Product Specification Sheet
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Averaging Pitot Tube Specification Guide

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OVERVIEW

This Product Specification Sheet defines the requirements for Averaging Pitot Tubes (APT). Specification is also included for electronic pressure instruments that are integrated with the APT sensor to create complete flowmeters.

VENDOR REQUIREMENTS

The manufacturer of the APT and pressure instrument shall be certified to ISO 9001.

The vendor shall have the ability to pre-assemble the APT primary with a pressure instrument, perform a leak-test, and calibrate the unit before shipment.

The vendor shall provide technical support for the APT sensor and the pressure instrument.

When a pressure instrument is supplied with the APT, each pressure instrument shall be individually tested for accuracy using calibration equipment traceable to NIST or an equivalent internationally recognized authority.

INSTRUMENT SPECIFICATIONS

The APT shall perform within ±0.75% of flow rate and the vendor shall make independent testing documentation available demonstrating this performance.

All line sizes serviced by the APT shall have the ability to accommodate an integral RTD.

The APT assembly shall allow the RTD to be installed or removed without shutting the process down.

The APT shall be complete with isolation valves and connections that are suitable for connecting a pressure instrument.

Averaging Pitot Tube Sensor

The APT sensor shall have a cross–sectional T shape shall allow flow separation at a fixed point independent of flow rate, pressure, or temperature. As a result, a stable flow coefficient shall be maintained over a wide range of Reynolds numbers.

The sensor shall be comprised of high and low pressure plenums and shall have the ability to accommodate an RTD integral to the sensor.

The sensor shape shall promote less turbulent zones on the backside of the sensor. Individual sensing ports must be located in this less turbulent region to measure the low–pressure. The number of sensing ports shall be a function of the pipe size.

The high–pressure shall be measured by a frontal slot design that extends the length of the sensor. The number of slots shall be a function of the pipe size.

Materials

The APT sensor shall be available in 316 Stainless Steel and Hastelloy® 276.

The mounting material shall be constructed from the same material as the process pipe.

When a sensor flange is provided, it shall be constructed from the same material as the APT sensor.

Mounting Type

The APT shall have a variety of mounting configurations including the following:

- Compression mounting option
  - Shall secure the tip of the APT sensor to the inside of the opposite wall of the pipe.
  - The APT shall be installed without a ferrule.
  - The compression connection shall be capable of withstanding 1440 psig at 100 °F (99 bar at 38 °C).
  - Graphite shall be the packing material in the compression mounting assembly.
- Flanged mounting option
  - Threaded and welded opposite side support assemblies shall be available.
- Compression and Flanged Combination mounting option
  - A connection option should be available that combines the mounting flange with the compression connection
- Hot-Tap mounting option
  - The APT shall have a mounting type that permits installation and removal without system shut-down
  - Threaded and flanged mounting types shall be available.
  - Manual and gear-drive assemblies shall be available.

Flowmeter Specifications

The vendor shall have the ability to supply the APT sensor integrated with the pressure instrument to create a complete flowmeter.

- The vendor shall have the ability to provide a flowmeter for both volumetric and mass flow output.

Functional Specifications

- The pressure instrument shall be supplied mounted directly on the APT sensor when the process temperature is less than 500 °F (260 °C).
- Differential pressure instruments shall be capacitance technology based.
- The pressure instrument sensor shall be hermetically sealed from the external environment.
- The pressure instrument shall have built-in transient protection

Communication Specifications

- Communication with the flowmeter shall occur via a hand held device.
- Digital communication with the flowmeter shall be via open protocols (e.g. HART®, FOUNDATION™ Fieldbus). Proprietary protocols are not permitted.
- The flowmeter shall allow field upgrading of communication protocols and the addition of advanced instrument software functions without changing the pressure sensor.

Software Specifications

- The flowmeter shall contain user definable low flow cut-off functionality.
- The pressure instrument shall be able to fully communicate with a Microsoft® Windows® based instrument management software via an open communication protocol.
- It shall be possible to store last calibration date and next calibration due date in the pressure instrument memory using a hand held configurator. This information should be available on windows-based instrument management software.
- All instruments shall retain original factory calibration settings in a permanent memory. It shall be possible to recall this calibration using a hand held communicator.

LCD Specifications

- The instrument indicator shall be LCD type. It shall display the numeric value and also have a 0–100% scale bar graph corresponding to the analog output. It shall be possible to configure the indicator to display more than one parameter (pressure, scaled output); in this case, the display will toggle / scroll to show all selected parameters. The indicator will display all alarms and alerts.

Volumetric Output Flowmeters

A volumetric measurement is ideal for liquid fluid types.

When the APT is integrated with a differential pressure instrument for volumetric output, the flowmeter shall perform:

- Within ±0.90% of volumetric flow rate in liquids
- Within ±1.4% of volumetric flow rate in gas and steam
- The vendor shall make independent testing documentation available demonstrating this performance

Functional Specifications

- Pressure instrument hardware/software failure alarm shall be selectable as high, low, or any user defined value.
- The flowmeter shall have the ability to detect impulse line plugging or should allow field upgrading to include this by the addition of an electronics card.

Software Specifications

- The flowmeter shall allow the digital output of the pressure instrument to be scaled to any user-defined unit (e.g 0–200 m^3/hr, 0–9000 gallons/min).
- The flowmeter shall allow the 4-20mA analog output to be scaled to any user defined unit (e.g 0–200 m^3/hr, 0–9000 gallons/min).
- The flowmeter shall allow custom user-entered digital alerts for both high and low values for the pressure reading. This digital alert will not affect the analog output.
- Flowmeters for custody transfer will have hardware and software write protect security. Hardware security will override software.

LCD Specifications

- It shall be possible to remote mount electronics with a display up to 100 ft (30 m) from the pressure sensor. These electronics will allow full configuration of the instrument via a hand held communicator.

Mass Flow Output Flowmeters

For compressible fluid applications (i.e. steam and gases), multivariable differential pressure flowmeters are ideal. These flowmeters shall perform real-time calculations by compensating for changes in the APT K factor, gas expansion factor, velocity of approach factor, density or compressibility, viscosity, and Reynolds Number.

When a multivariable pressure instrument is integrated with the APT, the flowmeter shall perform within ±1.0 percent of mass flow rate in gas and steam.

The vendor shall make independent testing documentation available demonstrating this performance.

Functional Specifications

- The flowmeter shall provide a fully compensated mass flow output with a single pipe penetration.
- The flowmeter shall have a Gage Pressure (GP) sensor to measure GP.
- The pressure instrument shall be two-wire and multivariable (pressure, differential pressure, and temperature).

Software Specifications

- Pressure instrument outputs shall be a 4-20mA analog signal, user-selectable to represent mass flow, differential pressure, static pressure, or temperature, with a superimposed digital signal, using HART protocol.
- The pressure instrument shall perform continuous diagnostics, capable of self-test functions and be able to provide specific diagnostic information.
- Basic configuration capabilities of the pressure instrument shall allow the user the ability to input and store information including the range, engineering units, damping, drain / vent valves, flange, and O-ring materials, date, message, descriptor, tag number, and serial number.
- Mass flow configuration shall allow the user to input and store information including the fluid name, fluid density, fluid viscosity and APT sensor K factor.

To calculate mass flow, the pressure instrument shall utilize the full DP mass flow equation:

$$Qm=N*K*Y*D^2*SQRT(DP)*SQRT(\rho)$$

Where,
K = Flow Coefficient or K-factor
N = Unit Conversion Factor
D = Pipe Diameter
DP = Differential Pressure
ρ = (rho), Density
d2 = Bore of the Differential Producer

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