

## 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. Airflow Measurement Devices (AMD) with Temperature Output and Airflow Alarming Capability

#### 2.2 ACCEPTABLE MANUFACTURERS

- A. EBTRON, Inc. model GTX116-P+ 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) Fan Inlet airflow measurement devices.
      - 2) Measurement technologies using “chip-in-glass”, “chip-in-epoxy” or other “chip” type thermistors for the heated sensor component are not acceptable.
      - 3) Pitot tubes, Pitot arrays, Piezo rings and other differential pressure based devices are not acceptable.
      - 4) Vortex shedding devices are not acceptable.
- B. Products approved
  - 1. Approved performance equal

#### 2.3 PRODUCTS INCLUDED IN THIS SECTION

- A. Airflow Measurement Devices (AMD) with Temperature Output and Airflow Alarming Capability
  - 1. General
    - a. Provide one AMD 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 microprocessor-based transmitter and one or more sensor probes.

- 1) Devices that have electronic signal processing components on or in the sensor probe are not acceptable.
  - c. Airflow measurement shall be field configurable to determine the average Actual or Standard mass airflow rate.
    - 1) Actual airflow rate calculations shall have the capability of being corrected by the transmitter for altitudes other than sea level.
  - d. Temperature measurement shall be field configurable with velocity weighted average as the default, or manual selection of arithmetic average temperature.
2. Sensor Probes
  - a. Sensor probes shall be constructed of gold anodized, 6063 aluminum alloy tube, 316 stainless steel tube are available when required.
  - 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) Internal wiring connections shall be sealed and protected from the elements. They shall be capable of direct exposure to water without affecting instrument operation.
    - 2) Connectors of any type within the probe are not acceptable.
    - 3) Printed circuit boards within the probe are not acceptable.
  - e. Each sensor probe shall be provided with an integral, FEP jacket, plenum rated CMP/CL2P, UL/cUL Listed cable rated for exposures from -67° F to 392° F (-55° C to 200° C) and continuous and direct UV exposure.
    - 1) Plenum rated PVC jacket cables are not acceptable.
  - f. Each sensor probe cable shall be provided with a connector plug with gold plated pins for connection to the transmitter.
  - g. Each sensor probe shall contain one or more independently wired sensing nodes.
  - h. Sensor node airflow and temperature calibration data shall be stored in a serial memory chip in the cable connecting plug and not require matching or adjustments to the transmitter in the field.
  - i. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy with sensor housings constructed of glass-filled polypropylene. Upon request, the manufacture shall provide a written independent laboratory test result of 100% survival rate in a 30 day saltwater and acid vapor test.
    - 1) Devices that use epoxy or glass encapsulated chip thermistors are not acceptable.
    - 2) Devices with exposed leads are not acceptable.
  - J. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.
  - k. Each sensor node shall be individually calibrated at 16 measurement points to airflow standards directly calibrated at NIST to the NIST Laser Doppler Anemometer (LDA) primary velocity standard and have an accuracy of ±2% of reading over the entire calibrated airflow range of 0 to 5,000 FPM (25.4 m/s).
    - 1) Upon request the manufacture shall submit for AMD approval a copy of the NIST report of calibration used for the reference standard used.

- i. Devices claiming NIST traceability to third party laboratories and not directly to NIST are not acceptable
- ii. Devices calibrated against standards other than the NIST LDA are not acceptable.
- l. Accuracy shall include the combined uncertainty of the sensor nodes and transmitter.
- m. The installed airflow accuracy shall be:
  - 1) Ducts -  $\pm 3\%$  of reading when installed in accordance with the manufactures recommended placement guidelines.
  - 2) Non-ducted Outdoor Air intakes - better than or equal to  $\pm 5\%$  of reading when installed in accordance with the manufactures recommended placement guidelines.
- n. Devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter shall demonstrate compliance with this requirement over the entire operating range.
- o. Each sensing node shall have a temperature accuracy of  $\pm 0.15^\circ\text{F}$  ( $0.08^\circ\text{C}$ ) over an operating range of  $-20^\circ\text{F}$  to  $160^\circ\text{F}$ . ( $-28.9^\circ\text{C}$  to  $71.1^\circ\text{C}$ ) and humidity range of 0 to 100% RH.
- p. The number of independent sensor nodes provided shall be as follows:

Area ft <sup>2</sup> [m <sup>2</sup> ]	# Sensor Nodes
$\leq 0.5$ [ $\leq 0.046$ ]	1
$> 0.5 \ \& \ \leq 1$ [ $\leq 0.092$ ]	2
$> 1 \ \& \ \leq 2$ [ $> 0.092 \ \& \ \leq 0.185$ ]	4
$> 2 \ \& \ \leq 4$ [ $> 0.185 \ \& \ \leq 0.371$ ]	6
$> 4 \ \& \ \leq 8$ [ $> 0.371 \ \& \ \leq 0.743$ ]	8
$> 8 \ \& \ \leq 12$ [ $> 0.743 \ \& \ \leq 1.11$ ]	12
$> 12 \ \& \ \leq 14$ [ $> 1.11 \ \& \ \leq 1.30$ ]	14
$> 14$ [ $> 1.30$ ]	16

- 1) A total of 4 probes shall be required for openings with an aspect ratio  $\leq 1.5$  and with an area  $\geq 25 \text{ ft}^2$  ( $\geq 2.32 \text{ m}^2$ ).

3. Transmitter

- a. A remotely located microprocessor-based transmitter shall be provided for each measurement location.
- b. The transmitter shall be comprised of a main circuit board and interchangeable interface card.
- c. All printed circuit board interconnects, edge fingers, receptacle plug pins and PCB test points shall be gold plated.
- d. All printed circuit boards shall be electroless nickel immersion gold (ENIG) plated.
- e. All integrated circuitry shall be temperature rated as 'industrial-grade'. Submissions containing 'commercial-grade' integrated circuitry are not acceptable.
- f. The transmitter shall be capable of determining the airflow rate and temperature average of all connected sensor nodes in an array for a single location.

- 1) Separate integration buffers shall be provided for display airflow output, airflow signal output (analog and network) and individual sensor output (Bluetooth).
- g. The transmitter shall be capable of providing a high and/or low airflow alarm with user-defined set point and % of set point tolerance. Alarm shall be capable of being manually or automatically reset and low-limit cutoff value may be selected to disable the alarm. An alarm delay function shall also be field defined.
- h. The transmitter shall be capable of identifying an AMD malfunction via the system status alarm and ignore any sensor node that is in a fault condition.
- i. The transmitter shall be capable of field configuration, diagnostics and include Field Output Adjustment Wizard that allows for a one or two point field adjustment to factory calibration for installations that require adjustment.
- j. The transmitter shall be provided with a 16-character, alpha-numeric, LCD display.
- k. The transmitter shall be provided one of the following output options:
  - 1) two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals (AO1=airflow, AO2=temperature or alarm) and one RS-485 BACnet/Modbus connection, or
  - 2) two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals (AO1=airflow, AO2=temperature or alarm) and one Ethernet BACnet/Modbus connection, or one isolated RS-485 (field selectable BACnet MS/TP or Modbus RTU) network connection, or
  - 3) two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals (AO1=airflow, AO2=temperature or alarm) and one proprietary wireless connection to EBTRON "Commissioner" based devices, or
  - 4) One RS 485 BACnet/Modbus network connection and one Ethernet BACnet/Modbus or
  - 5) One Lonworks Free Topology network connection, or
  - 6) One thumb drive data logger (no output).
- l. The analog signal capability shall include two output terminals: the first (AO1), shall provide the total airflow rate and the second output (AO2) shall be field configurable to provide one of the following:
  - 1) temperature
  - 2) low and/or high airflow user-defined set point alarm, or
  - 3) system status alarm
- m. The network communications RS-485 (BACnet MS/TP or Modbus RTU) or Ethernet (BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) shall provide: the average airflow rate, temperature, hi and/or low airflow set point alarm, system status alarm, individual sensor node airflow rates and individual sensor node temperatures. Individual node airflow rates and temperatures shall NOT be available via the network with Lon.
- n. The transmitter shall be provided with a Bluetooth low energy interface card to interface with Android or iOS devices. Provide free Android or iOS software that allows real-time airflow and temperature monitoring and airflow and temperature traverses. Software shall capture, save or e-mail airflow and temperature data, transmitter settings and diagnostics information.
- o. The transmitter shall have an on-off power switch. Isolation transformers shall not be required.

- p. The transmitter shall be powered by 24 VAC (22.8 to 26.4 under load) @20 V-A maximum and use a switching power supply that is over-current and over-voltage protected.
  - q. The transmitter shall use a “watchdog” timer circuit to ensure automatic reset after power disruption, transients and brown-outs.
  - r. Each transmitter shall have an operating temperature range of -20° F to 120° F (-28.9° C to 48.9° C) and humidity range of 5 to 95% RH.
4. Listings and Certifications
- a. The AMD shall be UL/cUL 873 Listed as an assembly.
    - 1) Devices claiming compliance with the UL Listing based on individual UL component listing are not acceptable.
  - b. All network-capable AMD models supplied with RS-485 interface and BACnet protocol shall be BTL Listed.
  - c. The AMD shall be tested for compliance with the EMC Directive’s requirements and be certified to carry the CE Mark for European Union Shipments.

## PART 3 EXECUTION

### 3.1 SECTION INCLUDES

- A. Installation

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer’s placement guidelines. A written report shall be submitted to the consulting mechanical engineer if any discrepancies are found.