

FOX TECH TIP

Straight Run Conditions for Insertion Flow Meters

IMPORTANCE OF STRAIGHT RUNS

Straight-run is an important consideration when planning the installation of insertion flowmeters. Following the manufacturer's instructions and guidelines will ensure the best possible accuracy in a given installation.

For Fox Thermal insertion style products, the recommended minimum straight run requirements are 15 straight, unobstructed pipe diameters upstream of the insertion flowmeter and 10 downstream (15/10).

INSTALLATION SOLUTIONS FOR LIMITED PIPE RUNS

Flow meter accuracy is often dependent on achieving a uniform flow profile near the center of the pipe. Distortion and swirl are disturbances that can be remedied by extending the length of space between the cause of the disturbance and the sensing element (increasing straight pipe runs).

In those situations where additional straight pipe is not available, two common solutions are available: 1) install a Fox Thermal FC20 flow conditioner or 2) choose an inline style flow meter. If neither of these solutions are acceptable, the user must potentially accept lower accuracy or additional uncertainty of the measurement reading.

UNCERTAINTY IN SHORTER STRAIGHT RUNS

In applications where 15/10 straight pipe diameters are not available for an insertion style flow meter, the table below can be used to determine the impact on measurement accuracy.

INLINE FLOW METERS WITH BUILT-IN FLOW CONDITIONING

Fox Thermal inline style flow meters can be installed with shorter straight runs than insertion style flow meters. Additionally, Fox Thermal's inline flow meters offer built-in



Figure 2: Fox Thermal FC20 Flow Conditioner for use with insertion style flow meters.

flow conditioning and are available for pipe sizes from .75" to 6". The recommended minimum straight run requirements are 8 straight, unobstructed pipe diameters upstream of the insertion flowmeter and 4 downstream (8/4).

If even shorter straight runs are necessary for a particular installation, flow conditioners can be used.

FLOW CONDITIONING SOLUTION

In some applications, space isn't available for enough upstream or downstream straight pipe. In these cases, the FC20 flow conditioner can be a solution.

Insertion thermal mass flow meters are easy to install and

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|------------------------|-----|-----|----|----|----|----|-------|----|----|----|-----|-----|
| Distance* | 15D | 13D | 9D | 7D | 5D | 3D | PROBE | 3D | 5D | 7D | 9D | 10D |
| Direction | UP | UP | UP | UP | UP | UP | | DN | DN | DN | DN | DN |
| Additional uncertainty | 0% | <1% | 1% | 2% | 3% | 4% | | 3% | 2% | 1% | <1% | 0% |

Figure 1: Additional uncertainty found at distances up and downstream of the probe without flow conditioning solutions.

*Distance from probe to a single 90° elbow in pipe

require minimal straight pipe runs. In the past, the only option to reducing straight pipe runs for very tight spaces was to order flow meters with a flow body and built-in flow conditioner. To give customers more flexibility, Fox Thermal has developed the FC20 flow conditioner for use with insertion style flow meters.

Each flow meter is calibrated with the flow conditioner 2D upstream as shown in Figure 2 to ensure the highest accuracy.

TYPES OF OBSTRUCTIONS

There are several factors leading to irregular or turbulent flow:

- Single or multiple bends in pipe
- Tees or pipe branches
- Devices or valves placed in contact with the flow
- Pipe size transitions

Each of these obstruction types can lead to irregular or distorted flow in the pipe.

CALIBRATION VALIDATION PROVES DESIGN SUPERIORITY

CALIBRATION LAB

Fox Thermal's test tunnels are calibrated at appropriate intervals, monitored for stability, and under the custody of trained laboratory personnel. Measurement assurance procedures and monitoring results are maintained in the laboratory database to ensure that all calibrations are accurate, verifiable, and traceable to NIST primary standards.

CALIBRATION VALIDATION

Calibration Validation is a built-in feature that can be performed in-situ. It is designed to:

- Test the functionality of the sensor and its associated signal processing circuitry
- Check for build-up on sensor that could affect calibration
- Ensure that the meter still retains its original NIST-traceable calibration
- Check thermal conductivity (heat transfer) repeatability of the sensor

Use Calibration Validation to assure the meter is functioning correctly and to produce records for regulatory compliance when needed.



Fox Thermal's Calibration Lab utilizes NIST-traceable equipment.

TECHNOLOGY COMPARISON

STRAIGHT RUN REQUIREMENTS

Compare Upstream & Downstream Straight Run Requirements for Common Flow Meter Technologies

DP METERS

20 Upstream

10 Downstream

VORTEX METERS

35 Upstream

5 Downstream

TURBINE METERS

20 Upstream

5 Downstream

ULTRASONIC METERS

10-20 Upstream

10-20 Downstream



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