PART 1 - GENERAL

1.01 SUMMARY
   A. Section includes tubing, switches, sensors, and transmitters.

1.02 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings:
      1. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.03 CLOSEOUT SUBMITTALS
   A. Operation and maintenance data.

PART 2 - PRODUCTS

2.01 COPPER TUBING
   A. Copper Tube: ASTM B 360 Hard drawn copper.

2.02 AIR-PRESSURE SENSORS
   A. Duct Insertion Static Pressure Sensor:
      1. Insertion length shall be at 6 inches.
      2. Sensor with four radial holes of 0.04-inch diameter.
      4. Sensor with threaded end support, sealing washers and nuts.
      6. Suitable for flat oval, rectangular, and round duct configurations.
   B. Outdoor Static Pressure Sensor:
      1. Provides average outdoor pressure signal.
      2. Sensor with no moving parts.
      3. Kit includes sensor, copper tubing mounting hardware.
   C. Space Static Pressure Sensor for Wall Mounting:
      1. 100-micron filter mounted in stainless-steel wall plate senses static pressure.
      2. Wall plate provided with gasket and screws, and sized to fit standard single-gang electrical box.

2.03 AIR-PRESSURE SWITCHES
   A. Air-Pressure Differential Switch:
      1. Diaphragm operated to actuate an SPDT snap switch.
      2. Electrical Connections: Three-screw configuration, including one screw for common operation and two screws for field-selectable normally open or closed operation.
      3. Enclosure Conduit Connection: Knock out or threaded connection.
      4. User Interface: Screw-type set-point adjustment located inside removable enclosure cover.
5. High and Low Process Connections: 1/4” copper tubing.

6. Enclosure:
   a. Dry Indoor Installations: NEMA 250, Type 1.
   b. Outdoor and Wet Indoor Installations: NEMA 250, Type 4.

7. Operating Data:
   a. Electrical Rating: 15 A at 120- to 480-V ac.
   b. Pressure Limits:
      1) Continuous: 45 inches wg.
      2) Surge: 10 psig.
   c. Temperature Limits: Minus 30 to 180 deg F.
   d. Operating Range: Approximately 2 times set point.
   e. Repeatability: Within 3 percent.
   f. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.04 AIR-PRESSURE TRANSmitters

A. Air-Pressure Differential Transmitter:

1. Performance:
   a. Range: Approximately 2 times set point.
   b. Accuracy: Within 0.5 percent of the span at reference temperature of 70 deg F.
   c. Hysteresis: Within 0.02 percent of the span.
   d. Repeatability: Within 0.05 percent of the calibrated span.
   e. Stability: Within 0.25 percent of span per year.
   f. Overpressure: 15 psig.
   g. Temperature Limits: Minus 20 to 160 deg F.
   h. Compensate Temperature Limits: 35 to 135 deg F.
   i. Thermal Effects: 0.015 percent of full scale per degree F.
   j. Warm-up Time: Within 5 seconds.
   k. Response Time: One second.
   l. Shock and vibration shall not harm the transmitter.

2. Output Signals:
   a. Analog Current Signal:
      1) Two-wire, 4- to 20-mA dc current source.
      2) Signal capable of operating into 1000-ohm load.
   b. Analog Voltage Signal:
      1) Three wire, zero to 6 V.
      2) Minimum Load Resistance: 1000 ohms.

3. Operator Interface:
   a. Zero and span adjustments within 10 percent of full span.
   b. Potentiometer adjustments located on face of transmitter.

4. Construction:
   a. Type 300 stainless-steel enclosure.
   b. Swivel fittings for connection to copper tubing or barbed fittings for connection to polyethylene tubing. Fittings on front of instrument enclosure.
   c. Screw terminal block for wire connections.
   d. Vertical plane mounting.
   e. NEMA 250, Type 2.
   f. Mounting Bracket: Appropriate for installation.
   g. Reverse wiring protected.
   h. Calibrate to NIST-traceable standards and provide each transmitter with a certificate of calibration.
B. Air-Pressure Differential Indicating Transmitter:
   1. Performance:
      a. Range: Approximately 2 times set point.
      b. Accuracy Including Hysteresis and Repeatability: Within 1 percent of full scale at 77 deg F.
      c. Stability: Within 1 percent of full scale per year.
      d. Overpressure: 10 psig.
      e. Temperature Limits: 20 to 120 deg F.
      f. Thermal Effects: 0.055 percent of full scale per degree F.
   2. Display: Four-digit digital display with minimum 0.4-inch high numeric characters.
   3. Operator Interface:
      a. Zero and span adjustments.
      b. Selectable engineering units.
   4. Analog Output Current Signal:
      a. Two-wire, 4- to 20-mA dc current source.
      b. Signal capable of operating into a 1200-ohm load.
   5. Construction:
      a. Plastic casing with clear plastic cover.
      b. Integral fittings for copper tubing connections on side of instrument case for high- and low-pressure connections.
      c. Terminal block for wire connections.
      d. Vertical plane mounting.
      e. NEMA 250, Type 1.
      f. Nominal 4-inch diameter face.
      g. Mounting Bracket: Appropriate for installation.

2.05 AIR TEMPERATURE SWITCHES

A. Thermostat and Switch for Low Temperature Control in Duct Applications:
   1. Description:
      a. Two-position control.
      b. Field-adjustable set point.
      d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Performance:
      a. Operating Temperature Range: 15 to 55 deg F.
      b. Temperature Differential: 5 deg F, non-adjustable and additive.
      c. Enclosure Ambient Temperature: Minus 20 to 140 deg F.
      d. Sensing Element Maximum Temperature: 250 deg F.
      e. Voltage: 120-V ac.
      f. Current: 16 FLA.
      g. Switch Type: Two SPDT snap switches operate on coldest 12-inch section along element length.
   3. Construction:
      a. Vapor-Filled Sensing Element: Nominal 20 feet long.
      b. Dual Temperature Scale: Fahrenheit and Celsius visible on face.
      c. Set-Point Adjustment: Screw.
      d. Enclosure: Painted metal, NEMA 250, Type 1.
      e. Electrical Connections: Screw terminals.
      f. Conduit Connection: 1/2-inch trade size.
B. Thermostat and Switch for High Temperature Control in Duct Applications:
   1. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.
   2. Description:
      a. Two-position control.
      b. Field-adjustable set point.
      d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   3. Performance:
      a. Temperature Range: 100 to 160 deg F.
      b. Temperature Differential: 5 deg F.
      c. Ambient Temperature: Zero to 260 deg F.
      d. Voltage: 120-V ac.
      e. Current: 16 FLA.
      f. Switch Type: SPDT snap switch.
   4. Construction:
      b. Enclosure: Metal, NEMA 250, Type 1.
      c. Electrical Connections: Screw terminals.
      d. Conduit Connection: 1/2-inch trade size.

2.06 AIR TEMPERATURE TRANSMITTERS

A. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.

B. House electronics in NEMA 250 enclosure.
   1. Duct: Type 1
   2. Outdoor: Type 4.
   3. Space: Type 1.

C. Conduit Connection: 1/2-inch

D. Functional Characteristics:
   1. Input:
      a. 100-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.
      b. 1000-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.
   2. Span (Adjustable):
      a. Space: 40 to 90 deg F.
      b. Supply Air Cooling and Heating: 40 to 120 deg F.
      c. Supply Air Cooling Only: 40 to 90 deg F.
      d. Supply Air Heating Only: 40 to 120 deg F.
      e. Exhaust Air: 50 to 100 deg F.
      f. Return Air: 50 to 100 deg F.
      g. Mixed Air: Minus 40 to 140 deg F.
      h. Outdoor: Minus 40 to 140 deg F.
   3. Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc.
   4. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F.
   5. Match sensor with temperature transmitter and factory calibrate together.
E. Performance Characteristics:
1. Calibration Accuracy: Within 0.1 percent of the span.
2. Stability: Within 0.2 percent of the span for at least 6 months.
3. Combined Accuracy: Within 0.5 percent.

2.07 MOISTURE SWITCHES

A. Humidistat for Duct Applications:
1. Description:
   a. Two-position control.
   b. Field-adjustable set point.
   c. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Performance:
   a. Relative Humidity Range: 15 to 95 percent.
   b. Relative Humidity Differential: 5 percent.
   c. Ambient Temperature: 40 to 135 deg F.
   d. Voltage: 120-V ac.
   e. Current: 7.2 FLA.
   f. Switch Type: SPDT snap switch.

3. Construction:
   a. Enclosure: Metal, NEMA 250, Type 1.
   b. Electrical Connections: Screw terminals.

B. Humidistat for Space Applications:
1. Description:
   a. Two-position control.
   b. Field-adjustable set point.
   c. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Performance:
   a. Relative Humidity Range: 10 to 90 percent.
   b. Relative Humidity Differential: 5 percent.
   c. Ambient Temperature: 40 to 135 deg F.
   d. Voltage: 24-V ac.
   e. Pilot Duty: 60 VA.
   f. Switch Type: SPDT snap switch.

3. Construction:
   a. Enclosure: Plastic, NEMA 250, Type 1.
   b. Electrical Connections: Cable, 6 inches long.

2.08 MOISTURE SENSORS AND TRANSMITTERS

A. Sensor and Transmitter:
1. Performance:
   a. Relative Humidity Range: Zero to 100 percent.
   b. Accuracy: Within 2 percent.
   c. Operating Temperatures: Minus 30 to 130 deg F.
   d. Hysteresis: Within 1 percent.

2. Construction:
   a. Duct-type sensor for duct-mounted applications. Integral-type sensor for room or space applications.
   b. Sensor Body: 300 series stainless steel, 6 inches long for duct-mounted applications.
   c. For outdoor and duct applications, install circuitry in a NEMA 250, Type 4 or 4X enclosure.
3. Output Signal:
   a. Two-wire, 4- to 20-mA output signal with a drive capacity of at least 600 ohms at 24-V dc.
   b. Non-interacting zero and span adjustments.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL
A. All devices that require sensing tubes shall use 1/4” min diameter hard drawn copper properly attached with copper clips or compression fittings. No polymer tubing allowed.
B. Install products level, plumb, parallel, and perpendicular with building construction.
C. Properly support instruments, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 25 lb force.
D. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
E. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.02 ELECTRIC POWER
A. Furnish and install electrical power to products requiring electrical connections.
B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Safety Switches."
C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Conductors."
D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.03 INSTRUMENTS INSTALLATION
A. Mounting Location: Rough-in instrument-mounting locations before setting instruments and routing, cable, wiring, copper tubing, and conduit to final location.
B. Mounting Height:
   1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
   2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code, state, and Federal accessibility requirements within a range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform. Make every effort to mount at 60 inches.

3.04 CHECKOUT PROCEDURES
A. Check installed products before continuity tests and calibration.
B. Check instruments for proper location and accessibility.
C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.
3.05 DEMONSTRATION

A. Train Owner’s maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

B. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.

C. Record videos on DVD disks.

D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION