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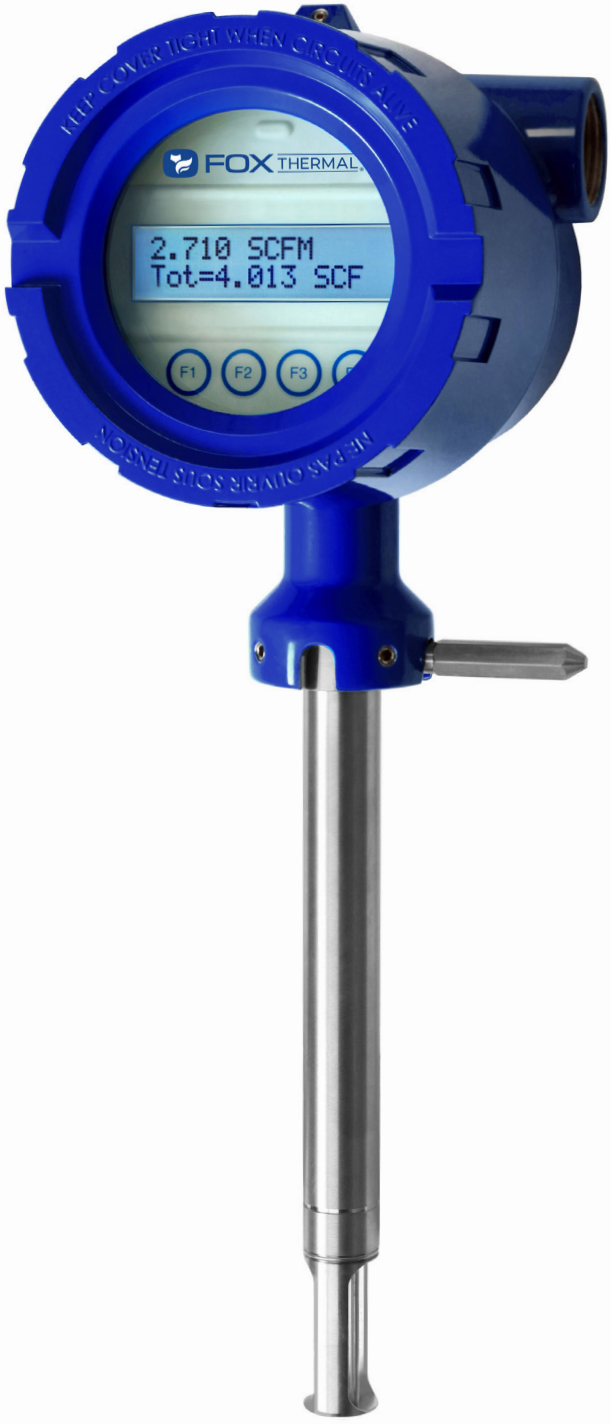
MODEL

FT1

Fox Thermal Gas Mass Flow Meter

HIGHLIGHTS

- DDC-Sensor™ (Direct Digitally Controlled)
- Gas-SelectX®: menu of field selectable gas compositions
- CAL-V™ Calibration Validation
- Insertion and Inline styles
- Measures gas flow rate in SCFM, MSCFD, KG/HR, and many more units
- Wide measurement range: up to 1000:1 turndown; 100:1 typical
- 4-20mA for flow rate or temperature; HART communication option
- Choice of second channel: Pulse output for flow/total, Modbus RTU (RS485), or BACnet MS/TP (RS485)
- USB port to connect to a PC, standard
- Free FT1 View™ Software available
- Welded, 316 SS sensor and flow body construction, carbon steel flow body optional
- Robust sensor design, sensing elements supported at both ends
- Microprocessor based, field-programmable electronics
- Optional on-board 2 line x 16 character, backlit display with configuration panel
- NIST traceable calibration
- Low-end sensitivity for leak detection
- Negligible pressure drop
- FM (U.S.) & FMc (CANADA) approved for Class I, Div 1; ATEX/IECEx approved for Zone 1
- NEMA 4X and CE Mark
- Flow Control Innovation Award Winner
- Processing's Breakthrough Product Award Winner



FOX® THERMAL

OIL & GAS | INDUSTRIAL | BIOGAS | WASTEWATER

THERMAL MASS TECHNOLOGY

FAST AND FLEXIBLE GAS FLOW MEASUREMENT

The Model FT1 thermal mass flow meter and temperature transmitter can be used in a large variety of industrial and commercial gas flow measurement applications. The FT1 offers the flexibility to monitor multiple gas types at the push of a button, rotate the housing as needed for tight installations, and configure meter settings from advanced software.

THEORY OF OPERATION

Fox Thermal flow meters use a constant temperature differential (constant Δ T) technology to measure the mass flow rate of air and gases. The thermal mass flow sensor consists of two Resistance Temperature Detectors (RTD's). The Reference RTD measures the gas temperature. The instrument electronics heat the mass flow sensor, or heated element, to a constant temperature differential (constant Δ T) above the gas temperature and measures the cooling effect of the gas flow. The electrical power required to maintain a constant temperature differential is directly proportional to the gas mass flow rate. The microprocessor linearizes this signal to deliver a linear 4-20mA output signal.

MODEL FT1

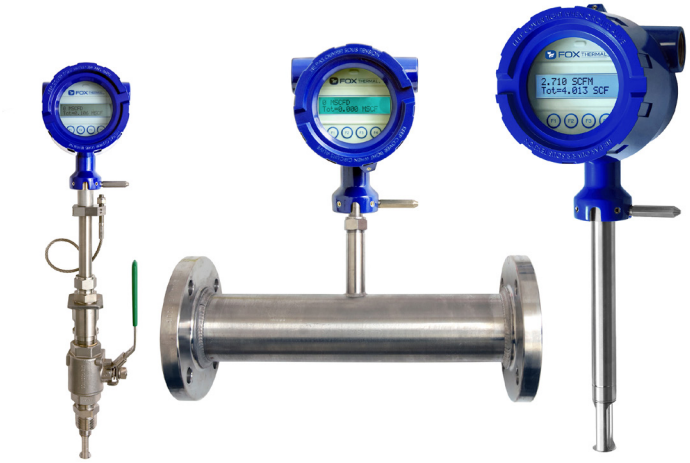
FOX THERMAL MODEL FT1 THERMAL GAS MASS FLOW METER FEATURES

The Fox Thermal Model FT1 measures gas flow rate in standard units without the need for temperature or pressure compensation. It provides an isolated 4-20mA output (with a HART option) and a selection of pulse, Modbus RTU (RS485), or BACnet MS/TP (RS485) for a second channel.

With an optional on-board 2-line x 16-character backlit display, operators can view flow rate, total, elapsed time, process gas temperature, and alarms. The display is also used in conjunction with the Configuration Panel to access flow meter settings, such as 4-20mA and pulse output scaling, pipe diameter, zero flow cutoff, flow filtering (damping), display options, and high or low alarm limits.

The Model FT1 is available in insertion and inline styles. The insertion style FT1 has a robust stainless steel probe and is easily installed by drilling a hole in the pipe and welding on an NPT branch outlet. A Fox Thermal-supplied compression fitting secures the probe in place. It is supplied with 316 stainless steel wetted materials standard. Inline styles of the FT1 are available in both stainless steel and carbon steel with NPT and 150lb flange options. See Specification section for details on sizing. A USB port to connect to a computer or laptop is standard; interface options include HART, Modbus RTU (RS485) and BACnet MS/TP (RS485).

Fox Thermal has certified cleaning and bagging procedures for flow meters to be used in oxygen applications.



The FT1 is available in insertion, inline, and remote styles. Insertion models can be ordered with retractors and inline flowbodies are manufactured with built-in flow conditioners.

ADVANCED FEATURES

Suitable for harsh and hazardous environments, the instrument features:

- Robust DDC-Sensor™Design
- Gas-SelectX® with a selection of pure gases or a gas mix (up to five gases)
- CAL-V™ Calibration Validation
- Rotatable enclosure: allows ±180 degree in four positions
- FM/FMc, ATEX, IECEx approvals. CE mark.
- 12 to 24VDC power input, standard
- NIST-traceable calibration
- Free FT1 View™ Software
- High and low alarm limits
- Wetted materials are all welded, 316 stainless steel

DIGITAL TECHNOLOGY PLATFORM

DDC-SENSOR™ TECHNOLOGY

The Fox Thermal DDC-Sensor™ is a state-of-the-art sensor technology used in the Fox Thermal Model FT1 Thermal Gas Flow Meter. The DDC-Sensor™, a Direct Digitally Controlled sensor, is unlike other thermal flow sensors available on the market. Instead of using traditional analog circuitry, the DDC-Sensor™ is interfaced directly to the FT1 microprocessor for more control, precision, and programmability. The DDC-Sensor™ accurately responds to changes in process variables (gas flow rate, pressure, and temperature) to determine mass flow rate, totalized flow, and temperature.

Fox Thermal's DDC-Sensor™ provides a technology platform for calculating accurate gas correlations. The FT1 correlation algorithms allow the meter to be calibrated on a single gas in the factory while providing the user the ability to select other gases in the Gas-SelectX® menu. With its DDC-Sensor™ and advanced correlation algorithm, the FT1 is a precision, multi-gas-capable thermal gas flow meter.

GAS-SELECTX® GAS SELECTION MENU

Process Engineers need fast, flexible solutions to their monitoring needs. For these cases, Fox Thermal has developed the Gas-SelectX® gas menu feature for the FT1 flow meter. Gas-SelectX® allows the user to choose from a menu of several common gases or gas mixtures for their application.

Gases available in Gas-SelectX® on the FT1 are:

- Air
- Argon
- Butane
- Carbon Dioxide
- Ethane
- Hydrogen
- Methane
- Natural Gas*
- Nitrogen
- Oxygen
- Propane
- 5-Gas Mix (proportions must equal 100%)

*Natural gas refers to pipeline-quality dry natural gas (NAESB standard for composition)

The meter's proprietary algorithms allow the user to switch gases or gas mixes in the field, as needed. This makes the FT1 ideal for measurement of Digester Gas, Liquefied Petroleum Gas (LPG) and a variety of other biogases. Whether you need to measure natural gas, air, CO2, or digester gas, the FT1 brings these options and more to the user with a push of a button.

CAL-V™

For customers that need a quick and easy way to verify the calibration of the meter in the field, the Model FT1 offers the CAL-V™ feature. This feature can be initiated through the meter's optional display configuration panel or the FT1 View™ Software. The test takes less than 5 minutes to run and produces a pass/fail result at the conclusion of the test. A fail result may indicate either a dirty sensor or the need to recalibrate.

If the CAL-V™ test is performed using the FT1 View™ software, a Calibration Validation Certificate can be produced at the conclusion of the test. The certificate will show the date and time of the test along with meter data such as the meter serial number. This in-situ calibration validation helps operators comply with environmental mandates and eliminates the cost and inconvenience of annual factory calibration.

FT1 VIEW™ SOFTWARE

Fox Thermal has developed advanced software - FT1 View™ - a free PC-compatible application available for download from the Fox Thermal website. Connect your laptop, PC, or control station to the meter using the USB port interface to access the meter's data and configure the meter's settings.

FT1 View™ allows:

- Quick access to all configuration parameters with pop-up windows and pull down menus
- Selection of measurement units, flow and temperature ranges, alarm settings and more
- Print or save a CAL-V™ Calibration Validation Certificate
- Set alarms; display alarm codes
- Simulation mode used to align 4-20mA output with the input to customer's PLC/DCS
- Raw data to be viewed in order to diagnose or trouble-shoot your meter
- Data logging to an Excel® spreadsheet

DIMENSIONS

INSERTION STYLES

Assuming there is no insulation or retractor, Fox recommends the following probe lengths:

Pipe Size	Probe Lengh
1.5" (40mm) to 6" (150mm)	6-inch
8" (200mm) to 12" (300mm)	9-inch
14" (350mm) to 18" (450mm)	12-inch

Use the equation below for larger pipe sizes

Probe Lengths in inches (cm) =	
6.0 (15.2)	9.0 (22.9)
12.0 (30.5)	15.0 (38.1)
18.0 (45.7)	24.0 (61.0)
30.0 (76.2)	36.0 (91.4)

EQUATION

Equation for selecting insertion flow meter probe length: Probe length = ½ pipe ID (in inches) + 3" + thickness of insulation (if any) + 10" (for retractor if supplied). Round up to the next standard probe length available.

Note: Contact Fox for longer probes.

INLINE STYLES

Inline pipe sizes, materials, and end connections are listed in the table below.

Inline pipe sizes in inches =														
0.75	○		◐	◓	1.50	○		◐	◓	3.00	○	●	◐	◓
1.00	○		◐	◓	2.00	○	●	◐	◓	4.00	○	●		◓
1.25	○		◐	◓	2.50	○	●	◐	◓	6.00	○	●		◓

○= SS ●= CS ◐= NPT Ends ◓= 150lb flanges

Note: See FT1 Model Codes document for more information.

Note: Inline flow bodies include built-in flow conditioners. FC20 Flow Conditioners are available as an option for insertion flow meters..

PROBE DIAMETER

Insertion and inline flow Meters: Probe diameter: ¾"

DRAWINGS

See FT1 Dimensional Drawings on Fox Thermal website.

APPROVALS

CE Mark: Approved

EMC Directive: 2014/30/EU

Electrical Equipment for Measurement, Control and Lab Use: EN61326-1:2013

EU Directive: 2014/68/EU

Weld Testing: EN ISO 15614-1 and EN ISO 9606-1, ASME B31.3

FM (FM16US0005X) & FMc (FM16CA0005X): Approved

Class I, Division 1, Groups B, C, D;

Class II, Division 1, Groups E, F, G;

Class III, Division 1; T4, Ta = -40˚ to 70˚C;

Class I, Zone 1, AEx/Ex db IIB + H2 T4; Gb Ta = -40˚C to 70˚C;

Type 4X, IP66/67

ATEX (FM16ATEX0013X): Approved

II 2 G Ex db IIB + H2 T4; Gb Ta = -40˚C to 70˚C; IP66/67

II 2 D Ex tb IIIC T135˚C; Db Ta = -40˚C to 70˚C; IP66/67

IECEx (IECEx FMG 16.0010X): Approved

Ex d IIB + H2 T4; Gb Ta = -40˚C to 70˚C; IP66/67

Ex tb IIIC T135˚C; Db Ta = -40˚C to 70˚C; IP66/67

ATEX and IECEx Standards:

EN 60079-0 + A11	IEC 60079-0
EN 60079-1	IEC 60079-1
EN 60079-31	IEC 60079-31
EN 60529 + A1 + A2	IEC 60529

FT1 meters installed for natural gas sub-metering at a major hotel/casino in Las Vegas, NV.

SPECIFICATIONS

PERFORMANCE SPECS

Flow Accuracy:
Air and N2: ±1% of reading ±0.2% of full scale
Other gases: ±1.5% of reading ±0.5% of full scale
Accuracy specification applies to customer's selected flow range
Maximum range: 15 to 25,000 SFPM (0.07 to 120 NMPS)
Minimum range: 15 to 500 SFPM (0.07 to 2.4 NMPS)
Straight, unobstructed pipe requirement:
- Insertion: 15 diameters upstream 10 downstream
- Inline: 8 diameters upstream, 4 downstream

Flow Repeatability: ±0.2% of full scale

Flow Response Time: 0.8 seconds (one time constant)

Temperature Accuracy: ±1° F (±0.6° C)

Calibration:
Factory Calibration to NIST traceable standards

CAL-V™:
In-situ, operator-initiated calibration validation

OPERATING SPECS

Gas-SelectX® Gas Selections:
Pure Gas menu and a 5-gas mix to suit any application.
See the Fox Thermal website for more information on current availability of gases.

Gas Pressure (maximum; at 100°F):
Insertion: 740 psig (51 barg)
316 SS inline w/NPT ends: 500 psig (34.5 barg)
316 SS inline w/150lb flanges: 230 psig (16 barg)
CS inline w/NPT ends: 500 psig (34.5 barg)
CS inline w/150lb flanges: 285 psig (20 barg)
Retractor: 150 psig (10.3 barg)
Notes:
- Check with factory for higher pressure options.
- With Teflon Ferrule option (P/N 106415), maximum gas pressure is 60 psig (4.1 barg).
- Pressure ratings stated for temperature of 100°F (38°C).

Temperature:
DDC-Sensor™: -40 to 250°F (-40 to 121°C)
Enclosure: -40 to 158°F (-40 to 70°C)*
*NOTE! Display dims below -4˚F (-20˚C); function returns once temperature rises again.

Flow Velocity Range:
15 to 25,000 SFPM at 70°F (0.07 to 120 NMPS at 0°C)
Turndown: up to 1000:1; 100:1 typical

Flow Ranges - Insertion Meters			
Pipe Diameter	SCFM	MSCFD	NM3/Hr
1.5" (40mm)	0 - 354	0 - 510	0 - 558
2" (50mm)	0 - 583	0 - 840	0 - 920
2.5" (63mm)	0 - 830	0 - 1,310	0 - 1,200
3" (80mm)	0 - 1,280	0 - 1,840	0 - 2,020
4" (100mm)	0 - 2,210	0 - 3,180	0 - 3,480
6" (150mm)	0 - 5,010	0 - 7,210	0 - 7,910
8" (200mm)	0 - 8,680	0 - 12,500	0 - 13,700
10" (250mm)	0 - 13,600	0 - 19,600	0 - 21,450
12" (300mm)	0 - 19,400	0 - 27,900	0 - 30,600

NOTE! To determine if the FT1 will operate accurately in other pipe sizes, divide the maximum flow rate by the pipe area. The application is acceptable if the resulting velocity is within the velocity range above. Check Fox Thermal website for velocity calculator.

Flow Ranges - Inline Meters			
Pipe Diameter	SCFM	MSCFD	NM3/Hr
0.75"	0 - 93	0 - 134	0 - 146
1"	0 - 150	0 - 216	0 - 237
1.25"	0 - 260	0 - 374	0 - 410
1.5"	0 - 354	0 - 510	0 - 558
2"	0 - 583	0 - 840	0 - 920
2.5"	0 - 830	0 - 1,310	0 - 1,200
3"	0 - 1,280	0 - 1,840	0 - 2,020
4"	0 - 2,210	0 - 3,180	0 - 3,480
6"	0 - 2,500	0 - 3,600	0 - 3,950

NOTE! Consult factory for flow ranges above those listed. Inline meters above 2,500 SCFM (3,950 NM3/H) may require third party calibration. Contact Fox Thermal.

Relative Humidity:
90% RH maximum; non-condensing

Units of Measurement (field-selectable):
SCFM, SCFH, NM3/M, NM3/H, NM3/D, NLPS, NLPM, NLPH, MCFD, MSCFD, SCFD, MMSCFD, MMSCFM, SM3/D, SM3/H, SM3/M, LB/S, LB/M, LB/H, LB/D, KG/S, KG/M, KG/H, SLPM, MT/H

Input Power: 12 to 24 VDC, 6 watts
Full input power range: 10 to 30 VDC.
20 Watt or greater power supply is recommended

Outputs:
Channel 1: Standard isolated 4-20mA output for flow or temperature; fault indication per NAMUR NE43; HART communication option.
Channel 2: Option of a pulse output or Serial Communication (Modbus RTU (RS485) or BACnet MS/TP (RS485))
Isolated pulse output: 5 to 24VDC, 20mA max., 0 to 100Hz for flow (the pulse output can be used as an isolated solid state output for alarms).

Serial Communication:
USB connector for connecting to a laptop or computer is standard.
Optional isolated communication outputs: Modbus RTU (RS485), BACnet MS/TP (RS485).
Free PC-based software tool - FT1 View™ - provides complete configuration, remote process monitoring, and data logging functions.

4-20mA and Pulse Verification:
Simulation mode used to align 4-20mA output and pulse output (if ordered) with the input to customer's PLC/DCS.

PHYSICAL SPECS

Probe diameter:
¾"

Sensor Material:
316 stainless steel

Enclosure:
NEMA 4X, aluminum, dual ¾" FNPT conduit entries.

CONFIGURATIONS

MODEL CODES - CHOOSE METER SIZE AND FEATURES

The FT1 is available in insertion and inline styles. The insertion meter is easily installed with a branch fitting and compression fitting and requires straight pipe runs of 15D upstream/10D downstream.

The inline model is available in ¾" to 6" sizes and includes built-in flow conditioners that eliminate the need for long, straight pipe runs. Straight run requirements are decreased to 8D upstream/4D downstream for the inline style meters.

Feature 1a: Insertion Sizes	
Code	Description
06I	Insertion meter with 6-inch probe
09I	Insertion meter with 9-inch probe
12I	Insertion meter with 12-inch probe
15I	Insertion meter with 15-inch probe
18I	Insertion meter with 18-inch probe
24I	Insertion meter with 24-inch probe
30I	Insertion meter with 30-inch probe
36I	Insertion meter with 36-inch probe
15R	15" probe w/150-psi retractor
18R	18" probe w/150-psi retractor
24R	24" probe w/150-psi retractor
30R	30" probe w/150-psi retracto
36R	36" probe w/150-psi retractor

Example:
FT1 – 06I – DD – P1

Notes:

- See model code document for full list of codes.
- All inline flowbodies are schedule 40 pipes, 316 stainless steel (SS). A100 Grade B carbon steel (CS) option available.*

Feature 1b: Inline Sizes	
Code	Description
075P	0.75-inch, male npt ends 12" face-to-face
10P	1-inch, male npt ends 12" face-to-face
125P	1.25-inch, male npt ends 12" face-to-face
15P	1.5-inch, male npt ends 12" face-to-face
20P*	2-inch, male npt ends 12" face-to-face
25P*	2.5-inch, male npt ends 18" face-to-face
30P*	3-inch, male npt ends 18" face-to-face
075F	0.75-inch, 150lb RF flanges 12" face-to-face
10F	1-inch, 150lb RF flanges 12" face-to-face
125F	1.25-inch, 150lb RF flanges 12" face-to-face
15F	1.5-inch, 150lb RF flanges 12" face-to-face
20F*	2-inch, 150lb RF flanges 12" face-to-face
25F*	2.5-inch, 150lb RF flanges 18" face-to-face
30F*	3-inch, 150lb RF flanges 18" face-to-face
40F*	4-inch, 150lb RF flanges 18" face-to-face
60F*	6-inch, 150lb RF flanges 24" face-to-face
20PC*	2-inch, male NPT ends 12" face-to-face
25PC*	2.5-inch, male NPT ends 18" face-to-face
30PC*	3-inch, male NPT ends 18" face-to-face
20FC*	2-inch, 150lb RF flanges 12" face-to-face
25FC*	2.5-inch, 150lb RF flanges 18" face-to-face
30FC*	3-inch, 150lb RF flanges 18" face-to-face
40FC*	4-inch, 150lb RF flanges 18" face-to-face
60FC*	6-inch, 150lb RF flanges 24" face-to-face

Feature 2: Display	
Code	Description
D0	No display & configuration panel
DD	Include rate/total display & configuration panel

Feature 3: Outputs and Serial Communication	
Code	Description
P1	4-20mA + Pulse Output
RS	4-20mA + Modbus RTU (RS485)
BH	4-20mA/HART + Pulse Output

*For carbon steel (CS) material, add "C" to applicable stainless steel (SS) codes. Example: *20P* = 2" SS; *20PC* = 2" CS.

COMPARISON

TECHNOLOGY COMPARISON

For customers searching for a lower cost, higher accuracy low flow measurement meter, thermal mass flow meters by Fox Thermal beat DP meters and the other flow technologies on the market today. Compare the model FT1 thermal mass flow meter equipped with the state-of-the-art DDC-Sensor™ technology, new expanded Gas-SelectX® gas selection menu, and CAL-V™ Calibration Validation as the alternative to other technologies.

Take a look at the other benefits Fox Thermal gas mass flow meters offer over other flow measurement technologies.

Technology Comparison		
	Other Technologies	Fox Thermal - Thermal Mass Flow Measurement
Flow Measurement of gases	Other technologies require multiple instruments to determine the volumetric flow rate at reference conditions.	Direct mass flow measurement of air and gases in standard volumetric units (ie MSCFD, SCFM, or NM3/H) or mass units (ie LBS/M or KG/H). Each meter has the option for the user to select a variety of flow units (see Operating Specs).
Pressure or temperature compensation	Differential pressure flow meters require pressure and temperature compensation.	No additional pressure or temperature compensation is required. This is a time and cost saving measure. No additional calculations or equipment are needed to calculate flow because the meter measures the mass flow rate.
Turndown	Vortex meters are only suitable for very high flow rates. DP meters do not have good turndown.	Repeatability and exceptionally broad measurement range: up to 1000:1 (100:1 typical). Whether the flow is at a very high or low velocity, Fox Thermal mass flow meters can measure it.
Pressure Drop	If a DP meter is used to measure low velocity flow, a very small orifice is required resulting in high pressure drop.	Low pressure drop - the pressure drop of a thermal mass flow meter is negligible.
Moving Parts	Meters with moving parts, like Turbine meters, require regular maintenance.	No moving parts which means no problems with wear, binding, etc.
Price	Ultrasonic meters are especially expensive.	Cost effective. Thermal mass flow meters offer a low cost alternative.
Installation	Some meter technologies are complicated and difficult to install, require additional equipment, or long straight pipe run requirements.	Easy to install with insertion and inline configurations. Insertion meters are easy to install, inline meters come equipped with flow conditioners to help reduce the straight run requirements. Communication options available and intrinsic to meter electronics.
Operation	Most manufacturers build meters for a single purpose, gas calibration, or application. The customer must sift through pages of specs to find the right meter for their application.	Microprocessor based, field rangeable electronics. Fox Thermal pioneered the use of microprocessors in thermal mass flow meters and continues to create innovative solutions to measurement needs across many industries and applications. Gas-SelectX®, available in the Model FT1, allows the user to change the gas selection in the field. Displays with configuration panels and free software allow users to interact and program the meter in the field. Using the online Product Configurator, the customer can enter process data into the system for an instant Fox Thermal product recommendation: no need to search a list of meters for the one that's right for you.

Make downtime a thing of the past.

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