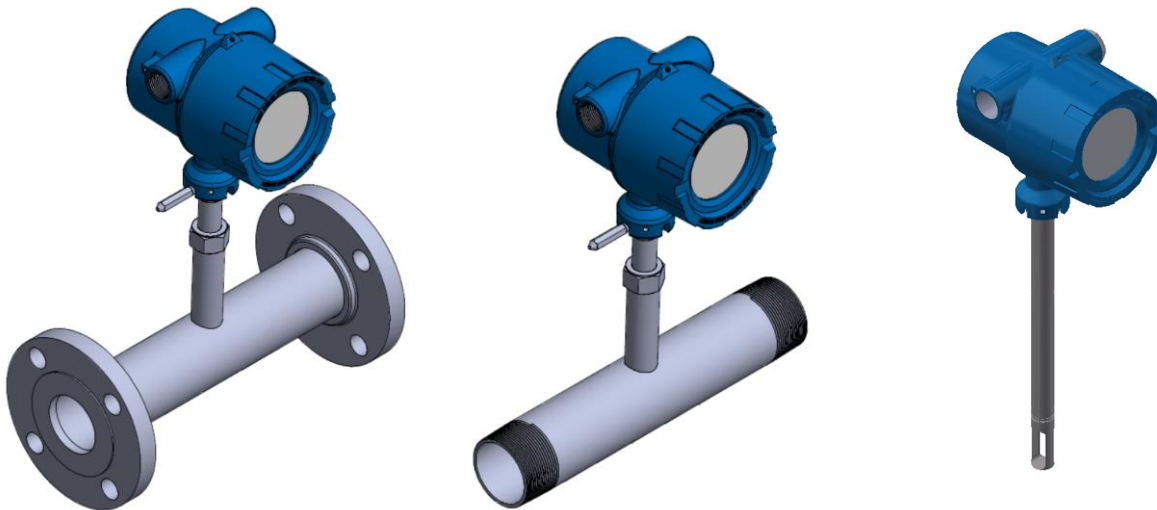


FMP Series

Gas Flow Meters for Permanent Installation



Product Description

The FMP... series flow meters measure and display the pressure / temperature compensated instantaneous flow of common fuel gases such as natural gas, propane, and digester gas. Totalized flow can also be displayed. Both an insertion type meter and an inline type meter (with flow straightening) are available.

The inline type of meter is orderable with either ANSI #150 flanges or NPT threads depending on pipe size.

Calibration of the meter can be automatically checked. Yearly re-calibrations are typically not required.

Product Description (continued)



Insertion style, available with either at 9" or a 12" probe. Used for 1 ½" thru 8" pipe. Installed through the wall of the pipe with a ¾" NPT weld-o-let and a compression fitting. Probe is stainless steel.



Inline flanged style with flow straightener, available in pipe sizes 2" thru 6" with ANSI #150 flanges. Carbon steel is standard, also available in stainless steel.



Inline NPT style with flow straightener, available in pipe sizes 1" thru 3". Carbon steel is standard, some sizes also available in stainless steel.

Product Description (continued)

The gas flow meter may be mounted in horizontal or vertical piping. See Figure 3 below for the necessary distance of straight pipe upstream and downstream of the meter. If the meter is not mounted per the requirements below, unstable and inaccurate flow readings are likely to result.

Note: Proper upstream and downstream pipe diameters are critical to achieve accurate and stable flow readings. Gas must be dry (non-condensing) – moisture droplets in the flow stream will also cause inaccurate and erratic flow readings.

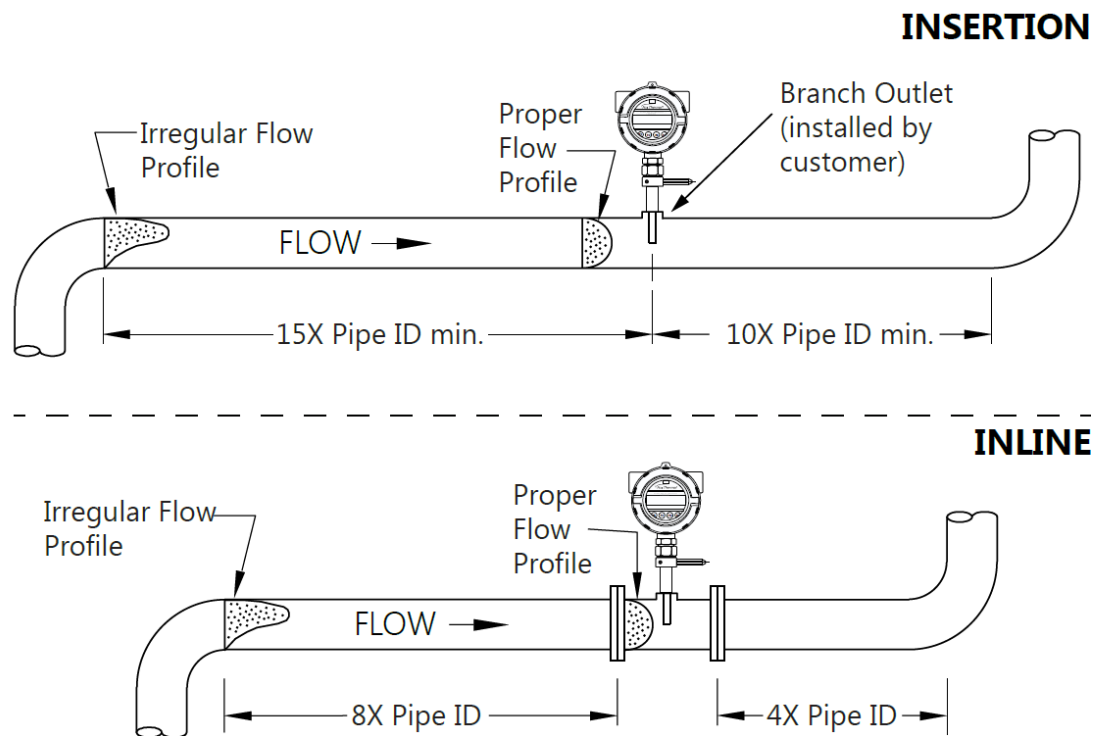


Figure 1: Necessary Amount of Straight Pipe for Mounting Flow Meter

Features

- Measures and displays the instantaneous flow of natural gas, propane, or biogas / digester gas
- Automatically compensates for gas temperature and pressure
- Insertion meter accommodates pipe sizes of 1-1/2" to 8"
- Inline meter accommodates pipe sizes of 1" to 6"
- Directly connects to external devices such as LMV5x, LMV3x, and PLC / touchscreen systems via 4-20mA or pulse output

Product Part Numbers

For flow meter kit part number identification only. Not all possible part number combinations are available. See Table 1 and Table 2 on the following pages for available flow meter kit part number combinations.

FMP 109 - B 200 - NG - A							
Flow Meter Kit Type							
Type of Meter							
109	= FT1 with 9" Probe - Insertion Type						
112	= FT1 with 12" Probe - Insertion Type						
360	= FT1 in Carbon Steel NPT - Inline Type						
365	= FT1 in Stainless Steel NPT - Inline Type						
460	= FT1 in Carbon Steel Flanged - Inline Type						
465	= FT1 in Stainless Steel Flanged - Inline Type						
Output Signals							
B	= Both Analog 4-20 and Pulse						
Schedule 40 Pipe Size							
150	= 1-1/2 inch						
200	= 2 inch						
250	= 2-1/2 inch						
300	= 3 inch						
400	= 4 inch						
500	= 5 inch						
600	= 6 inch						
800	= 8 inch						
Type of Gas							
NG	= Natural Gas						
PG	= Propane Gas						
WG	= Biogas (Waste Gas)						
Additional Descriptor							
A	= Standard						

Product Part Numbers (continued)**Table 1: Insertion Type Gas Flow Meters**

PART #	SCH 40 Pipe Trade Size	Meter Probe Length	Gas Type	Min Flow (Cutoff)	Max Flow (AGA)	Max Boiler Output	Max Boiler Output
	(in)	(in)		(SCFH)	(SCFH)	(BHP) ¹	(LB/HR) ²
FMP109-B150-NG-A	1 1/2	9	Natural Gas	47	20758	527	17810
FMP109-B200-NG-A	2			78	34215	869	29356
FMP109-B250-NG-A	2 1/2			111	48818	1240	41885
FMP109-B300-NG-A	3			171	75378	1914	64673
FMP109-B400-NG-A	4			295	129802	3296	111368
FMP109-B500-NG-A	5			464	203987	5180	175017
FMP109-B600-NG-A	6			669	294577	7480	252741
FMP112-B300-NG-A	3	12		171	75378	1914	64673
FMP112-B400-NG-A	4			295	129802	3296	111368
FMP112-B600-NG-A	6			669	294577	7480	252741
FMP112-B800-NG-A	8			1159	510095	12952	437651
FMP109-B150-PG-A	1 1/2	9	Propane	47	20758	1318	44525
FMP109-B200-PG-A	2			78	34215	2172	73389
FMP109-B250-PG-A	2 1/2			111	48818	3099	104712
FMP109-B300-PG-A	3			171	75378	4785	161683
FMP109-B400-PG-A	4			295	129802	8240	278420
FMP109-B500-PG-A	5			464	203987	12949	437541
FMP109-B600-PG-A	6			669	294577	18700	631852
FMP112-B300-PG-A	3	12		171	75378	4785	161683
FMP112-B400-PG-A	4			295	129802	8240	278420
FMP112-B600-PG-A	6			669	294577	18700	631852
FMP112-B800-PG-A	8			1159	510095	32381	1094127

Notes:

- Boiler Horsepower numbers assume the following:
 - Natural gas heating value of 1000 BTU / SCF
 - Propane heating value of 2500 BTU / SCF
 - Biogas heating value of 550 BTU / SCF
 - Boiler efficiency of 85%
- Steam flow numbers assume 230°F feedwater and 100 PSIG steam.

Product Part Numbers (continued)

Table 1: Insertion Type Gas Flow Meters (continued)

PART #	SCH 40 Pipe Trade Size	Meter Probe Length	Gas Type	Min Flow (Cutoff)	Max Flow (AGA)	Max Boiler Output	Max Boiler Output
	(in)	(in)		(SCFH)	(SCFH)	(BHP) ¹	(LB/HR) ²
FMP109-B150-WG-A	1 1/2	9	Biogas / Digester Gas	47	20758	290	9796
FMP109-B200-WG-A	2			78	34215	478	16146
FMP109-B250-WG-A	2 1/2			111	48818	682	23037
FMP109-B300-WG-A	3			171	75378	1053	35570
FMP109-B400-WG-A	4			295	129802	1813	61252
FMP109-B500-WG-A	5			464	203987	2849	96259
FMP109-B600-WG-A	6			669	294577	4114	139007
FMP112-B300-WG-A	3	12		171	75378	1053	35570
FMP112-B400-WG-A	4			295	129802	1813	61252
FMP112-B600-WG-A	6			669	294577	4114	139007
FMP112-B800-WG-A	8			1159	510095	7124	240708

Notes:

- Boiler Horsepower numbers assume the following:
 - Natural gas heating value of 1000 BTU / SCF
 - Propane heating value of 2500 BTU / SCF
 - Biogas heating value of 550 BTU / SCF
 - Boiler efficiency of 85%
- Steam flow numbers assume 230°F feedwater and 100 PSIG steam.

Product Part Numbers (continued)

Table 2: Inline Type Gas Flow Meters with Integral Flow Straightener – also see pressure drop tables

PART #	SCH 40 Pipe Trade Size	Gas Type	Spool Piece w/ integral flow straightener	Min Flow (Cutoff)	Max Flow (AGA)	Max Boiler Output	Max Boiler Output
	(in)			(SCFH)	(SCFH)	(BHP) ¹	(LB/HR) ²
FMP365-B100-NG-A	1	Natural Gas	Stainless Steel / NPT	20	8812	224	7561
FMP365-B125-NG-A	1 1/4			35	15251	387	13085
FMP365-B150-NG-A	1 1/2			47	20758	527	17810
FMP360-B200-NG-A	2		Carbon Steel / NPT	78	34215	869	29356
FMP360-B250-NG-A	2 1/2			111	48818	1240	41885
FMP360-B300-NG-A	3			171	75378	1914	64673
FMP460-B200-NG-A	2		Carbon Steel / ANSI 150# Flanged	78	34215	869	29356
FMP460-B250-NG-A	2 1/2			111	48818	1240	41885
FMP460-B300-NG-A	3			171	75378	1914	64673
FMP460-B400-NG-A	4			295	129802	3296	111368
FMP460-B600-NG-A	6			341	150000	3809	128697
FMP465-B200-NG-A	2		Stainless Steel / ANSI 150# Flanged	78	34215	869	29356
FMP465-B250-NG-A	2 1/2			111	48818	1240	41885
FMP465-B300-NG-A	3			171	75378	1914	64673
FMP465-B400-NG-A	4			295	129802	3296	111368
FMP465-B600-NG-A	6			341	150000	3809	128697

Notes:

- Boiler Horsepower numbers assume the following:
 - Natural gas heating value of 1000 BTU / SCF
 - Propane heating value of 2500 BTU / SCF
 - Biogas heating value of 550 BTU / SCF
 - Boiler efficiency of 85%
- Steam flow numbers assume 230°F feedwater and 100 PSIG steam.
- Inline flow meters have an integral flow straightener. This may cause significant pressure drop at high velocity / flow rates. See Tables 3 thru 5.

Product Part Numbers (continued)

Table 2: Inline Type Gas Flow Meters with Integral Flow Straightener (continued) – also see pressure drop tables

PART #	SCH 40 Pipe Trade Size	Gas Type	Spool Piece w/ integral flow straightener	Min Flow (Cutoff)	Max Flow (AGA)	Max Boiler Output	Max Boiler Output
	(in)			(SCFH)	(SCFH)	(BHP) ¹	(LB/HR) ²
FMP365-B100-PG-A	1	Propane	Stainless Steel / NPT	20	8812	559	18902
FMP365-B125-PG-A	1 1/4			35	15251	968	32712
FMP365-B150-PG-A	1 1/2			47	20758	1318	44525
FMP360-B200-PG-A	2		Carbon Steel / NPT	78	34215	2172	73389
FMP360-B250-PG-A	2 1/2			111	48818	3099	104711
FMP360-B300-PG-A	3			171	75378	4785	161682
FMP460-B200-PG-A	2		Carbon Steel / ANSI 150# Flanged	78	34215	2172	73389
FMP460-B250-PG-A	2 1/2			111	48818	3099	104711
FMP460-B300-PG-A	3			171	75378	4785	161682
FMP460-B400-PG-A	4			295	129802	8240	278419
FMP460-B600-PG-A	6			341	150000	9522	321742
FMP365-B100-WG-A	1	Biogas / Digester Gas	Stainless Steel / NPT	20	8812	123	4158
FMP365-B125-WG-A	1 1/4			35	15251	213	7197
FMP365-B150-WG-A	1 1/2			47	20758	290	9795
FMP365-B200-WG-A	2			78	34215	478	16146
FMP365-B250-WG-A	2 1/2			111	48818	682	23037
FMP365-B300-WG-A	3			171	75378	1053	35570
FMP465-B200-WG-A	2		Stainless Steel / ANSI 150# Flanged	78	34215	478	16146
FMP465-B250-WG-A	2 1/2			111	48818	682	23037
FMP465-B300-WG-A	3			171	75378	1053	35570
FMP465-B400-WG-A	4			295	129802	1813	61252
FMP465-B600-WG-A	6			341	150000	2095	70783

Notes:

- Boiler Horsepower numbers assume the following:
 - Natural gas heating value of 1000 BTU / SCF
 - Propane heating value of 2500 BTU / SCF
 - Biogas heating value of 550 BTU / SCF
 - Boiler efficiency of 85%
- Steam flow numbers assume 230°F feedwater and 100 PSIG steam.
- Inline flow meters have an integral flow straightener. This may cause significant pressure drop at high velocity / flow rates. See Table 3 thru 5.

Flow and Pressure Drop Data – Inline Meters

Inline meters have an integral flow straightener, and this flow straightener incurs a pressure drop. The pressure drop (differential pressure across the meter) due to this straightener can be significant at high velocities and flow rates. Pressure drop for insertion type flow meters is negligible and is not charted.

Table 3: Flow rates of Natural Gas at 1-10 inWC differential pressure – 1 PSIG Inlet Pressure

Part Number (FMPx6x-)	Meter Size (in)	Cv	Meter Inlet Pressure 27.72 in WC (1 PSIG)							
			1 inWC		2 inWC		5 inWC		10 inWC	
			SCFH	BHP	SCFH	BHP	SCFH	BHP	SCFH	BHP
B100-NG-A	1	23	1,290	33	1,823	46	2,877	73	4,057	103
B125-NG-A	1-1/4	32	1,794	46	2,536	64	4,003	102	5,645	143
B150-NG-A	1-1/2	52	2,916	74	4,121	105	6,505	165	9,173	233
B200-NG-A	2	106	5,944	151	8,401	213	13,260	337	18,698	475
B250-NG-A	2-1/2	167	9,364	238	13,235	336	20,891	530	29,458	748
B300-NG-A	3	244	13,682	347	19,338	491	30,523	775	43,041	1,093
B400-NG-A	4	411	23,046	585	32,573	827	51,413	1,305	72,499	1,841
B600-NG-A	6	731	40,989	1,041	57,934	1,471	91,443	2,322	128,946	3,274

Table 4: Flow rates of Natural Gas at 10-35 inWC differential pressure – 5 PSIG Inlet Pressure

Part Number (FMPx6x-)	Meter Size (in)	Meter Inlet Pressure (5 PSIG)							
		10 inWC		20 inWC		25 inWC		35 inWC	
		SCFH	BHP	SCFH	BHP	SCFH	BHP	SCFH	BHP
B100-NG-A	1	4,550	116	6,405	163	7,144	181	8,413	163
B125-NG-A	1-1/4	6,330	161	8,911	226	9,940	252	11,706	226
B150-NG-A	1-1/2	10,287	261	14,481	368	16,152	410	19,022	368
B200-NG-A	2	20,970	532	29,518	750	32,925	836	X	X
B250-NG-A	2-1/2	33,037	839	46,505	1,181	X	X	X	X
B300-NG-A	3	48,270	1,226	67,948	1,725	X	X	X	X
B400-NG-A	4	81,307	2,065	114,453	2,906	127,664	3,242	X	X
B600-NG-A	6	144,612	3,672	X	X	X	X	X	X

Notes:

1. Boiler Horsepower numbers assume the following:
 - a. Natural gas heating value of 1000 BTU / SCF
 - b. Boiler efficiency of 85%
 - c. "X" indicates that the maximum allowable flow is exceeded

Flow and Pressure Drop Data – Inline Meters (continued)

Table 5: Flow rates of Natural Gas at 10-30 inWC differential pressure – 10 PSIG Inlet Pressure

Part Number (FMPx6x-)	Meter Size (in)	Meter Inlet Pressure (10 PSIG)							
		10 inWC		20 inWC		25 inWC		30 inWC	
		SCFH	BHP	SCFH	BHP	SCFH	BHP	SCFH	BHP
B100-NG-A	1	5,100	129	7,185	182	8,019	204	8,768	223
B125-NG-A	1-1/4	7,095	180	9,997	254	11,156	283	12,198	310
B150-NG-A	1-1/2	11,530	293	16,245	412	18,129	460	19,822	503
B200-NG-A	2	23,502	597	33,115	841	X	X	X	X
B250-NG-A	2-1/2	37,027	940	X	X	X	X	X	X
B300-NG-A	3	54,100	1,374	76,227	1,936	X	X	X	X
B400-NG-A	4	91,127	2,314	128,399	3,260	X	X	X	X
B600-NG-A	6	X	X	X	X	X	X	X	X

Notes:

1. Boiler Horsepower numbers assume the following:
 - a. Natural gas heating value of 1000 BTU / SCF
 - b. Boiler efficiency of 85%
 - c. "X" indicates that the maximum allowable flow is exceeded

Higher inlet pressures (higher gas line pressure) compress the gas so that more gas can flow through a given cross sectional area. This results in higher flows at higher inlet pressures for a given differential pressure across the inline flow meter.

Looking at it in a different way, if inlet pressure is higher than stated in the tables above the differential pressure will be lower for a given flow rate.

For other fuels and pressure drops the following pages give equations so that the flow can be calculated.

Flow and Pressure Drop Data – Inline Meters (continued)

Flow rate (SCFH) thru the meter for a given pressure drop may be estimated using the equation below and the C_v values from Table 3.

$$Q = 1360 \times C_v \times \left(\sqrt{\frac{P_1 + P_2}{GT_f}} \right) \times \left(\sqrt{\frac{P_1 - P_2}{2}} \right)$$

...where...

C_v = Flow coefficient (see Table 3)

G = Specific gravity of gas (see Table 6)

P_1 = Absolute inlet pressure in PSIA (PSIG + 14.7)

P_2 = Absolute outlet pressure in PSIA (PSIG + 14.7)

Q = Flow rate in SCFH

T_f = Media temperature in degrees Rankine ($^{\circ}\text{F} + 460$)

Boiler horsepower is calculated using the equation below.

$$\text{Boiler hp} = Q \times (\text{HHV}) \times \eta \times \frac{1 \text{ Boiler hp}}{33,475 \text{ BTU/HR}}$$

...where...

Q = Flow rate (SCFH)

HHV = Higher Heating Value (BTU/SCF)

η = Boiler efficiency (assume: 85% efficiency or 0.85)

Table 6: Constants for Boiler Horsepower Calculations by Applicable Gases

Type of Gas	Specific Gravity	Higher Heating Value (BTU/SCF)
Natural Gas	0.64	1000
Propane	1.52	2500
Digester Gas	0.86	550

Specifications

Operating characteristics	Media to be measured	Natural gas, propane, biogas, air, and others
	Units for flow	SCFH and others ¹
	Maximum flow	See Table 1 and Table 2
	Maximum pressure (at 100° F)	
	Insertion	740 PSIG [51 bar] – SS Ferrule ²
	Inline NPT	300 PSIG [20.6 bar]
	Inline #150 Flanged CS	285 PSIG [20.3 bar]
	Inline #150 Flanged SS	230 PSIG [15.8 bar]
	Ambient temperature range	-40 to 158°F [-40 to 70°C]
	Media temperature range	-40 to 250°F [-40 to 121°C]
	Accuracy	+/- 1.5% of reading +/- 0.5% of full scale
	Straight length pipe requirements	
	Insertion upstream	15 x pipe ID min.
	Insertion downstream	10 x pipe ID min.
	Inline upstream	8 x pipe ID min.
	Inline downstream	4 x pipe ID min.
	Repeatability	+/- 0.20% of full scale
	Maximum medium humidity	90% (non-condensing)
	Meter turndown	1000 to 1 max. 100 to 1 Typical
	Power requirements	12 to 28 VDC 20 watts max.
	Standard output signals	4-20mA analog 0 to 100 Hz pulse
	Enclosure ratings	NEMA 4x (IP66/67) ³ FM Class 1 Division 1 Groups B,C,D

Notes:

1. SI units for flow are possible by changing the configuration of the meter.
2. The insertion type meters must be used with Stainless Steel (SS) ferrules for the 740 PSIG rating. If the non-swaging PTFE (Teflon) ferrules are used, max pressure is 60 PSIG. Stainless steel ferrules are recommended for permanent installations.
3. Proper liquid tight fittings are required to maintain NEMA 4X ratings.
4. Meter automatically compensates for the pressure and temperature of the gas.

Components

Figure 1 shows the components included with a FMP109... or a FMP112... insertion flow meter for permanent installation. Please see Installation Instructions FMP-1100 for additional information.



Figure 1: Components Included with the FMP109... or a FMP112... Insertion flow meter

1. Insertion flow meter FMP109... (9" probe) or FMP112... (12" probe)
2. Tube to pipe adapter - 3/4" tube to 1" NPT
3. Tube to pipe adapter - 3/4" tube to 3/4" NPT
4. Not Shown – PTFE (Teflon) ferrule kit
5. Not Shown – FT1 flow meter manual
6. Not Shown – Two spare flow meter fuses

Note: Meter requires an external DC power source (typically 24 VDC- 30W) for operation

Components (continued)

Figure 2 shows the components included with a FMP36... or a FMP46... inline flow meter for permanent installation. Please see Installation Instructions FMP-1100 for additional information.

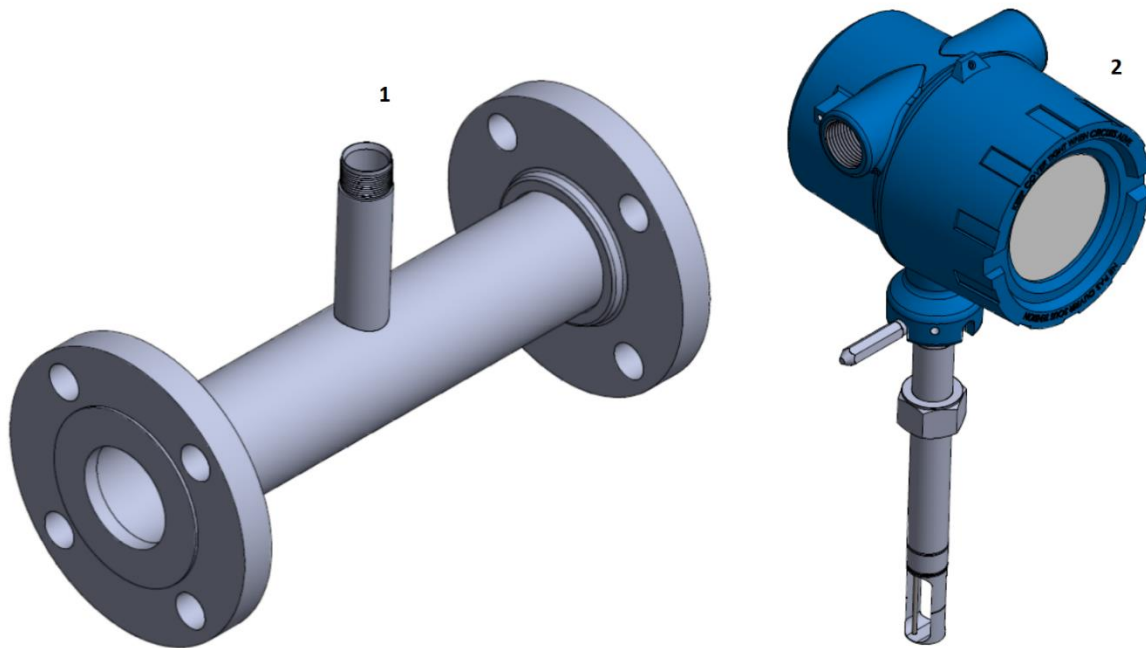


Figure 2: Components Included with the FMP36... or FMP46... Inline flow meter

1. Spool piece with integral flow straightener – ANSI #150 shown
2. Flow meter matched to flow straightener
3. Not Shown – FT1 flow meter manual
4. Not Shown – Two spare flow meter fuses

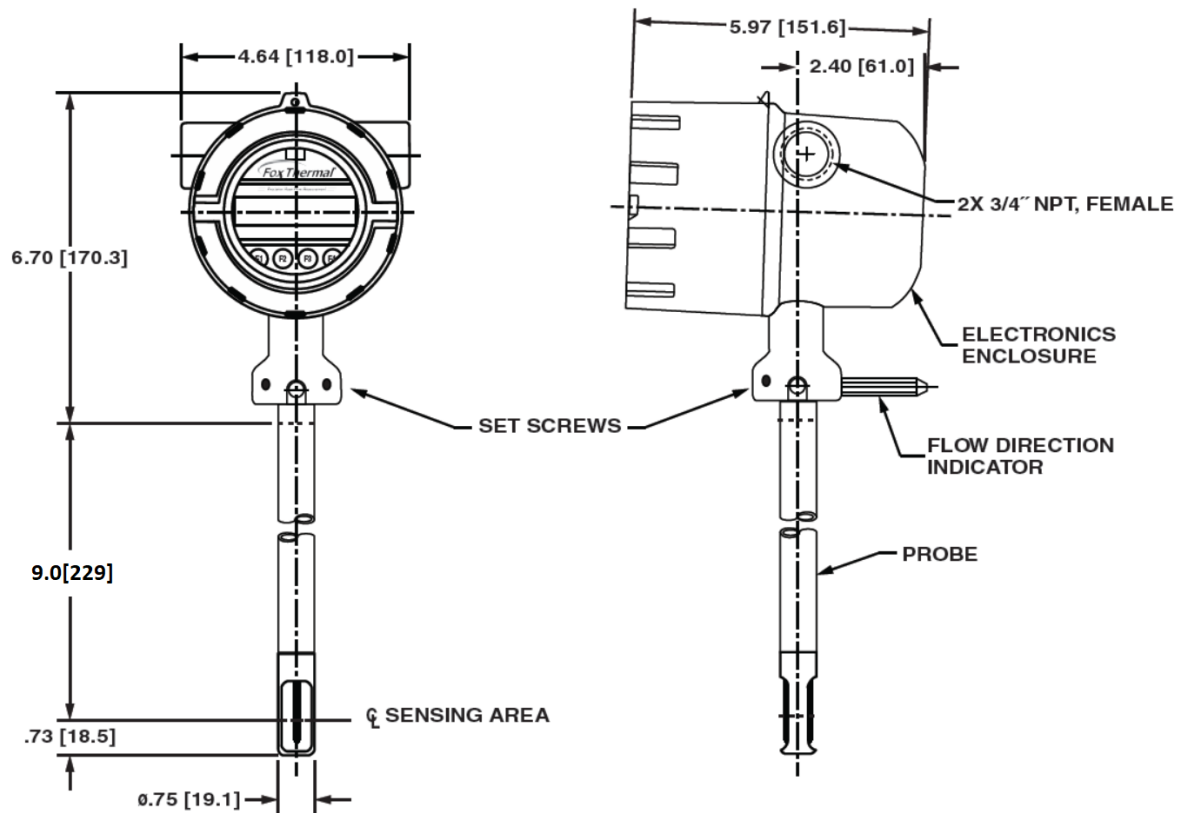
Note: Meter requires an external DC power source (typically 24 VDC – 30W) for operation.

Note: Some inline meters ship in two pieces, as shown above. Both the meter and the spool piece are labeled with a matching serial number. Ensure that the serial number on the meter matches the serial number on the flow section when assembled especially when multiple, identical meters are ordered and installed.

Dimensions

Dimensions in inches; millimeters in brackets

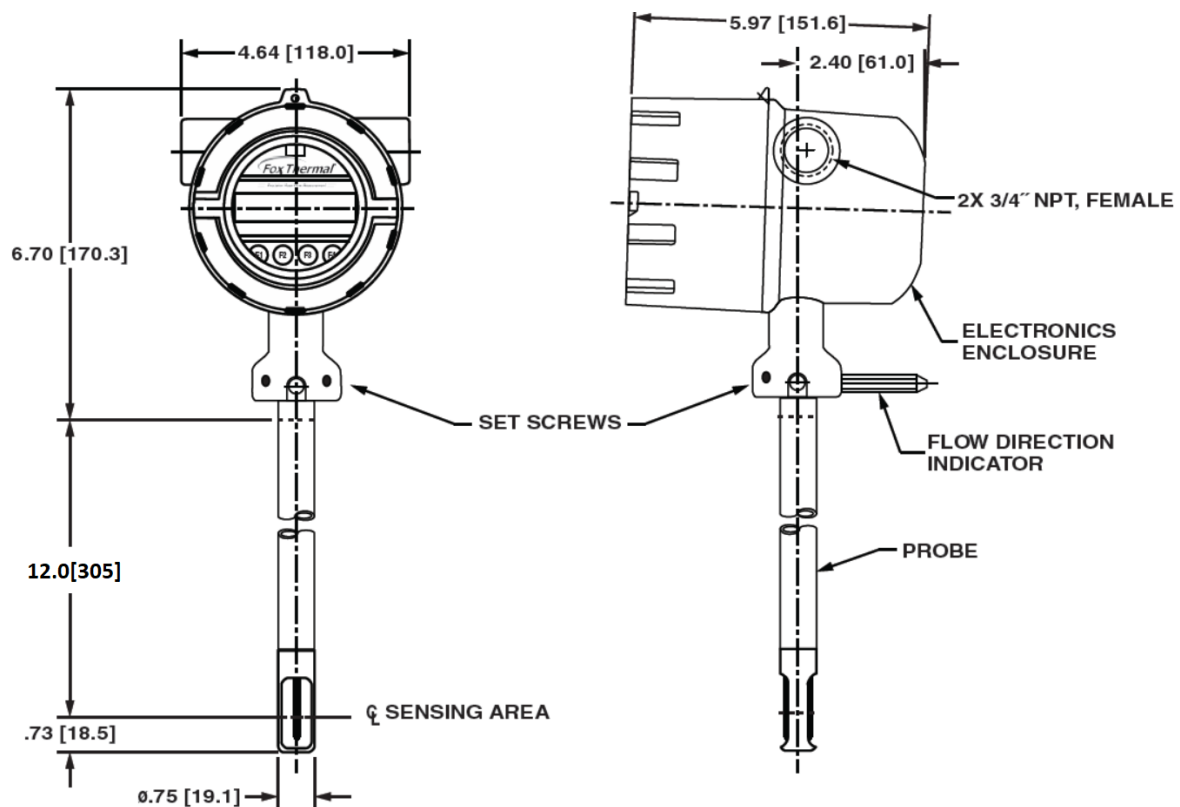
Insertion Type – FMP109...



Dimensions (continued)

Dimensions in inches; millimeters in brackets

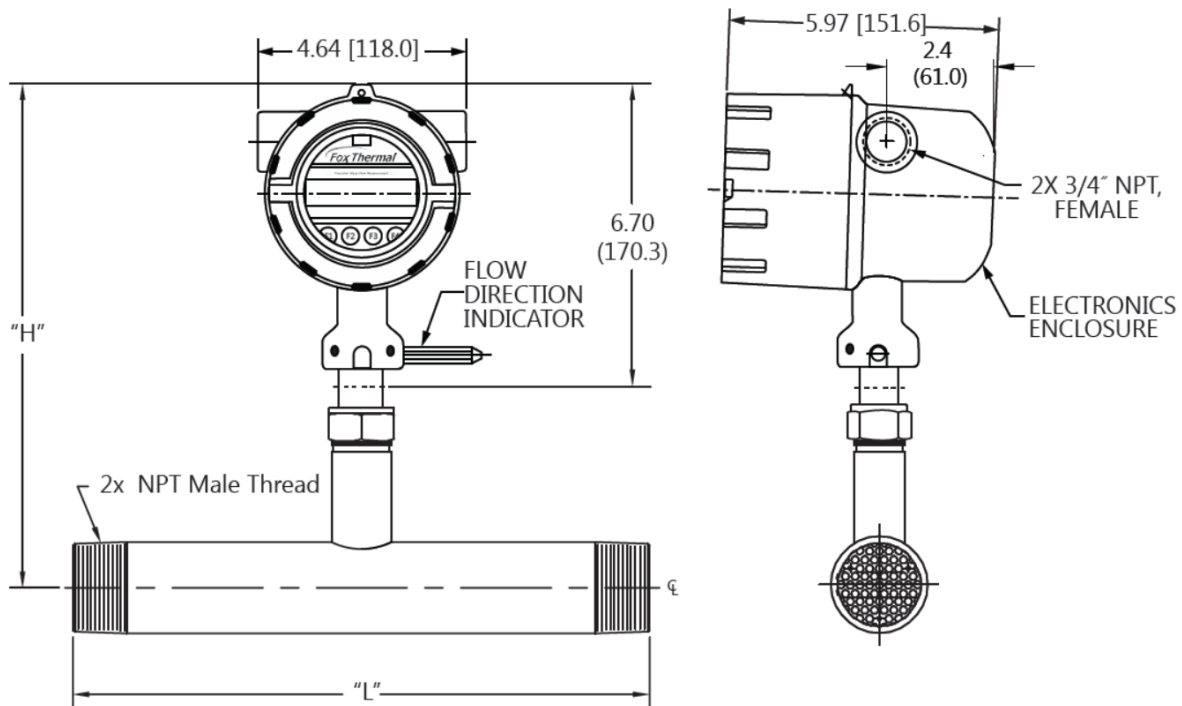
Insertion Type – FMP112...



Dimensions (continued)

Dimensions in inches; millimeters in brackets

Inline Type (NPT) – FMP36....

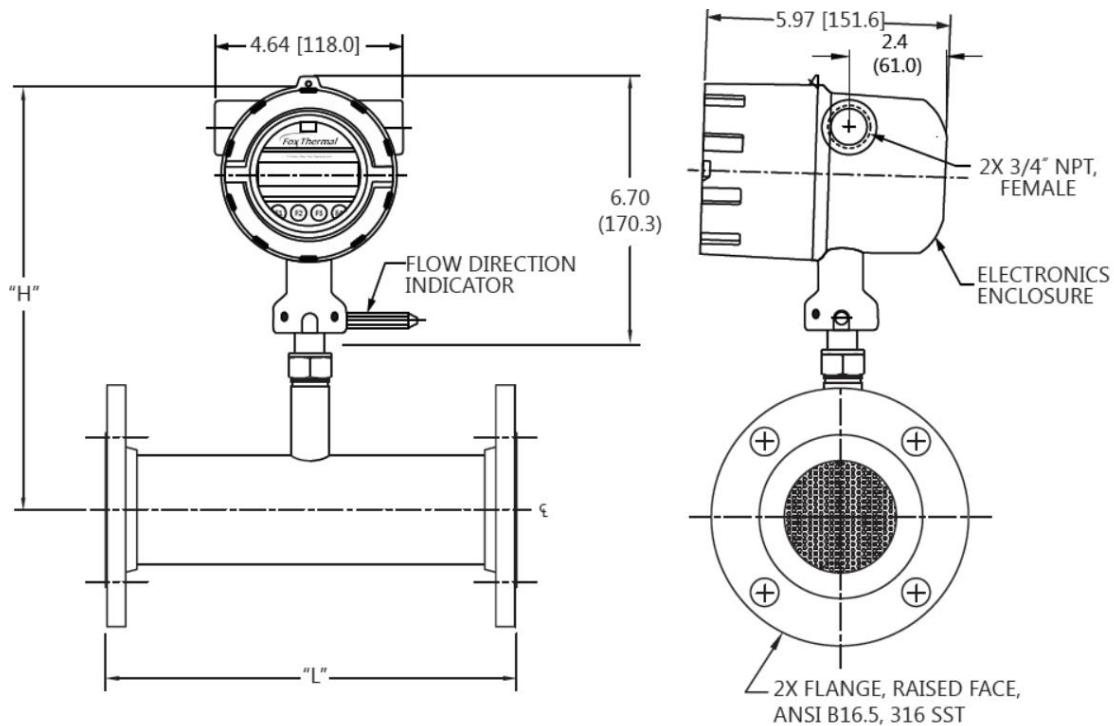


FMP36... Dimensions			
Part #	SCH 40 Pipe Size - in	Dimension "L"	Dimension "H"
FMP36x-B100...	1	12 (305)	10.7 (272)
FMP36x-B125...	1 1/4	12 (305)	10.7 (272)
FMP36x-B150...	1 1/2	12 (305)	12.7 (323)
FMP36x-B200...	2	12 (305)	12.7 (323)
FMP36x-B250...	2 1/2	18 (458)	12.7 (323)
FMP36x-B300...	3	18 (458)	12.7 (323)

Dimensions (continued)

Dimensions in inches; millimeters in brackets

Inline Type (ANSI #150) – FMP46....



FMP46... Dimensions			
PART#	SCH 40 Pipe Size - in	Dimension "L"	Dimension "H"
FMP46x-B200...	2	12 (305)	12.7 (323)
FMP46x-B250...	2 1/2	18 (458)	12.7 (323)
FMP46x-B300...	3	18 (458)	12.7 (323)
FMP46x-B400...	4	18 (458)	12.7 (323)
FMP46x-B600...	6	24 (611)	12.7 (323)

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