences:

At alarm condition, light is energized to flash and [**audible alarm**] [**horn**] <**\_\_\_\_\_\_\_\_**> is energized.

[**Audible alarm**] [**Horn**] <**\_\_\_\_\_\_\_\_**> is de-energized when ACKNOWLEDGE switch is pushed.

System annunciates alarm conditions by continuous light until trouble condition has cleared.

Alarm is annunciated again if second alarm occurs before first alarm has cleared.

* + - 1. CONTROL AIR DAMPERS
         1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8134&mf=04&src=wd):

Substitutions: **[Section 016000 - Product Requirements] [Not permitted**].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Subparagraph insert "State of \_\_\_\_\_\_\_\_ Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to <**\_\_\_\_\_\_\_\_**> standards.

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=9665) Subject to compliance with requirements, provide products by one of the following:

Arrow United Industries.

Ruskin Company.

Approved equivalent.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

* + - * 1. Frames:

Materials: [**Galvanized steel**] [**Extruded aluminum**] [**Rolled carbon steel**] [**Stainless steel**], welded or riveted with corner reinforcement.

Minimum Thickness: [**12**] <**\_\_\_\_\_\_\_\_**> gage ([**2.7**] <**\_\_\_\_\_\_\_\_**> mm).

* + - * 1. Blades:

Material: [**Galvanized steel**] [**Extruded aluminum**] [**Rolled carbon steel**] [**Stainless steel**].

Blade Size:

Width: [**8**] [**6**] <**\_\_\_\_\_\_\_\_**> inches ([**200**] [**150**] <**\_\_\_\_\_\_\_\_**> mm).

Length: [**48**] <**\_\_\_\_\_\_\_\_**> inches ([**1.2**] <**\_\_\_\_\_\_\_\_**> m).

Minimum Thickness: [**22**] <**\_\_\_\_\_\_\_\_**> gage ([**0.85**] <**\_\_\_\_\_\_\_\_**> mm).

Attach to minimum 1/2-inch (13-mm) shafts with set screws.

* + - * 1. Seals:

Blades:

Material: [**Synthetic elastomeric**] [**Neoprene**].

[**Inflatable.**]

Mechanically attached.

Field replaceable.

Jambs: Stainless-steel spring.

Select appropriate shaft bearing type. Lubricant-free bearings are generally more expensive but may be better suited to higher pressure applications.

* + - * 1. Bearings:

Shaft: [**Oil-impregnated, sintered bronze**] [**Graphite-impregnated nylon sleeve, with thrust washers at bearings**] [**Lubricant-free, stainless steel, single row, ground, flanged, radial, antifriction type with extended inner race**] <**\_\_\_\_\_\_\_\_**>.

Linkage: [**Oil-impregnated, sintered bronze**] [**Graphite-impregnated nylon**] <**\_\_\_\_\_\_\_\_**>.

Following maximum air leakage rate is based on International Energy Conservation Code.

* + - * 1. Outside Air Damper Leakage: Maximum rate of [**3**] <**\_\_\_\_\_\_\_\_**> cfm per sq. ft. ([**0.13**] <**\_\_\_\_\_\_\_\_**> L/s per sq m) at [**1**] <**\_\_\_\_\_\_\_\_**>-inch wg ([**250**] <**\_\_\_\_\_\_\_\_**>-Pa) pressure differential.

Consider using one of following two Paragraphs for leakage rates for other air system dampers.

* + - * 1. Damper Leakage: Less than [**1**] [**0.5**] <**\_\_\_\_\_\_\_\_**> percent, based on approach velocity of 2,000 fpm (10 m/s) and 4-inch wg (1-kPa) pressure differential.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Damper Leakage: Maximum leakage rate of <**\_\_\_\_\_\_\_\_**> cfm per sq. ft. (<**\_\_\_\_\_\_\_\_**> L/s per sq m) at [**1**] <**\_\_\_\_\_\_\_\_**>-inch wg ([**250**] <**\_\_\_\_\_\_\_\_**>-Pa) pressure differential.
        2. Maximum Pressure Differential: 6-inch wg (1.5 kPa).
        3. Temperature Limits: Minus 40 to 200 degrees F (Minus 40 to 93 degrees C).
      1. ELECTRIC DAMPER ACTUATORS
         1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8135&mf=04&src=wd):

Substitutions: [Section 016000 - Product Requirements] [Not permitted].

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=9748) Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

Belimo

Bettis

Siemens

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Subparagraph insert "State of \_\_\_\_\_\_\_\_ Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to <**\_\_\_\_\_\_\_\_**> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

* + - * 1. Operation: [**Two position**] [**Reversing type, proportional motor**], [**spring return**] <**\_\_\_\_\_\_\_\_**>.
        2. Enclosure: Comply with NEMA 250 “Enclosures for Electrical Equipment (1000 Volts Maximum)”, Type [**1**] [**3**] [**4**] [**7**] [**9**] <**\_\_\_\_\_\_\_\_**>.
        3. Mounting: Direct.
        4. Stroke:

Full Stroke: 90 seconds, end to end.

Spring Return: 15 seconds, return to normal.

* + - * 1. Protection: Electronic stall.
        2. Electrical Characteristics:

Control Input: [**Zero to 10 V dc**] [**or**] [**zero to 20 mA dc**].

* + - * 1. Nominal Power: [**24**] [**120**] V ac.
        2. Torque: Sized for minimum 150 percent of required duty.
        3. Duty Cycle: Rated for 65,000 cycles.
        4. Accessories:

Cover-mounted transformer.

Auxiliary potentiometer.

Damper linkage.

Direct-drive feedback potentiometer.

Output position feedback.

Field-selectable, rotational, spring return direction.

Field-adjustable zero and span.

End switch.

* + - 1. CONTROL VALVES
         1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8136&mf=04&src=wd):

Substitutions: [Section 016000 - Product Requirements] [Not permitted].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Subparagraph insert "State of \_\_\_\_\_\_\_\_ Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to <\_\_\_\_\_\_\_\_> standards.

* + - * 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Johnson Controls, Inc.

Siemens Industry, Inc., Building Technologies Division.

Approved equivalent.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

* + - * 1. Globe Pattern:

2 Inches (50 mm) and Smaller:

Body and Trim: Bronze.

Stem: Rising.

Disc: Renewable composition.

End Connections: Screwed[**, with back seating capacity packable under pressure**].

2-1/2 Inches (65 mm) and Larger:

Body: Iron.

Trim: Bronze.

Stem: Rising.

Disc: Plug type; renewable.

Seats: Renewable.

End Connections: Flanged.

Hydronic Systems:

Service Pressure Rating: 125 psig (860 kPa) at 250 degrees F (121 degrees C).

Plugs and Seats: Replaceable; [**stainless steel**] [**brass**].

Indicate valve sizing criteria in following Subparagraphsubparagraph, or delete following Subparagraphsubparagraph and indicate valve pressure drop in schedule following END OF SECTION or in control valve schedule on Drawings.

Sizing:

Valves: [**3**] <**\_\_\_\_\_\_\_\_**> psi ([**20**] <**\_\_\_\_\_\_\_\_**> kPa) maximum pressure drop at design flow rate.

Two-Way Valve Actuators: Size to close valves against pump shutoff head.

Two-Way Valve Flow Characteristics: Equal percentage.

Steam Systems:

Service Pressure Rating: 125 psig (860 kPa) at 250 degrees F (121 degrees C).

Plugs and Seats: Replaceable; stainless steel.

Indicate valve sizing criteria in one of following three Subparagraphsubparagraphs, or delete following Subparagraphsubparagraphs and indicate valve pressure drop in schedule following END OF SECTION or in control valve schedule on Drawings.

Sizing: Pressure drop across steam valve as indicated on Drawings and at maximum flow rate.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Sizing: 10 psig (70 kPa) inlet pressure and 5 psi (35 kPa) pressure drop.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Sizing:

Low-Pressure Systems: Pressure drop across steam valve equal to 80 percent of inlet steam pressure and at maximum flow rate.

High-Pressure Systems: Pressure drop across steam valve equal to 42 percent of inlet steam pressure and at maximum flow rate.

Furnish valves with modified linear characteristics.

* + - * 1. Ball Valves:

Body: Forged brass.

Ball: Chrome-plated brass.

Stem: Blowout proof.

O-Rings:

Material: [**EPDM**] <**\_\_\_\_\_\_\_\_**>.

Minimum Pressure Rating: 600 psig (4.1 MPa).

Fluid Temperature Range: Minus 20 to 250 degrees F (Minus 29 to 121 degrees C).

Flow Characteristics:

Two-Way Valves: Equal percentage.

Three-Way Valves: Equal percentage through control port and linear through bypass port.

End Connections:

Threaded for two-way valves 3 inches (76 mm) and smaller.

Threaded for three-way valves 2 inches (50 mm) and smaller.

Indicate valve sizing criteria in following Subparagraphsubparagraph, or delete following Subparagraphsubparagraph and indicate valve pressure drop in schedule following END OF SECTION or in control valve schedule on Drawings.

Sizing:

Valves: [**3**] <**\_\_\_\_\_\_\_\_**> psi ([**20**] <**\_\_\_\_\_\_\_\_**> kPa) maximum pressure drop at design flow rate.

Two-Way Valve Actuators: Sized to close valves against pump shutoff head.

* + - * 1. Butterfly Valves:

Service Pressure Rating: 125 psig (860 kPa) at 250 degrees F (121 degrees C).

Body Style: [**Wafer**] [**or**] [**lug**].

Body and Bonnet: [**ASTM A126, cast iron**] [**or**] [**ASTM A536, ductile iron**].

Neck: Extended.

Stem: Stainless steel.

Sleeve and Stem Seals:

Material: [**EPDM**] [**or**] [**Buna-N**].

Field replaceable.

Disc: [**Bronze**] [**Aluminum bronze**] [**Stainless steel**].

Seat:

Resilient; replaceable.

Maximum Service Temperature: [**180**] [**250**] degrees F ([**82**] [**121**] degrees C).

Indicate valve sizing criteria in following Subparagraphsubparagraph, or delete following Subparagraphsubparagraph and indicate valve pressure drop in schedule following END OF SECTION or in control valve schedule on Drawings.

Sizing: [**1**] <**\_\_\_\_\_\_\_\_**> psi ([**7**] <**\_\_\_\_\_\_\_\_**> kPa) maximum pressure drop at design flow rate.

* + - * 1. Terminal Unit Control Valves:

Type: Two way or three way, as indicated [**in schedule following END OF SECTION**] [**on Drawings**].

Body: Brass, Class 250.

Ball: Nickel-plated brass, with optimizer insert for modulating applications.

Stem: Blowout proof.

End Connections: Threaded.

Actuator: Integral.

Spring-Return Valves: Required for unit ventilator heating valves and other terminal equipment with outside air.

Non-Spring-Return Valves: Furnish manual override capability built into actuator.

Fluid Temperature:

Minimum: 20 degrees F (Minus 7 degrees C).

Maximum: 250 degrees F (121 degrees C).

Two-Way and Three-Way Valve Flow Characteristics: Equal percentage.

Indicate valve sizing criteria in following Subparagraphsubparagraph, or delete following Subparagraphsubparagraph and indicate valve pressure drop in schedule following END OF SECTION or in control valve schedule on Drawings.

Sizing:

Valves: [**4**] <**\_\_\_\_\_\_\_\_**> psi ([**28**] <**\_\_\_\_\_\_\_\_**> kPa) maximum pressure drop at design flow rate.

Valve Actuators: Sized to close valves against pump shutoff head.

* + - 1. ELECTRIC VALVE ACTUATORS
         1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8137&mf=04&src=wd):

Substitutions: [Section 016000 - Product Requirements] [Not permitted].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Subparagraph insert "State of \_\_\_\_\_\_\_\_ Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to <**\_\_\_\_\_\_\_\_**> standards.

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13401) Subject to compliance with requirements, provide products by the following:

[Belimo Aircontrols (USA), Inc](http://www.specagent.com/Lookup?uid=123457112789).

[Honeywell](http://www.specagent.com/Lookup?uid=123457112790).

[Johnson Controls, Inc](http://www.specagent.com/Lookup?uid=123457121420).

[Siemens Industry, Inc., Building Technologies Division](http://www.specagent.com/Lookup?uid=123457121410).

[Valve Solutions, Inc](http://www.specagent.com/Lookup?uid=123457112793).

Approved equivalent.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

* + - * 1. Description: Fully factory assembled and sized to operate with sufficient reserve power to provide smooth modulating action or two-position action under every condition.
        2. Motor:

Type: [**Permanent-split capacitor**] [**or**] [**shaded pole**].

Gear Trains: Completely oil immersed and sealed.

Spring-Return Motors: Furnish integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, and feedback potentiometer.

* + - * 1. Actuator:

Description: Nonhydraulic design for minimum 100,000 full-stroke cycles at rated torque.

Type: Direct coupled.

Rating: Not less than twice thrust needed for actual operation of valve.

Coupling: V bolt and V-shaped, toothed cradle.

Overload Protection: [**Electronic overload**] [**or**] [**digital rotation-sensing circuitry**].

Failsafe Operation: Mechanical, spring-return mechanism.

Non-Spring-Return Actuators: Furnish external, manual gear release.

Spring-Return Actuators: Furnish manual override, taking no more than 10 turns completely.

Electrical Characteristics:

Two-Position Spring Return: 24 V [**ac**] [**or**] [**dc**]; maximum 10 VA.

Modulating: 24 V ac; maximum 15 VA.

Proportional Signal: [**2 to 10 V dc**] [**or**] [**4 to 20 mA dc**].

Position Feedback Signal: 2 to 10 V dc.

Temperature Rating: Minus 22 to 140 degrees F (Minus 30 to 60 degrees C).

Run Time: 200 seconds open and 40 seconds closed.

* + - * 1. Sizing: Size for torque required for valve closing at maximum pump differential pressure, regardless of water loop system pressures.
      1. OUTSIDE AIR MEASURING AND MODULATION DEVICE
         1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8138&mf=04&src=wd):

Substitutions: **[Section 016000 - Product Requirements] [Not permitted**].

* + - * 1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

Honeywell

Johnson Controls

Trane Co.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Subparagraphsubparagraph insert "State of \_\_\_\_\_\_\_\_ Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to <**\_\_\_\_\_\_\_\_**> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

Device velocity range is 300 to 2,000 fpm (1.5 to 10 m/s).

* + - * 1. Description: Factory-assembled damper, airflow monitor, actuator, and accessories.
        2. Performance and Design Criteria:

Temperature Rating: Minus 40 to 140 degrees F (Minus 40 to 60 degrees C).

Accuracy: Plus or minus 5 percent.

Maximum Leakage: [**2**] [**3**] <**\_\_\_\_\_\_\_\_**> cfm per sq. ft. ([**0.09**] [**0.13**] <**\_\_\_\_\_\_\_\_**> L/s per sq m) at [**1**] <**\_\_\_\_\_\_\_\_**>-inch wg ([**250**] <**\_\_\_\_\_\_\_\_**>-Pa) pressure differential.

Measurement Range: 15 percent to 100 percent of unit nominal airflow.

Adjusts airflow for temperature variations.

Signal: 2 to 10 V dc signal corresponding to actual airflow.

* + - * 1. Damper and Airflow Measurement Assembly Sizing: Accommodate [**minimum**] [**economizer**] outside airflow [**as indicated on Drawings**].
        2. Frame: Extruded aluminum.
        3. Blades:

Modulating Air Control:

Type: Airfoil shaped, single piece.

Action: Parallel.

Orientation: Horizontal.

Material: Heavy-gage 6063-T5 extruded aluminum.

Maximum Width: 5 inches (127 mm).

Stationary Sensing:

Type: Airfoil shaped, single piece.

Orientation: Horizontal.

Material: Heavy-gage 6063-T5 extruded aluminum.

Maximum Width: 5-1/4 inches (133 mm).

Finish: Anodized.

* + - * 1. Bearings: Self-lubricating molded synthetic sleeve, turning within extruded hole in frame.
        2. Seals:

Blade:

Extruded rubber.

Mechanically attached to blade edge.

Jamb:

Type: Flexible metal compression.

Material: Stainless steel.

Linkage: Concealed in frame.

Axles:

Minimum Diameter: 1/2 inch (13 mm).

Material: Plated steel.

Shape: Hex.

Mechanically attached to blade.

Mounting: Vertical.

Electric Actuator:

Type: Modulating, with position feedback.

24 V, 60 Hz.

* + - * 1. Digital Controller:

Description:

Programming logic and calibration in nonvolatile EPROM.

Controller: Generic zero- to 10-V dc inputs and outputs for interface to building automation system.

* + - * 1. Performance and Design Criteria:

Temperature Rating: Minus 40 to 140 degrees F (Minus 40 to 60 degrees C).

Accuracy: Plus or minus 5 percent.

Maximum Leakage: [**2**] [**3**] <**\_\_\_\_\_\_\_\_**> cfm per sq. ft. ([**0.09**] [**0.13**] <**\_\_\_\_\_\_\_\_**> L/s per sq m) at [**1**] <**\_\_\_\_\_\_\_\_**>-inch wg ([**250**] <**\_\_\_\_\_\_\_\_**>-Pa) pressure differential.

Measurement Range: 15 percent to 100 percent of unit nominal airflow.

Airflow adjusted for temperature variations.

Signal: 2 to 10 V dc, corresponding to actual airflow.

* + - * 1. Air-Straightener Section:

Depth: 3 inches (76 mm).

Sleeve:

Length: 5 inches (127 mm).

Attached to damper-airflow monitor frame.

* + - * 1. Finish: Mill aluminum.
        2. Accessories:

Actuator Heater: Facilitate actuator operation in minimum ambient temperature of minus 40 degrees F (minus 40 degrees C).

* + - 1. DIRECT DIGITAL CONTROL SYSTEM COMPONENTS
         1. Temperature Sensors:

Type: [**Resistance temperature detector**] [**or**] [**thermistor**].

Accuracy:

In following Subparagraphsubparagraph, consider a plus or minus 1 degree F (0.6 degree C) accuracy for standard applications and plus or minus 0.2 degree F (0.1 degree C) if high accuracy is required.

Plus or minus [**1**] [**0.2**] degree F ([**0.6**] [**0.1**] degree C).

Sensing Accuracy: Plus or minus 0.5 degree F (0.3 degree C).

Minimum Display Accuracy and Resolution: Plus or minus 1 degree F (0.6 degree C).

Communications Port: Built in.

Space Sensors:

Digital with LCD display, day-night override button, and set point slide adjustment override options.

Set Point Slide Adjustment: Capable of being software-limited by automation system, to limit amount of room adjustment.

Outside Air Sensors:

Inlet Fitting: Watertight.

Furnish with shield for protection from direct sunlight.

Duct Temperature Sensors:

Type: Rigid or averaging, as indicated in sequence of operations.

Averaging Sensor Minimum Length: 5 feet (1.5 m).

Duct Cross Sections Greater than 10 sq. ft. (0.9 sq m): Serpentine averaging element to sense stratified air temperatures.

Piping Temperature Sensors: Separable brass well.

* + - * 1. Humidity Sensors:

Type: [**Capacitance**] [**or**] [**bulk polymer, resistance**].

Maximum Drift: 3 percent of full scale per year.

Room Sensors:

Sensing Range: [**Zero to 100**] [**20 to 80**] percent.

Accuracy of plus or minus [**5**] <**\_\_\_\_\_\_\_\_**> percent relative humidity.

Duct Sensors:

Sensing Range: [**Zero to 100**] [**20 to 80**] percent.

Accuracy of plus or minus [**5**] <**\_\_\_\_\_\_\_\_**> percent relative humidity.

Accessories:

Sampling chamber.

Element guard.

Mounting plate.

Outdoor Air Humidity Sensors:

Sensing Range: 20 to 95 percent relative humidity.

Suitable for ambient conditions of minus 40 to 170 degrees F (minus 40 to 77 degrees C).

Accuracy: Plus or minus 2 percent relative humidity at 77 degrees F (25 degrees C).

Accessories:

Element guard.

Mounting plate.

* + - * 1. Differential Pressure Switches:

Description:

As specified in sequences of operation for status purposes in air and water applications.

UL listed; SPDT snap acting; pilot-duty rated at minimum 125 VA.

Settings: Fully adjustable.

Enclosure: Comply with NEMA 250 “Enclosures for Electrical Equipment (1000 Volts Maximum)”, Type [**1**] <**\_\_\_\_\_\_\_\_**>.

Scale Range: <**\_\_\_\_**> to <**\_\_\_\_**> psig (<**\_\_\_\_**> to <**\_\_\_\_**> kPa).

Differential: <**\_\_\_\_\_\_\_\_**> psi (<**\_\_\_\_\_\_\_\_**> kPa).

* + - * 1. Static Pressure Sensor:

Description:

Nondirectional sensor with suitable range for expected input.

Temperature compensated.

Accuracy: Plus or minus 1 percent of full scale, with repeatability of 0.5 percent.

Output: [**4 to 20 mA**] [**or**] [**zero to 5 V dc**] [**zero to 10 V dc**].

Building Static Pressure Range:

[**Minus 0.1 to 0.1**] [**Minus 0.25 to 0.25**] [**Minus 0.5 to 0.5**] [**Minus 1 to 1**]-inch wg ([**Minus 25 to 25**] [**Minus 60 to 60**] [**Minus 125 to 125 Pa**] [**Minus 250 to 250**] Pa).

Jumper selectable.

Duct Static Pressure Range:

[**Zero to 1**] [**Zero to 2.5**] [**Zero to 5**] [**Zero to 10**]-inch wg ([**Zero to 250**] [**Zero to 620**] [**Zero to 1 245**] [**Zero to 2 490**] Pa).

Jumper adjustable.

* + - * 1. Static Pressure Sensors:

Type: Differential pressure.

Sensor Range:

Closely match to system static pressure.

[**Minus 0.5 to 0.5**] [**Minus 1 to 1**] [**Zero to 2.5**]-inch wg ([**Minus 125 to 125**] [**Minus 250 to 250**] [**Zero to 620**] Pa).

Accuracy: Plus or minus 5 percent of sensing range.

* + - * 1. Airflow Switches:

Description: UL listed; SPDT snap acting; pilot-duty rated at minimum 125 VA.

Type: Paddle or differential pressure, as indicated in sequences of operation.

Scale Range: <**\_\_\_\_**> to <**\_\_\_\_**> ft./min (<**\_\_\_\_**> to <**\_\_\_\_**> m/s).

Differential: <**\_\_\_\_\_\_\_\_**> ft./min (<**\_\_\_\_\_\_\_\_**> m/s).

Sensitivity: Adjustable.

Enclosure: Comply with NEMA 250 “Enclosures for Electrical Equipment (1000 Volts Maximum)”, Type [**1**] <**\_\_\_\_\_\_\_\_**>.

* + - * 1. Water Flow Switches:

Description: UL Listed; SPDT snap acting; pilot-duty rating at minimum 125 VA.

Type: Paddle with stainless-steel or bronze paddle.

Scale Range: <**\_\_\_\_**> to <**\_\_\_\_**> ft./min (<**\_\_\_\_**> to <**\_\_\_\_**> m/s).

Differential: <**\_\_\_\_\_\_\_\_**> ft./min (<**\_\_\_\_\_\_\_\_**> m/s).

Sensitivity: Adjustable.

Enclosure: Comply with NEMA 250 “Enclosures for Electrical Equipment (1000 Volts Maximum)” Type [**1**] <**\_\_\_\_\_\_\_\_**>.

Furnish vaporproof type for chilled water applications.

* + - * 1. Carbon Monoxide Detectors:

Description: Single- or multi-channel, dual-level detectors, using solid-state sensors with three-year minimum life.

Temperature Range: 23 to 130 degrees F (Minus 5 to 54 degrees C).

Calibrated Setting: 50 and 100 ppm, with maximum 120-second response time to 100 ppm of carbon monoxide.

* + - * 1. Carbon Dioxide Sensors:

Description: Design for indoor carbon dioxide levels, according to ASHRAE 62.1 “Ventilation for Acceptable Indoor Air Quality”.

Linear Output: 4 to 20 mA dc over range of zero to 2,000 ppm of carbon dioxide, for interface to direct digital control system.

Duct-Mounted Sensors: Airtight enclosure and sampling tube.

* + - * 1. Carbon Dioxide Sensor and Transmitter:

Description: Single detector, using solid-state infrared sensors.

Temperature Range: 23 to 130 degrees F (Minus 5 to 54 degrees C).

Calibrated Setting: Zero to 2 percent, with continuous or averaged reading.

Output: 4 to 20 mA dc.

Mounting: Wall.

* + - * 1. Oxygen Sensor and Transmitter:

Description: Single detector, using solid-state zircon cell sensing.

Temperature Range: Minus 32 to 1,100 degrees F (Zero to 590 degrees C).

Calibrated Setting: Zero to 5 percent, with continuous or averaged reading.

Output: 4 to 20 mA dc.

Mounting: Wall.

* + - * 1. Refrigerant Detectors:

Description: Dual-level detectors, using solid-state sensors.

Alarm:

Preset: 300 ppm.

Indicator light.

SILENCE switch and light.

TEST switch and light.

TROUBLE light.

Auxiliary Relay: Preset for 150 ppm.

* + - * 1. Occupancy Sensor:

Type: Passive infrared.

Mounting: Flush.

Accessories:

Time delay.

Daylight sensor lockout.

Sensitivity control.

180-degree field of view, with vertical sensing adjustment.

* + - 1. DUCT-MOUNTED SMOKE DETECTOR

Coordinate specifying of smoke detectors with fire detection and alarm system located in Division 28 {13}. Duct-mounted smoke detectors need to be compatible with fire detection and alarm system.

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8140&mf=04&src=wd):

Substitutions: [Section 016000 - Product Requirements] [Not permitted].

* + - * 1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

Honeywell

Johnson Controls

Trane Co.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

* + - * 1. Comply with NFPA 72 “National Fire Alarm and Signaling Code”.
        2. Type: [**Ionization**] [**Photoelectric**].
        3. Furnish [**two-wire detector with common**] [**four-wire detector with separate**] power supply and signal circuits.
        4. Accessories:

Auxiliary SPDT relay contact.

Key-operated NORMAL-RESET-TEST switch.

Duct sampling tubes extending width of duct.

Visual indicator for detector actuation.

Duct-mounted housing.

* + - 1. DIFFERENTIAL PRESSURE MONITOR
         1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=8139&mf=04&src=wd):

Substitutions: **[Section 016000 - Product Requirements] [Not permitted**].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Subparagraph insert "State of \_\_\_\_\_\_\_\_ Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to <**\_\_\_\_\_\_\_\_**> standards.

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=9789) Subject to compliance with requirements, provide products by the following:

Dwyer Instruments, Inc.

Approved equivalent.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

* + - * 1. Description: Through-the-wall measurement of differential pressure.
        2. Digital Display:

Differential pressure in inches (Pa).

State of pressure mode.

HIGH PRESSURE alarm.

LOW PRESSURE alarm.

General failure.

Status of door switch.

Anteroom status.

* + - * 1. Accessories:

Keyed switch to change mode from positive to negative to neutral.

LED indicator for normal and alarm status.

[**Audible alarm**] [**Horn**] <**\_\_\_\_\_\_\_\_**> indicating alarm condition, with silencing button.

Communications port.

[**One remote pressure transmitter**] [**Two remote pressure transmitters**].

Auxiliary alarm relay output.

Door switch contact.

Calibration tool.

* + - 1. OPERATION
         1. Electrical Characteristics: As specified in Section 260503 - Equipment Wiring Connections and following:

[**<\_\_\_\_\_\_\_\_> hp (<\_\_\_\_\_\_\_\_> W)**] [**<\_\_\_\_\_\_\_\_> rated load amperes**].

Voltage: <**\_\_\_\_\_\_\_\_**> V, [**single**] [**three**] phase, 60 Hz.

Maximum [**Fuse Size**] [**Circuit Breaker Size**] [**Overcurrent Protection**]: <**\_\_\_\_\_\_\_\_**> A.

Minimum Circuit Ampacity: <**\_\_\_\_\_\_\_\_**>.

Minimum Power Factor: <**\_\_\_\_\_\_\_\_**> percent at rated load.

* + - * 1. Motors: As specified in Section 230513 - Common Motor Requirements for HVAC Equipment.
        2. Disconnect Switch: Factory mounted [**in control panel**] [**on equipment**].

1. EXECUTION
   * + 1. EXAMINATION
          1. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.
          2. Verify that pneumatic tubing is clear of water, oil, and other contaminants.
          3. Verify that compressed-air supply has operating filter and dryer before installing control devices or actuators.
          4. Verify that air-handling units and ductwork installation has been completed and that air filters are in place before installing sensors in airstreams.
          5. Verify locations of thermostats[**, humidistats,**] and other exposed control sensors with Drawings before installation.
          6. Verify that building systems to be controlled are ready to operate.
       2. INSTALLATION
          1. Tubing:

In mechanical rooms, install [**bundled plastic tubing with junction boxes**] [**or**] [**single plastic tubing within tray or raceway**].

Install tubing concealed from view in [**finished**] [**occupied**] <**\_\_\_\_\_\_\_\_**> spaces.

Install tubing exposed only in [**mechanical rooms**] [**storage rooms**] <**\_\_\_\_\_\_\_\_**> [**and**] [**other unfinished spaces**].

Mechanically attach tubing to supporting surfaces.

Install minimum 1-inch (25-mm) tubing sleeves through concrete surfaces, extended 6 inches (150 mm) above floors and 1 inch (25 mm) below bottom surface of slabs.

Purge tubing with dry, oil-free compressed air before connecting control instruments.

Consider using following Subparagraphsubparagraph for heating or chilled water systems to charge the system expansion tank.

Install instrument air tubing with check and hand valves to expansion tanks, using Schrader fittings and hose.

Install instrument air tubing with check and hand valves to [**chiller**] <**\_\_\_\_\_\_\_\_**>.

Copper Tubing:

Install copper tubing in mechanical rooms at following locations:

Where tubing may be subject to damage.

Where tubing may be subject to ambient temperature exceeding 200 degrees F (93 degrees C).

Where tubing is to be installed adjacent to heating pipes passing through common sleeve.

Where tubing may not be readily accessible.

[**Solder**] [**Braze**] copper tubing joints, except at instruments and equipment.

Install compression fittings at instruments and equipment.

* + - * 1. [**Thermostats**] [**Humidistats**] [**Space Temperature Sensors**] <**\_\_\_\_\_\_\_\_**> [**and**] [**Other Exposed Control Sensors**]:

Install after locations have been coordinated with other work.

Install [**60**] [**48**] [**42**] inches ([**1.5**] [**1.2**] [**1.05**] m) above floor.

Align with light switches [**and**] <**\_\_\_\_\_\_\_\_**>.

* + - * 1. Thermostats:

Install freeze-protection thermostats using flanges and element holders.

Install outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors [**with sun shield**].

Provide separable sockets for liquids and flanges for air bulb elements, as specified in Section 232116 - Hydronic Piping Specialties.

In following two Subparagraphsubparagraphs, edit list of locations or indicate on Drawings.

Install thermostats in aspirating boxes in [**public areas**] [**entrances**] [**handball courts**] [**gymnasiums**] [**high security areas**] [**and**] <**\_\_\_\_\_\_\_\_**>[**, and as indicated on Drawings**].

Install guards on thermostats in [**public areas**] [**entrances**] [**handball courts**] [**gymnasiums**] [**high security areas**] [**and**] <**\_\_\_\_\_\_\_\_**>[**, and as indicated on Drawings**].

* + - * 1. Control Panels:

Install control panels adjacent to associated equipment on vibration-free walls or freestanding supports.

[**Use one cabinet for more than one system in same equipment room**] [**Use one cabinet for each system**].

Install engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face, as specified in Section 230553 - Identification for HVAC Piping and Equipment.

Label with appropriate equipment or system designation as specified in Section 230553 - Identification for HVAC Piping and Equipment.

Install HAND-OFF-AUTO switches to override automatic interlock controls when switch is in HAND position.

* + - * 1. Install conduit and electrical wiring as specified in Section 260503 - Equipment Wiring Connections.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following Paragraph insert "State of \_\_\_\_\_\_\_\_ Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

* + - * 1. Installation Standards: Install Work according to <**\_\_\_\_\_\_\_\_**> standards.
      1. FIELD QUALITY CONTROL
         1. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
        2. After completion of installation, test and adjust control equipment.
        3. Submit data showing set points and final adjustments of controls.
        4. Test pneumatic systems to maximum system pressure of 30 psig (200 kPa).
        5. Calibration:

Check calibration of instruments.

Recalibrate instruments out of calibration.

Replace defective instruments.

* + - * 1. Manufacturer Services: Furnish services of manufacturer’s representative experienced in installation of products furnished under this Section for not less than <**\_\_\_\_\_\_\_\_**> [**days**] [**hours**] on-Site for installation, inspection, field testing, and instructing Director’s Representative’s personnel in maintenance of equipment.
        2. Equipment Acceptance:

Adjust, repair, modify, or replace components failing to perform as specified, and rerun tests.

Make final adjustments to equipment under direction of manufacturer's representative.

* + - * 1. Furnish Installation Certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.
      1. DEMONSTRATION
         1. Section 017000 - Execution and Closeout Requirements: Requirements for demonstration and training.
         2. Demonstrate complete operation of systems, including sequence of operation, equipment startup, shutdown, routine maintenance, and emergency repair procedures, to Director’s Representative's personnel.
      2. MAINTENANCE
         1. Section 017000 - Execution and Closeout Requirements: Requirements for maintenance service.

Evaluate need for maintenance- and emergency-service-based Project requirements. If desired, retain following Paragraphs.

* + - * 1. Provide service and maintenance of control system for [**one year**] [**<\_\_\_\_\_\_\_\_> years**] from date of Substantial Completion.
        2. Furnish complete service of controls systems, including callbacks.
        3. Inspections:

Perform minimum of <**\_\_\_\_\_\_\_\_**> complete normal inspections of approximately <**\_\_\_\_\_\_\_\_**> hours' duration in addition to normal service calls to inspect, calibrate, and adjust controls.

Furnish [**two**] [**four**] <**\_\_\_\_\_\_\_\_**> complete subsequent inspections [**per year**] [**, one in each season,**] to inspect, calibrate, and adjust controls.

Submit written report after each inspection.

* + - * 1. Examine unit components [**weekly**] [**semimonthly**] [**monthly**] [**bimonthly**], and clean, adjust, and lubricate equipment.
        2. Provide systematic examination, adjustment, and lubrication of unit and controls checkout and adjustments.
        3. Repair or replace parts according to manufacturer's operating and maintenance data, using parts produced by manufacturer of original equipment.
        4. Perform Work without removing units from service during normal building occupied hours.
        5. Provide emergency callback service [**at all hours**] [**during working hours**] for this maintenance period.
        6. Replacement Parts:

Maintain adequate stock of parts [**locally**] [**near place of the Work**], for replacement or emergency purposes.

Ensure personnel availability to fulfill parts service without unreasonable loss of time.

* + - * 1. Perform Work using personnel under supervision [**and in direct employ**] of manufacturer or original installer.
        2. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of [**Director’s Representative**] <**\_\_\_\_\_\_\_\_**>.

END OF SECTION 230900