Stack Flow Monitoring

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When are Flow Monitors Required?

- Emissions Reporting includes mass flow rate calculations.
- For natural gas and fuel oil applications, mass calculations are made using fuel flow rate data and F-Factor based calculations as provided by the EPA. In these cases a fuel flow monitor is generally not required.
- For fuels of varying consistency, such as wood burners and other biomass applications, a stack flow monitor must be used to make the required mass emissions rate calculations.
- Alberta, Canada, CEMS Code calls for flow monitors to be used on all applications, including natural gas turbines.

Moisture Basis

- A flow monitor can be used to determine the total flow rate which then can be multiplied by the pollutant volumetric concentration, then converted to mass flow using the stack gas density.

- However, dry extractive CEMS measure pollutants on a dry basis, but the flow monitor provides the total stack volumetric flow rate on a wet basis. So, stack moisture has to be determined in order to convert the stack flow from wet to a dry basis.
    - A Wet O2 analyzer (along with the standard Dry O2) analyzer can be used to make the moisture
    - A moisture constant may be used instead of calculating the moisture on a real time basis. This may require acceptance form the governing authority

Flow Monitor Types

- Pitot Tubes
  - S-Type most commonly used by CiSCO and CEMS RATA testing teams.
    - Part 60 Appendix A, Method 2.
  - Cross-stack, averaging pitot tubes also available. These work on the same principle as the S-type pitot tube but use different calculation factors.
- Ultrasonic
  - TML: Expensive and more intensive installation requirements.
- Thermal Mass Flow Meters
  - Suspectable to inaccuracies due to stack moisture.

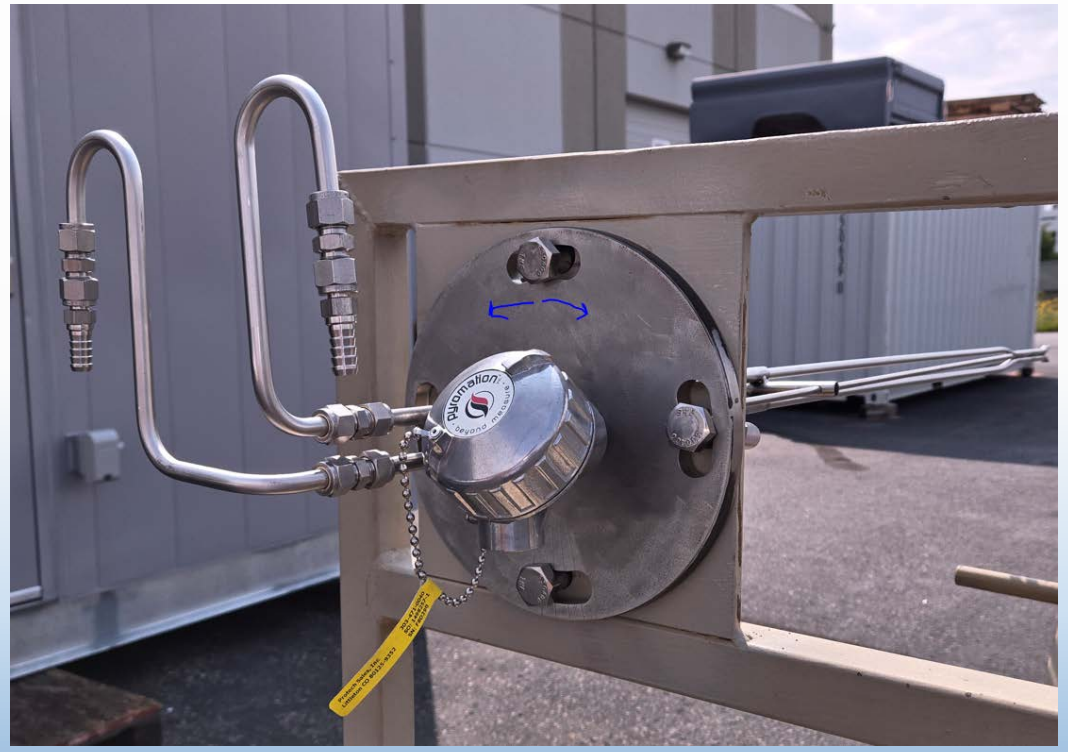
S-Type Pitot Tube

- Temperature is measured along with DP to be used in the calculation of velocity and to standardize measurement.

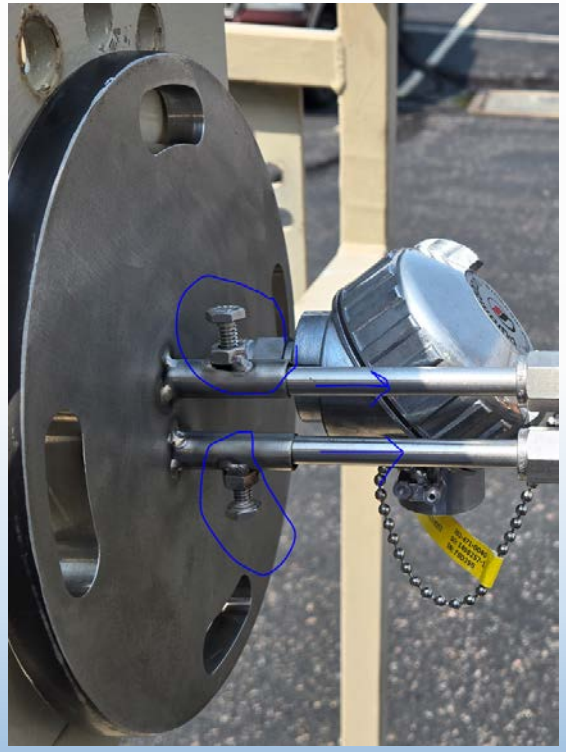
- Exploits the difference between the head (Dynamic) pressure (facing the flow) and the static pressure point (facing away from the flow). This is known as the differential pressure (DP).

- Calculations with several input parameters are used along with the differential pressure to calculate stack gas velocity. Knowing the stack area allows the determination of volumetric stack flow rate

CiSCO Flow Monitor: S-Type Pitot Tube



- Adjustments may be made to the Pitot Tube location and angle to improve results.
- During a RATA, comparison between the RATA Measurement and the Pitot Tube can be improved by changing the depth of the pitot tube into the stack and/or rotating the pitot tube left or right.

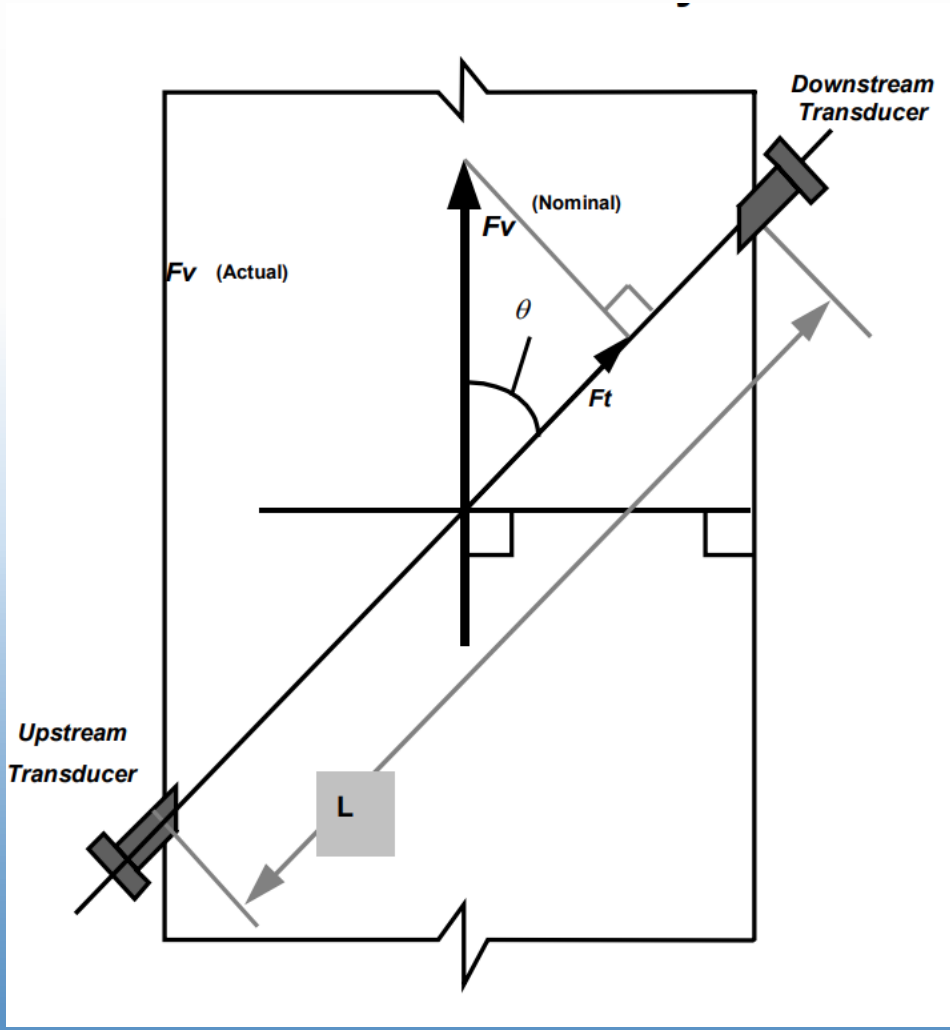


CiSCO Flow Monitor FM-8203: Measuring Components

- Differential Pressure Measurement
  - Dwyer
- Thermocouple transmitter for stack temperature.
- Repeatable flow span pressure circuit for validation of the DP meter transmitter.
- Equalization/Isolation valves for zero check.
- Temperature transmitter checks not required.
- Accessible low and high pressure ports on the face of the monitor allow for DP measurement accuracy checks.
- Blowback and interference check capability.
- Calculations of Flow are performed in CeDAR.

CiSCO Flow Monitor FM-8203:

Ultrasonic Flow Monitor:



- Time of Flight Theory
  - Two transducers that also act as Receivers send bursts of ultrasonic waves aimed diagonally at each other.
  - Changes in the time between burst and reception of the wave varies with presence of moving gas.
  - Stack Gas velocity is calculated from the variance in transit times between the transducers. Stack temperature can also be calculated for singe fuel sources.

Ultrasonic Versus Pitot Tube

- Ultrasonic much more expensive.
- Requires dual stack access platforms due to the distance between transducers.

Questions and General Discussion