SECTION 230923.14 FLOW INSTRUMENTS

*Data contained in this guide specification may be placed in either of the following sections, depending on the specifics of the system design, or incorporated within the next higher level controls specifications (230923.14 FLOW INSTRUMENTS or even higher in 230923 DIRECT DIGITAL CONTROL (DDC) SYSTEMS FOR HVAC).*

PART 2 PRODUCTS

2.1 SECTION INCLUDES

A. Acceptable Manufacturers
   1. EBTRON, Inc.
   2. Approved performance equal

B. Products Included in this Section
   1. Permanently mounted Airflow Measurement Device (AMD) with temperature output and integral airflow alarm, for installation in: small ducts or terminal units, outdoor air intakes for small ducts, and airflow tracking applications.

2.2 ACCEPTABLE MANUFACTURERS

A. EBTRON, Inc. model EF-x2000-T is the basis of design
   1. Basis of Design and Acceptable Manufacturers
      a. Airflow measurement devices shall use the principle of thermal dispersion and provide one self-heated bead-in-glass thermistor and one zero power bead-in-glass thermistor at each sensing node.
         1) Thermal dispersion devices that indirectly heat a thermistor are not acceptable.
      b. Substitution requests for acceptance less than 60 days prior to bid date or products submitted in non-conformance with the requirements of this specification will not be considered.
         1) For any product to be considered for substitution, a written document shall be submitted to the engineer detailing exceptions and compliance, section-by-section with supporting documentation, before an approval will be considered.
         2) Any product submitted as an equal shall be expected to comply with all performance capabilities and functional aspects of this specification.
      c. Excluded devices:
         1) Measurement technologies using “chip-in-glass”, “chip-in-epoxy” or other “chip” type thermistors for the heated sensor component are not acceptable.
         2) Pitot tubes, pitot arrays and other differential pressure measurement devices.
         3) Vortex shedding airflow measurement devices.
      d. The manufacturer's authorized representative shall review, approve placement and the operating airflow rates for each measurement location indicated on the plans.

B. Products approved as equals that comply with all requirements in this section.
   1. [List approved equals here that comply with ALL requirements of this specification]

2.3 PRODUCTS INCLUDED IN THIS SECTION

A. Airflow Measurement Device (AMD) with Temperature Output and Integral Airflow Alarming
   1. General
      a. Provide one AMD with an integral airflow alarm for each measurement location provided on the plans, schedules and/or control diagrams to determine the average airflow rate and temperature at each measurement location.
      b. Each AMD shall be provided with a remotely mounted microprocessor-based transmitter and one or two sensor probes.

1) Devices that have electronic signal processing components in the sensor probe are not acceptable.

c. Airflow measurement shall determine the average actual airflow rate.

d. Temperature measurement shall determine the velocity weighted average temperature by factory default or the arithmetic average by manual field selection.

2. Sensor Probe Design

a. Sensor probes shall be constructed of 6063 extruded aluminum alloy tube [*optional* 316 stainless steel tubes].

b. Sensor probe mounting brackets shall be constructed of 304 stainless steel.

c. Probe internal wiring between the connecting cable and sensor nodes shall be Kynar coated copper.

1) PVC jacketed internal wiring is not acceptable.

d. Probe internal wiring connections shall consist of solder joints and spot welds.

1) Connectors of any type within the probe are not acceptable.

2) Printed circuit boards within the probe are not acceptable.

e. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy.

1) Devices that use epoxy or glass encapsulated chip thermistors are not acceptable.

f. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.

g. Each sensor node shall be calibrated to volumetric standards at a minimum of 7 calibration points.

h. The number of independent sensor nodes provided shall be as follows:

| Diameter - in [mm] | # Sensor Nodes |
|---|---|
| 4 [101.6] | 1 |
| ≥ 5 & ≤ 16 [≥ 127 & ≤ 406.4] | 2 |

i. Probe to transmitter cables shall be FEP jacketed, plenum rated CMP/CL2P and UL/cUL Listed, -67° to 392° F (19.4° C to 200° C) and UV tolerant. Cables shall include a terminal plug for connection to the remotely mounted transmitter. PVC jacketed cables or PVC insulated conductors are not acceptable with ducted sensor probes.

3. Transmitter

a. An integral microprocessor-based transmitter shall be provided for each measurement location.

b. All printed circuit board interconnects and test points shall be gold plated.

c. All printed circuit boards shall be electroless nickel immersion gold (ENIG) plated.

d. All integrated circuitry shall be temperature rated as 'industrial-grade'. Submissions containing 'commercial-grade' integrated circuitry are not acceptable.

e. The transmitter shall be capable of determining the average actual airflow rate and temperature of the sensor nodes in the array.

f. The transmitter shall be capable of identifying an AMD malfunction and ignore a sensor node that is in a fault condition, while simultaneously indicating a fault visually and over the network.

g. The transmitter shall be provided with one of the following:

1) Two scalable, protected and field selectable analog output signals (0-5 / 1-5 VDC or 0-10 / 2-10 VDC, choose one), or

2) One non-isolated RS-485 network connection (field selectable BACnet MS/TP or Modbus RTU protocol). Provide individual 24 VAC transformers at each network transmitter requiring isolated RS-485 connection.

h. One analog output shall be airflow (AO1), while the second output (AO2) shall be configurable as average temperature (default), adjustable airflow alarm or system alarm.
   1) When the alarm is active, the alarm condition shall be indicated on the LCD display.
   2) Alarm reset shall be manual or automatic.
   3) Alarm set points shall be adjustable by type, tolerance, delay, disable/enable, and analog signal indication for AO2.

i. RS-485 network communications shall provide the average airflow rate, average temperature, system status alarm, Hi-Lo airflow alarm, individual sensor node airflow rates and individual sensor node temperatures.

j. Each transmitter shall provide one dry contact relay with onboard jumper to drive a remote LED. The relay shall be rated for no less than 30 VDC or 24 VAC @ 3 amp max and user configurable as N.O. or N.C. during set up.

k. The transmitter shall have a built-in field adjustment wizard for one or two point output adjustments to the factory calibration, when required.

l. The transmitter shall be powered by 24 VAC (22.8 to 26.4 under load) @8 V-A.

m. The transmitter shall provide an integral LCD display for display of airflow, temperature and alarms; and a pushbutton user interface for configuration and diagnostics.

n. The transmitter shall be mounted in an environment protected from direct contact with water.

o. The transmitter shall independently process the airflow and temperature of each sensor node prior to averaging and output.

p. The transmitter shall use a “watchdog” timer circuit to ensure continuous operation in the event of brown-out and/or power failure.

4. Performance and calibration
   a. Each sensing node shall have an airflow accuracy of ±3% of reading (typical) ±4% max. from 0 to 3,000 FPM (15.24 m/s) over a temperature range of 0° F to 160° F (-18° to 71° C). Airflow accuracy shall be maintained at lower operating temperatures of -20° F to 160° F (-29° C to 71° C) but the velocity range shall be limited to 0 – 2,000 FPM (10.2 m/s).
      1) Accuracy shall include the combined uncertainty of the sensor nodes and transmitter.
      2) Devices whose overall performance at the host controller input terminals is the combined accuracy of the transmitter and sensor probes shall demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.
   b. Each sensor node shall be factory calibrated at a minimum of 7 airflow rates including zero (still air), to to NIST Traceable standards.
   c. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to standards that are traceable to the National Institute of Standards and Technology (NIST).
   d. Each sensing node shall have a temperature accuracy of ± 0.15° F (± 0.08° C) over a calibrated range of -20° F to 160° F (-28.9° C to 71.1° C).
   e. Minimum calibrated and operating temperature range for the sensor probes shall be -20° F to 160° F (-28.9° C to 71.1° C).
   f. Operating temperature range for the transmitter shall be -20° F to 120° F (-28.9° C to 48.9° C).
5. Listings and Certifications
   a. The AMD shall be UL 60730-1 and 60730-2-9 Listed as an assembly and subscribed to the UL Follow-up Services.

1) Devices claiming compliance with the UL Listing based on individual UL component listings are not acceptable.