SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

2.8 ELECTRONIC SENSORS

A. Manufactured, brand labelled or distributed by Belimo.

B. The manufacturer shall warrant all components for a period of 5 years, except where noted, from the date of production with the first two years unconditional. Carbon dioxide and humidity sensing elements shall have a 2 year calibration warranty.

C. Duct, Pipe and Outdoor Sensors
   1. General: Sintered connections to protect against moisture and vibration, elements encased in epoxy resin with a fluidized bed coating, temperature sensing element joined to wire insulation.
   2. Elements:
      a. Thermistor Temperature Sensors:
         1) Accuracy: +/- **0.35 F (0.2 C)** at **77° F (25° C)** reference.
      b. Resistance Temperature Detector (RTD):
         1) Passive Accuracy: PT 1/3 DIN, Class B, +/- **0.5°F (0.3 °C)** at **32°F (0 °C)** reference;
         2) Active Accuracy: +/- 1% at **70°F (21° C)** reference and +/- 2.5% of the upper value of the selected range.
      c. Capillary Tube (low limit detection only): Copper material.
   3. Configurations:
      a. Integral Insertion: Stainless steel probe;
      b. Cable: Stainless steel probe fitted to single shielded pair, plenum rated to **302 °F (150 °C)** 22AWG, tinned copper, green jacket, 300V;
      c. Averaging: Single continuous sensing element for the entire length or multi-nodal.
   4. Outputs:
      a. Passive:
         1) Resistance: Thermistor or RTD.
      b. Active:
         1) Current: 4-20mA;
         2) Voltage: 0-5 or 0-10 VDC.
   5. Hardware:
      a. Provide mounting hardware kits with complete assembly.
   6. Accessories:
      a. Provide with weather/solar shield for outdoor installations.
   7. Agency Listings:
      a. UL listed: cULus acc. to UL60730-1A/-2-9/-2-13, CAN/CSA E60730-1:02/-2-9, CE acc. to 2004/108/EC and 2006/95/EC, NEMA 4X, IP65, UL Enclosure Type 4X.

D. Humidity Sensors:
   1. General: Provide active relative humidity sensors in conjunction with active carbon dioxide and/or passive temperature sensing elements for indoor and/or outdoor installations;
   2. Element: Complementary Metal Oxide Semiconductor (CMOS) type.
   3. Accuracy: +/- 2% of relative humidity between 10% and 90% relative humidity range.
   4. Configurations:

a. Duct Mount: Provide probe with stainless steel wire mesh filter and adjustable mounting flange.
b. Surface Mount (outside air): Provide with enclosure suitable for temperatures **minus 31** to **plus 160 ° F [(minus 35 to plus 70 ° C)]** and detectable mounting plate.

5. Outputs:
   a. Passive:
      1) Resistance: Thermistor or RTD.
   b. Active (Relative Hunidity):
      1) Current: 4-20mA;
      2) Voltage: 0-5 or 0-10 VDC;
      3) Addressable: BACnet MS/TP or Modbus RTU.
6. Agency Listings:
   a. UL listed: cULus acc. to UL60730-1A/-2-9/-2-13, CAN/CSA E60730-1:02/-2-9, CE acc. to 2004/108/EC and 2006/95/EC, NEMA 4X, IP65, UL Enclosure Type 4X.

E. Room Sensors
1. General: Provide room sensing units with passive temperature or integral active temperature, relative humidity (dew point), and carbon dioxide elements as indicated.
2. Elements:
   a. Temperature:
      1) Thermistor Temperature Sensors:
         Accuracy: +/-**0.35 F (0.2 C)** at **77° F (25° C)**.
      2) Resistance Temperature Detector (RTD):
         Accuracy (passive): PT 1/3 DIN, Class B, +/- **0.5 °F (0.3°C)** at **32 °F (0 °C)** reference; Accuracy (active): +/- 1% at **70 °F (21 °C)** reference.
      3) Wall Coupling Factor: 35% or better.
   b. Relative Humidity
      1) CMOS type;
      2) Accuracy: +/- 2% of relative humidity between 10% and 90% of relative humidity range and transducer error in a temperature range of **32 to 122 °F (0 °C to 50 °C)**.
   c. Carbon Dioxide
      1) Non-dispersive infrared (NDIR) type ;
      2) Accuracy: 50 ppm and +/- 3% of measured CO_2 value and transducer error;
      3) Calibration: Dual channel technology.
3. Manual Override:
   a. Passive: Provide for all units;
   b. Active: Provide as indicated.
4. Interface:
   a. Provide Near Field Communication (NFC) for all active units for equipment set-up, installation, and/or commissioning.
5. Outputs:
   a. Passive:
      1) Resistance: Thermistor or RTD.
   b. Active (temperature, relative humidity, dew point, carbon dioxide):
      1) Voltage: 0-5, 0-10 (MP-Bus), or 2-10 VDC;
6. Enclosures:
   a. Rating: NEMA 1/IP30
   b. Color: White, RAL 9003.
   c. Orientation: Vertical.
   d. Passive Sensor Unit:

1) Cover: [**Manufacturer's standard**] [**Blank Stainless Steel Wall Plate**]
2) Set-Point Adjustment: **[N/A] [Exposed].**

e. Active Sensor Unit:
1) Cover: Manufacturer's standard.

F. Condensation Detector
1. General: Detects condensation on exterior piping surfaces, switch output changes state at piping surface dew point.
2. Element: Two (2) interdigitated electrodes on an aluminum core substrate
3. Range: 10-90% rH
4. Configurations: Surface mount
a. Integral (spring loaded)
b. Remote: Cable connection
5. Outputs:
a. SPDT relay, switching current 1A at 24V (maximum), 5mA at 10V (minimum)
b. LED (local) indication
6. Agency Listings:
a. UL listed: cULus acc. to UL60730-1A/-2-9/-2-13, CAN/CSA E60730-1:02/-2-9, CE acc. to 2004/108/EC and 2006/95/EC, NEMA 4X, IP65, UL Enclosure Type 4X.

G. Pressure Switches Transmitters and Transducers:
1. Differential Air Pressure
a. General: Electromechanical diaphragm type, suitable for air and non-combustible gases with relative humidity 0-95% non-condensing, **5 to 140 °F (-15 to 60 °C)** ambient and working fluid temperature ranges.
b. Provide equipment as specified below:
1) **0.08 to 1.2 inch wc (20 to 300 Pa)**: Accuracy: +/- 5%; Precision: +/- **0.02 inch wc (5 Pa);** Minimum Differential: **0.04 inch wc (10 Pa)**
2) **0.2 to 2 inch wc** (**50 to 500 Pa**): Accuracy: +/- 2.5%; Precision: +/- **0.02 inch wc (5 Pa);** Minimum differential: **0.08 inch wc (20 Pa).**
3) **0.8 to 4 inch wc (0.2 to 1 MPa)**: Accuracy: +/- 1%; Precision: +/- **0.02 inch wc (5 Pa);** Minimum differential: **0.4 inch wc (100 Pa).**
4) **2.0 to 10 inch wc (0.5 to 2.5 MPa):** Accuracy: +/- 1%; Precision: +/- **0.02 inch wc** (5 Pa); Minimum differential: 0.6 inch wc (150 pa)
c. Configurations:
1) Duct-mounted, field adjustable setpoint, automatic reset
d. Output:
1) Switch Rating: 1A at 250VAC
e. Hardware
1) Provide with two (2) pressure probes and connection tubing.
f. Agency Listings: UL508, UL Class 2 power, NEMA 13 (enclosure).

2. Differential Air Pressure Transducer/Transmitter
a. General: Solid state (piezoelectric) type, suitable for air and non-combustible gases with relative humidity 0-95% non condensing, **15 to 120 °F (-10 to 50 °C)** working fluid and ambient temperature ranges.
b. Range and Accuracy:
1) Range**: 0 to 2 inch wc (0 to 489 Pa)**: Accuracy: +/- **0.02 inch wc (5 Pa)**;
2) Range**: 2 to 28 inch wc (0.5 to 7 MPa)**: Accuracy: +/- **0.04 inch wc (10 Pa)**.
c. Configurations (furnished with eight (8) different field selectable pressure ranges):

1) Duct-mounted;
2) Surface-mounted.

d. Outputs:
1) Transducer: 0-5, 0-10 VDC;
2) Transmitter: 4-20mA;
3) Addressable: Modbus RTU, BACnet MS/TP.

e. Hardware:
1) Provide with two (2) pressure probes and connection tubing.

f. Accessories:
1) Furnish with LCD display;
2) Provide with Auto-Zero calibration (**0 to 10 inch wc (0 to 2.5 kPa)** only).

g. Agency Listings:
1) UL listed: cULus acc. to UL60730-1A/-2-9/-2-13, CAN/CSA E60730-1:02/-2-9, CE acc. to 2004/108/EC and 2006/95/EC, NEMA 4X, IP65, UL Enclosure Type 4X.

3. Liquid Gauge Pressure Transducer/Transmitter

a. General: Electromechanical (strain gauge on steel membrane) type, suitable for aqueous propylene glycol solutions, **-40 to 220 °F (-40 to 105 °C)** ambient, **-40 to 225 °F (-40 to 107°C)** fluid temperature ranges.

b. Ranges and Maximum Pressures:
1) **0 to 15 psig (0 to 103 kPa)**; **30 psig (207 kPa)** overpressure maximum, **45 psig (310 kPa)** burst pressure;
2) **0 to 50 psig (0 to 345 kPa)**; **100 psig (689 kPa)** overpressure maximum, **150 psig (1.3 MPa)** burst pressure;
3) **0 to 100 psig (0 to 689 kPa)**; **200 psig (1.4 MPa)** overpressure maximum, **300 psig (2.1 MPa)** burst pressure;
4) **0 to 200 psig (0 to 1.4 MPa)**; **400 psig (2.8 MPa)** overpressure maximum, **600 psig (4.1 MPa)** burst pressure.
5) **0 to 580 psig (0 to 4.0 MPa)**; **1160 psig (8.0 MPa)** overpressure maximum, **1740 psig (12.0 MPa)** burst pressure.

c. Accuracy: +/- 0.5% of full scale at **77°F (25°C)**, +/- 2% of full scale at **-40°F (-40°C)** and **221°F (105°C)**.

d. Configuration: ¼" NPT piping connection.

e. Outputs:
1) Transducer: 0-10 VDC;
2) Transmitter: 4-20 mA.

f. Hardware: Furnish with ¼" to ½" NPT adaptor bushing.

g. Agency Listings:
1) UL listed: cULus acc. to UL60730-1A/-2-9/-2-13, CAN/CSA E60730-1:02/-2-9, CE acc. to 2004/108/EC and 2006/95/EC.

4. Liquid Differential Pressure Transducer/Transmitter

a. General: Electromechanical (strain gauge on steel membrane) type, suitable for aqueous propylene glycol solutions, **15 to 175 °F (-10 to 80 °C)** working fluid temperature range, **15 to 120 °F (-10 to 50 °C)** ambient temperature range from 10 to 95% relative humidity non-condensing,

b. Ranges and Maximum Pressures:
1) **0 to 15 psid (0 to 103 kPa)**; **85 psid (586 kPa)** overpressure maximum, **300 psid (2.1 MPa)** burst pressure;

2) **0 to 30 psid (0 to 207 kPa)**; **85 psid (586 kPa)** overpressure maximum, **300 psig (2.1 MPa)** burst pressure;
3) **0 to 50 psid (0 to 345 kPa)**; **230 psid (1.6 MPa)** overpressure maximum, **300 psig (2.1 MPa)** burst pressure;
4) **0 to 100 psid (0 to 689 kPa)**; **230 psid (1.6 MPa)** overpressure maximum, **300 psid (2.1 MPa)** burst pressure.

c. Accuracy: +/- 1% of measuring range from **23 to 167°F (-5 to 75°C)**.
d. Configuration: ¼" NPT piping connection.
e. Outputs:
1) Transducer: 0-10 VDC;
2) Transmitter: 4-20 mA.
f. Agency Listings:
1) UL listed: cULus acc. to UL60730-1A/-2-9/-2-13, CAN/CSA E60730-1:02/-2-9, CE acc. to 2004/108/EC and 2006/95/EC.

END OF SPECIFICATION SUBSECTION

1.2 AIR QUALITY

A. Manufactured, brand labelled or distributed by Belimo.

B. Carbon Dioxide Sensor Transducer/Transmitter
1. Element: Non-dispersive infrared (NDIR) type;
2. Accuracy: +/- 50 ppm plus 3% of reading over a temperature range of **32 to 122 °F (0 to 50 °C)**.
3. Calibration: Automatic
4. Configuration: Duct-mounted probe
5. Outputs:
a. Transducer : 0 to 5 VDC or 0-10 VDC
b. Transmitter: 4 to 20 mA

C. Volatile Organic Compound (VOC) Transducer
1. Element: Heated SnO_2 (Tin Oxide) semiconductor technology; suitable over a temperature range of **32 to 122 °F (0 to 50 °C).**
2. Calibration: Automatic
3. Configuration: Duct-mounted probe
4. Outputs
a. Transducer : 0 to 5 VDC or 0-10 VDC
b. Transmitter: 4 to 20 mA

D. Agency Listings:
1. UL listed: cULus acc. to UL60730-1A/-2-9/-2-13, CAN/CSA E60730-1:02/-2-9, CE acc. to 2004/108/EC and 2006/95/EC, NEMA 4X, IP65, UL Enclosure Type 4X.

END OF SPECIFICATION SUBSECTION

SECTION 230923.14 - FLOW INSTRUMENTS

1.1 LIQUID FLOW SENSORS

E. General Requirements for Liquid Flow Sensors:

1. Manufactured, brand labeled or distributed by Belimo.
2. Manufacturer shall certify that each flow sensor indicated complies with specified performance requirements and characteristics.
3. Product shall be wet calibrated with NIST traceable instrumentation and employing NIST testing procedures.

F. In-line Ultrasonic Flow Sensor **NPS 6 (DN 150)** and Smaller:

1. Element:
   a. Type: Transit time flow measurement technology incorporating glycol concentration and fluid temperature compensation.
   b. Materials: Nickel plated forged brass body.
2. Media: Chilled and heating water, aqueous propylene glycol solutions to 60% maximum.
3. Piping Connection:
   a. **NPS 2 (DN 50)** and Smaller:
      1) Inlet: Female NPT
      2) Outlet: Male NPT
   b. NPS 2-1/2 through NPS 6 (DN 65 through DN 150)
      1) Inlet and Outlet: **[ANSI Class 125] [ANSI Class 250]**
4. Ranges.
   a. Velocity:
      1) **NPS ½ to NPS 2 (DN 15 to DN 50): 0.08 to 9.62 fps (0.02 to 2.93 mps)**;
      2) **NPS 2-1/2 to NPS 6 (DN 65 to DN 150): 0.10 to 9.92 fps (0.03 to 3.02 mps)**.
   b. Volumetric Flow Rate:
      1) **0.07 to 855 gpm (0.004 to 45.0 lps)**
   c. Ambient Temperature: **-22 to 122 F (-30 to 50 C)**.
5. Maximum Fluid Temperature: **250 F (120 C).**
6. Maximum Body Pressure: **360 psig at 100 F (2.5 MPa at 38 C)**
7. Performance:
   a. Accuracy:
      1) Water: +/- 2% of full scale at **77 °F (25 °C)** reference.
      2) Aqueous Propylene Glycol (60% maximum): +/- 6%.
   b. Precision: +/- 0.5% of full scale.
   c. Linearity: +/- 1.2% of full scale.
   d. Maximum Pressure Drop:
      1) **NPS ½ to NPS 2 (DN 15 to DN 50): 2.16 psid (15 kPa)**
      2) **NPS 2-1/2 to NPS 6 (DN 65 to DN 150): 3.13 psid (22 kPa)**
8. Transducer:
   a. Power Supply:
      1) Voltage: 24VAC/DC
      2) Dissipation: 0.5W
      3) Apparent power: 1VA.
   b. Output:
      1) 0-10 VDC, 1.25mV resolution
      2) Linearity: +/- 2%
   c. Enclosure:

1) Material: Polycarbonate, with neoprene sealed cover.
2) Rating: NEMA Type 2

d. Operating Temperature Range: **-4 to +250 °F (-20 to +120 C)**

e. Electrical Connection: **3 ft. (1 m)** 18 gauge appliance cable

END OF SPECIFICATION SUBSECTION