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 PRODUCTS INCLUDED IN THIS SECTION
- A. Acceptable Manufacturers
  - 1. EBTRON, Inc.
  - 2. Approved performance equal
- B. Duct and plenum mounted airflow and temperature measurement devices (ATMD) with integral control damper and sleeve assembly (for unducted plenum return air openings or outdoor air intake duct or plenum openings)

2.2 ACCEPTABLE AMD MANUFACTURERS and MODELS
- A. EBTRON, Inc. model AIR IQ 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 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) Vortex shedding airflow measurement devices.
      - 4) Pitot tubes, pitot arrays, piezo-rings and other differential pressure measurement devices.
- 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 section]

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 adjusted automatically by the transmitter for altitudes other than sea level.

d. Temperature measurement shall be field configurable to determine the velocity weighted temperate or simple arithmetic average temperature.

2. Sensor Probes
   a. Sensor probes shall be constructed of gold anodized, 6063 aluminum alloy tube [insert 316 stainless steel tube in lieu of 6063 aluminum alloy tube, 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 and suitable for direct exposure to water.
      2) Connectors of any type within the probe are not acceptable.
      3) Printed circuit boards within the probe are not acceptable.
   e. Probe internal wiring connections shall be sealed and protected from the elements and suitable for direct exposure to water.
   f. 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.
   g. Each sensor probe cable shall be provided with a connector plug with gold plated pins for connection to the transmitter.
   h. Each sensor probe shall contain one or more independently wired sensing nodes.
   i. 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.
   j. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy. 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.
   k. Each thermistor sensor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.
   l. 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.
      1) Submissions for AMD approval shall include a copy of the actual NIST report of calibration 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.

(iii) Devices with sensors calibrated against NIST temperature standards only are not acceptable.

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

Duct or Plenum Area (ft^2)	Total # Nodes / Location	Duct or Plenum Area (m^2)
≤ 1	**1 or 2**	≤ 0.092
>1 to ≤4	**4**	>0.092 to ≤ 0.371
>4 to ≤ 8	**6**	>0.371 to ≤ 0.742
>8 to ≤ 12	**8**	>0.742 to ≤ 1.11
>12 to ≤16	**12**	>1.11 to ≤ 1.49
≥ 16	**16**	≥ 1.49

c) Submittal documents shall include schedules indicating the number of sensors per location, the duct area and the equivalent density (#/area) for approval.

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 an 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. 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 (IR-interface).

f. The transmitter shall be capable of providing a high and/or low airflow alarm.

g. 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.

h. The transmitter shall be provided with a 16-character, alpha-numeric, LCD display.

1) The airflow rate, temperature, Hi-Lo airflow alarm and system status alarm shall be visible on the display.

i. The transmitter shall be provided with 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), in combination with [select one of the following]

1) one isolated RS-485 (field selectable BACnet MS/TP or Modbus RTU) network connection, or

2) One isolated Ethernet (simultaneously supported BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection.

j. Analog output signals shall provide the total average airflow rate (AO1) and be field configurable (AO2) to output one of the following:

1) temperature

2) Hi-Lo airflow set point alarm, or

3) system status alarm

k. The transmitter shall also be available with a single isolated LonWorks Free Topology network interface or alternatively with one USB connection for thumb-drive data logging of sensor data. Neither of these alternatives includes analog output signals.

l. Network communications shall provide: the average airflow rate, temperature, Hi-Lo airflow set point alarm, system status alarm, individual sensor node airflow rates and individual sensor node temperatures.

m. [Optional - insert if desired:] Provide an infra-red I/O card mounted on the transmitter PCB for communication to a handheld retrieval device that can download individual sensor node airflow and temperature data in real time.

n. The transmitter shall be powered by 24 VAC (22.8 to 26.4 under load) @20 V-A max. and use a switching power supply that is over-current and over-voltage protected.

o. The transmitter shall use a "watchdog" timer circuit to ensure continuous operation in the event of brown-out or power failure.

4. Performance
   a. Each sensing node shall have an airflow accuracy of ±2% of reading over an operating range of 0 to 5,000 FPM (25.4 m/s).
      1) Accuracy shall include the combined uncertainty of the sensor nodes and transmitter.
         (i) 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.
   b. Each sensing node shall have a temperature accuracy of ±0.15° F (0.1° C) over an operating range of -20° F to 160° F. (-28.9° C to 71° C).
5. Listings and Certifications
   a. The AMD shall be UL/cUL873 Listed as an assembly.
      1) Devices claiming compliance with the UL Listing based on individual UL component listing are not acceptable.
   b. The AMD shall be BTL Listed.
   c. The AMD shall be tested for compliance with EMC Directive's requirements and be certified to carry the CE Mark for European Union Shipments.

B. INTEGRAL CONTROL DAMPER and SLEEVE
1. Provide one or more damper sections integrated with the AFMD, for each location indicated on the plans.
2. Provide a factory assembled, extruded aluminum (6063T5) sleeve with an integral damper frame not less than 0.080" in thickness for each damper section. Sleeve depth, including damper frame, shall be 15" for ducted applications and 18" for un-ducted applications. Unducted applications shall include a 3" radius aluminum entry flair. Provide an additional 7" (10" for ducted applications) between the downstream edge of an intake louver and the leading edge of the entry flair for outside air intake applications that are close coupled to intake louvers.
3. Provide extruded aluminum (6063T5) damper blade profiles. Blade seals shall be extruded EPDM. Frame seals shall be extruded silicone. Seals shall be secured in an integral slot within the aluminum extrusions.
4. Bearings shall be composed of a Celcon inner bearing fixed to a 7/16" aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.

5. Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion resistant, zinc plated steel, complete with cup-point trunion screws for a slip-proof grip.
6. Leakage shall not exceed 3 cfm/ft^2 face area against 1" w.g. differential static pressure.
7 Dampers shall be available with either opposed blade action or parallel blade action and made to size without blanking off free area.
8. Modulating electronic actuator of sufficient number and adequate size should be factory mounted and tested. Specific details can be found in section 23 09 13.13 *Actuators and Operators.*

PART 3 EXECUTION

3.1 SECTION INCLUDES

A. Installation

B. Adjusting

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.

3.3 ADJUSTING

A. The AMD shall not be adjusted to match field measurements without approval from the consulting mechanical engineer when installations meet or exceed manufacturer's suggested placement guidelines. Field adjustment, when required shall be accomplished using transmitter firmware that calculates adjustment gain and offset coefficients based on one or two reference measurements.