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Flow Measurement Catalog

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Flow Measurement Catalog

Product Catalog

Sixth Edition

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Spirax Sarco, your global partner
Spirax Sarco assists our customers to achieve environmentally friendly solutions for energy savings, process efficiencyimprovements and plant health, safety and regulatory requirements. Originally formed as the Sanders Rehders Company in 1888 in London, our worldwide steam business is today part of the Spirax Sarco Engineering plc Group, which has been listed on the London Stock Exchange since 1959.

With over 100 years of expertise across industry, our holistic approach allows us to apply unequaled engineering knowledge in putting together complete solutions for our customers. 1,100 engineers in 33 countries worldwide work alongside steam users and specifiers to improve the performance of their plant and processes, and maximize return on investment.

A flow meter solutions provider
EMCO is the brand of precision flow meters for liquid, gas, and steam applications, accommodating a wide range of pipe sizes. Field proven for over 40 years, the EMCO product line offers solutions for measurement, including industrial inline vortex, industrial insertion vortex and turbine, and variable area flow products. EMCO products provide a wide range of metering solutions to diverse industries, including the military, hospitals, universities, and many Fortune 500 companies.

Our aim is to provide a metering solution that helps our customers achieve operational improvement through their production capability, usually in the form of reduced energy usage, improved product quality, lower emissions and greater production throughout. Reducing emissions, carbon footprint, and your company's impact on the environment is our goal. Not only will this have a strong social and environmental impact but also a positive economic impact today and well into the future.

Flowmeters

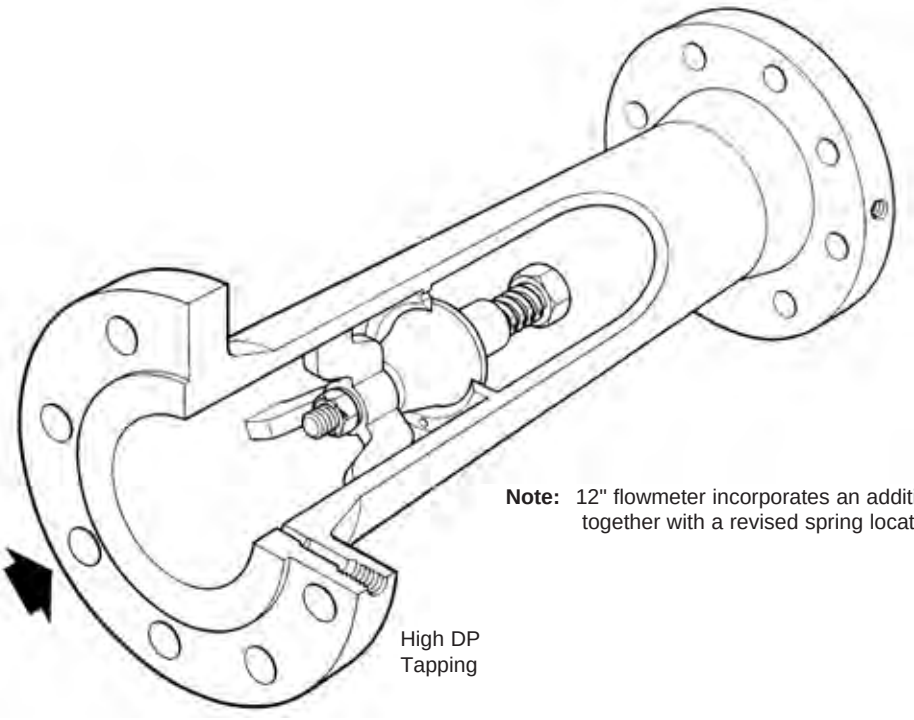
for steam, liquids and gases.

Our range of Flowmeters are suitable for accurate measurement of steam, liquids and gases in pipe sizes 1/2" to 80" at flowing pressures to 5,000 psig and flowing temperatures to 842°F.

Flow Measurement Index

Flow Measurement Index

Gilflo Flowmeters - 'Spool' Pipeline Unit



Note: 12" flowmeter incorporates an additional shaft support together with a revised spring location.

Description

The Gilflo 'Spool' flowmeter is installed in the pipeline and produces a differential pressure which is related to the rate of flow. It can be used with most industrial fluids, gases and both saturated and superheated steam.

Sizes and Pipe Connections

3", 4", 6", 8" and 12"
Flanges available to ANSI B.16.5 class 300

Limiting Conditions

Minimum operating pressure	9 psig
Maximum operating pressure	740 psig
Minimum operating temperature	-58˚F
Maximum operating temperature	842˚F
Maximum viscosity	30 centipoise

Turndown

The Gilflo will provide accurate measurement over a flow range of 100:1.

Accuracy

To achieve accuracy of a ± 1% of reading, all Gilflo meters must be used in conjunction with a device capable of performing electronic linearism such as:

- M750 Flow Computer
- Customer's EMS, DCS or equivalent
- M800 Steam Flow Computer
- M800 Gas Flow Computer

Note: When used with M800 flow computers, Gilflo accuracy is +/- 1% of reading from 5% to 100% of maximum rated flow. For flows from 1% to 5% of maximum rated flow, accuracy will be better than ± 1% FSD.

Repeatability

The Gilflo is repeatable to better than 0.25%.

Pressure Drop

Less than 140 inches H_2O (349 mbar) at rated capacity

Flow Capacity

To determine the maximum flow capacity of a Gilflo 'Spool', it is necessary to calculate the equivalent water flowrate (Q_e). See under the section ''Sizing the Gilflo 'Spool' flowmeter".

Materials of Construction

Body	Carbon Steel	ASTM A105/A106/A234
Internals	Mostly Stainless Steel	S304/S316
Spring	Inconel X750	

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

Gilflo Flowmeters - 'Spool' Pipeline Unit

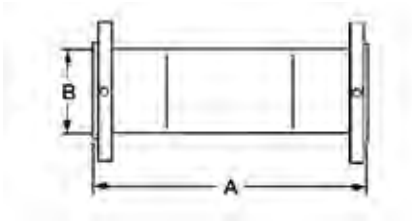
Dimensions / Weights (approximate) in inches and lbs

SIZE	A	B	Weight
3"	13	3.5	37
4"	21	4.5	81
6"	28	6.6	167
8"	31	8.6	191
12"	40	13	240

H.P. and L.P. pressure tappings are threaded 1/4" NPT (female).

Installation

A separate installation booklet is supplied with each Gilflo 'Spool' flowmeter. The following main points are given for guidance:



1. The Gilflo should be installed with a minimum of 6 straight pipe diameters upstream and 3 downstream. No valves, fittings or cross sectional changes permitted within these pipe lengths. Where an increase in pipe diameter is necessary upstream of a Gilflo flowmeter, the length of straight pipe should be increased to 12 diameters. Similarly, where a Gilflo flowmeter is installed downstream of two 90° bends in two planes, a pressured reducing valve or a partially open valve, 12 pipe diameters should be allowed.

2. The Gilflo flowmeter should normally be mounted horizontally. Vertical installation (with flow vertically downward) is also permissible and must be specified when ordering. Ensure flow is in the correct direction and avoid reverse flow.

3. For steam applications, good basic steam engineering practice should be followed:-
   - Ensure all pipework is adequetly insulated.
   - Ensure correct line drainage through adequate trapping.
   - Where practicable, fit a steam separator upstream of the flowmeter. This should be drained using a float trap set.
   - Ensure good alignment and support of all associated pipework.
   - Achieve line size reduction by the use of eccentric reducers.
   - Avoid close installation (less than 25 pipe diameters) upstrem or downstream of a pressure reducing valve or modulating valve.

See the "Gilfo flowmeters - system overview" TIS 8.008 which provides information of a Gilflo metering system.

Maintenance

There are no user serviceable parts within the 'Gilflo' Spool flowmeter. Mechanical checks to confirm correct operation are described in the manuas that accompanies the flowmeters.

Sizing the Gilflo 'Spool' Flowmeter

1. Determine Equivalent Water Flowrate (Q_e) in U.S. gpm using formulas:

Liquids:

$$Q_e = \frac{m}{500}\sqrt{\frac{D_e}{D_l}} \quad \text{or} \quad Q_e = Q_l\sqrt{\frac{D_l}{D_e}}$$

Q_e = equivalent flow rate of water at 70°F (U.S. gpm)
m = maximum flow rate of service liquid (lb/hr)
D_e = density of water at calibration (62.305 lb/ft³)
D_l = density of service liquid (lb/ft³)
Q_l = maximum flow rate of service liquid (US gpm)

Gases:

$$Q_e = \sqrt{\frac{(0.0158) \times m}{D \times \frac{P_f}{P_s} \times \frac{T_s}{T_f}}}$$

or

$$Q_e = (0.948) \times Q_g \sqrt{D \times \frac{P_s}{P_f} \times \frac{T_f}{T_s}}$$

Q_e = water equivalent flow rate at 70°F (U.S. gpm)
m = maximum flow rate of gas (lb/hr)
D = gas density at 14.7 psia, 520°R (60°F) (lb/ft³)
P_f = flowing pressure of gas (psia)
P_s = standard atmospheric pressure (14.7 psia)
T_s = standard absolute temperature (520°R)
T_f = flowing temperature of gas (°R=°F + 460)
Q_g = maximum flow rate of gas (SCFM)

Steam:

$$Q_e = (0.0158) \times m\sqrt{v}$$

Q_e = water equivalent flow rate at 70°F (U.S. gpm)
m = maximum flow rate of steam (lb/hr)
v = specific volume of steam at normal pressure and temperature (ft³/lb)

2. Select from the table below the meter with a Q_e max. that most closely matches (but exceeds) the application Q_e determined in step 1.

Note: These equivalent water flowrates are based on a differencial pressure of 140 inches H_2O (349 mbar). For saturated steam flow measurement, the table below gives flow capacities in lb/h.

size	Q_e max (gpm)	15 psig	50 psig	75 psig	100 psig	150 psig	200 psig	400 psig
3"	97	1671	2419	2825	3184	3794	4321	6007
4"	249	4302	6230	7276	8199	9771	11129	15469
6"	440	7598	11002	12849	14479	17255	19653	27318
8"	1045	18033	26113	30498	34366	40954	46646	64838
12"	1958	33777	48912	57125	64371	76711	87373	121448

Note: These capacities are based on a differential pressure across the meter of 140 inches H_2O (349 mbar).
Minimum flow is 1% of maximum (100:1 turndown).

How To Order

1 - 6" our Gilflo 'Spool' flowmeter flanged to ANSI B-16-5 class 300.

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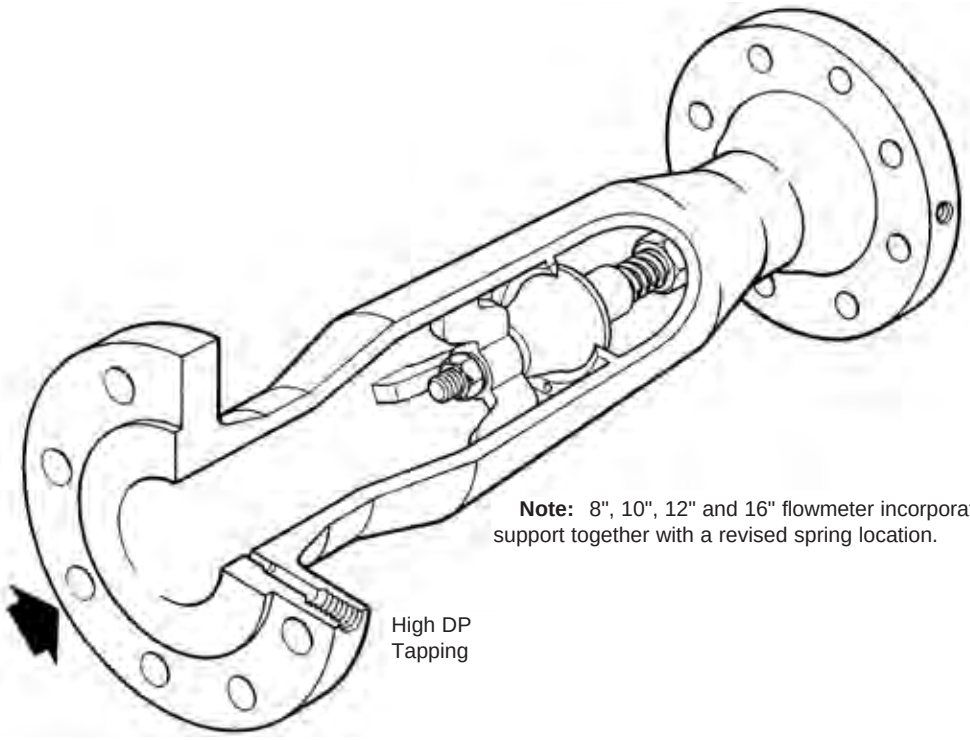
Gilflo Flowmeters - ‘B’ Pipeline Unit



Note: 8", 10", 12" and 16" flowmeter incorporates an additional shaft support together with a revised spring location.

Description

The Gilflo ‘B’ flowmeter is installed in the pipeline and produces a differential pressure which is related to the rate of flow. It can be used with most industrial fluids, gases and both saturated and superheated steam.

Sizes and Pipe Connections

2", 3", 4", 6", 8", 10", 12" and 16"
Flanges available to ANSI B.16.5 class 300

Limiting Conditions

Minimum operating pressure	9 psig
Maximum operating pressure	740 psig
Minimum operating temperature	-58˚F
Maximum operating temperature	842˚F
Maximum viscosity	30 centipoise

Turndown

The Gilflo will provide accurate measurement over a flow range of 100:1.

Accuracy

To achieve accuracy of a ± 1% of reading, all Gilflo meters must be used in conjunction with a device capable of performing electronic linearism such as:

- M750 Flow Computer
- Customer’s EMS, DCS or equivalent
- M800 Steam Flow Computer
- M800 Gas Flow Computer

Note: When used with M800 flow computers, Gilflo accuracy is +/- 1% of reading from 5% to 100% of maximum rated flow. For flows from 1% to 5% of maximum rated flow, accuracy will be better than ± 1% FSD.

Repeatability

The Gilflo is repeatable to better than 0.25%.

Pressure Drop

Less than 140 inches H_2O (349 mbar) at rated capacity

Flow Capacity

To determine the maximum flow capacity of a Gilflo ‘B’, it is necessary to calculate the equivalent water flowrate (Q_e). See under the section ‘’Sizing the Gilflo ‘B’ flowmeter”.

Materials of Construction

Body	Carbon Steel	ASTM A105/A106/A234
Internals	Mostly Stainless Steel	S304/S316
Spring	Inconel X750	

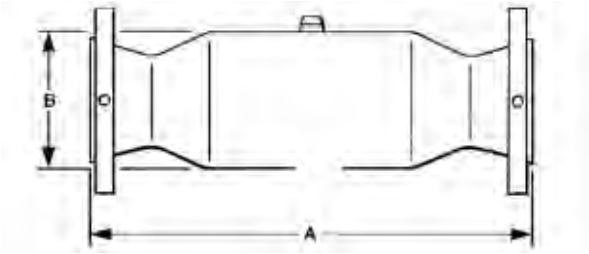
Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

Gilflo Flowmeters - 'B' Pipeline Unit

Dimensions / Weights (approximate) in inches and lbs

SIZE	A	B	Weight
2"	19	3.5	31
3"	21	4.5	48
4"	28	6.6	105
6"	31	8.6	191
8"	39	12.7	270
10"	57	16	565
12"	63	18	748
16"	79	24	1980

H.P. and L.P. pressure tappings are threaded 1/4" NPT (female).
On 16" meter, the pressure tappings are on the body.



Installation

A separate installation booklet is supplied with each Gilflo 'B' flowmeter. The following main points are given for guidance:

1. The Gilflo should be installed with a minimum of 6 straight pipe diameters upstream and 3 downstream. No valves, fittings or cross sectional changes permitted within these pipe lengths. Where an increase in pipe diameter is necessary upstream of a Gilflo flowmeter, the length of straight pipe should be increased to 12 diameters. Similarly, where a Gilflo flowmeter is installed downstream of two 90° bends in two planes, a pressured reducing valve or a partially open valve, 12 pipe diameters should be allowed.

2. The Gilflo flowmeter should normally be mounted horizontally. Vertical installation (with flow vertically downward) is also permissible and must be specified when ordering. Ensure flow is in the correct direction and avoid reverse flow.

3. For steam applications, good basic steam engineering practice should be followed:
   - Ensure all pipework is adequetly insulated.
   - Ensure correct line drainage through adequate trapping.
   - Where practicable, fit a steam separator upstream of the flowmeter. This should be drained using a float trap set.
   - Ensure good alignment and support of all associated pipework.
   - Achieve line size reduction by the use of eccentric reducers.
   - Avoid close installation (less than 25 pipe diameters) upstream or downstream of a pressure reducing valve or modulating valve.

See the "Gilfo flowmeters - system overview" TI-8-008-US which provides information of a Gilflo metering system.

Maintenance

There are no user serviceable parts within the 'Gilflo' Spool flowmeter. Mechanical checks to confirm correct operation are described in the manuals that accompanies the flowmeters.

Sizing the Gilflo 'B' Flowmeter

1. Determine Equivalent Water Flowrate (Q_e) in U.S. gpm using formulas:

Liquids:

$$Q_e = \frac{m}{500}\sqrt{\frac{D_e}{D_l}} \quad \text{or} \quad Q_e = Q_l\sqrt{\frac{D_l}{D_e}}$$

Q_e = equivalent flow rate of water at 70°F (U.S. gpm)
m = maximum flow rate of service liquid (lb/hr)
D_e = density of water at calibration (62.305 lb/ft³)
D_l = density of service liquid (lb/ft³)
Q_l = maximum flow rate of service liquid (US gpm)

Gases:

$$Q_e = \sqrt{\frac{(0.0158) \times m}{D \times \frac{P_f}{P_s} \times \frac{T_s}{T_f}}}$$

or

$$Q_e = (0.948) \times Q_g \sqrt{D \times \frac{P_s}{P_f} \times \frac{T_f}{T_s}}$$

Q_e = water equivalent flow rate at 70°F (U.S. gpm)
m = maximum flow rate of gas (lb/hr)
D = gas density at 14.7 psia, 520°R (60°F) (lb/ft³)
P_f = flowing pressure of gas (psia)
P_s = standard atmospheric pressure (14.7 psia)
T_s = standard absolute temperature (520°R)
T_f = flowing temperature of gas (°R=°F + 460)
Q_g = maximum flow rate of gas (SCFM)

Steam:

$$Q_e = (0.0158) \times m\sqrt{v}$$

Q_e = water equivalent flow rate at 70°F (U.S. gpm)
m = maximum flow rate of steam (lb/hr)
v = specific volume of steam at normal pressure and temperature (ft³/lb)

2. Select from the table below the meter with a Q_e max. that most closely matches (but exceeds) the application Q_e determined in step 1.

Note: These equivalent water flowrates are based on a differencial pressure of 140 inches H_2O (349 mbar). For saturated steam flow measurement, the table below gives flow capacities in lb/h.

size	Q_e max (gpm)	15 psig	50 psig	75 psig	100 psig	150 psig	200 psig	400 psig
2"	94	1625	2353	2748	3096	3690	4203	5842
3"	308	5332	7721	9018	10162	12110	13793	19172
4"	494	8559	12394	14475	16311	19438	22139	30773
6"	1202	20825	30156	35220	39687	47295	53868	74876
8"	2136	37004	53585	62582	70520	84040	95719	133050
10"	2938	50894	73700	86075	96993	115587	131651	182995
12"	5100	88356	127948	149431	168385	200666	228554	317690
16"	8284	143530	207845	242744	273534	325972	371275	516072

Note: These capacities are based on a differential pressure across the meter of 140 inches H_2O (349 mbar).
Minimum flow is 1% of maximum (100:1 turndown).

How To Order

1 - 6" our Gilflo 'B' flowmeter flanged to ANSI B-16-5 class 300.

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Gilflo Flowmeters - System Overview

Description

The Gilflo flowmetering system consists of 2 major parts:-

1. The Gilflo pipeline unit. This may be a Gilflo 'B' or 'Spool' design. This is installed in the line where the flow is to be measured. Using impulse pipework, this is connected to:-
2. The M610 DP Transmitter Assembly. This measures the differential pressure across the Gilflo pipeline unit and converts it to a 4-20 mA output signal. This output signal can be used in a number of ways:-
   - a- To drive a suitable chart recorder or act as an input to an EMS/DCS. This gives a non-compensated signal proportional to rate of flow.
   - b-To supply an M750 Display Unit. This gives a non-compensated display of totalized flow and rate of flow.
   - c-To supply an M800 series Flow Computer, whose keypad allows the user to select the parameters to be viewed as well as allowing access to the numerous facilities available. The diagram shows these configurations.

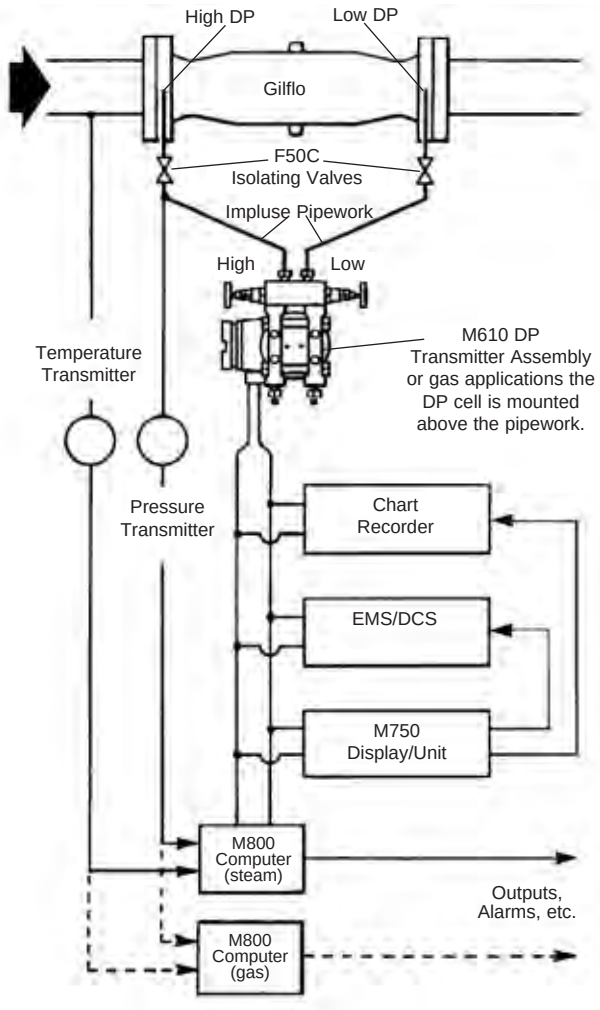
Note:- The Gilflo pipeline unit can be used to measure the flow of most industrial liquids, gases and vapors within the pressure and temperature limits detailed in the TIS's.
Full density compensation from pressure and temperature transmitters is available when using the M800 series Flow Computer for steam applications or the M800 Series Flow Computer for gas applications. See TIS's for details.

Installation

Care must be taken to meet all the requirements of the Installation and Maintenance Instructions that are included with the equipment.

Installation points to watch:-

1. Ensure all pipework is adequately supported and properly aligned.
2. The Gilflo pipeline unit should be selected on capacity rather than line size. Where pipe size reduction on steam systems is necessary, use eccentric reducers to avoid waterlogging.
3. The minimum recommended lengths of straight pipe are 6D upstream and 3D downstream.
4. Take care to ensure the correct direction of flow as indicated by the arrow on the meter body.
5. Take precautions to avoid reverse flow through the meter.
6. Avoid installing the meter downstream of a pressure reducing valve (especially on steam systems) as this may cause inaccuracies and/or possible damage. Similarly avoid installing the meter downstream of a partially open valve.
7. Remember that actuated valves may cause rapid pressure fluctuations which could cause damage.
8. On steam or liquid systems take care to ensure that all impulse lines remain full to prevent damage to the DP transmitter through contact with steam or high temperature liquid.
9. For steam applications, care should be taken to ensure adequate line drainage, trapping etc., so as to avoid condensate slugs impacting the meter. Where practical, steam separators should be fitted. These should be drained using a float trap set.
10. For gas applications ensure that the DP cell and impulse lines are positioned above the pipework. Also ensure that the impulse lines allow free drainage of moisture away from the DP cell and back into the pipeline.



Electrical wiring

All electrical wiring must be carried out to the appropriate standards. Full wiring interconnection details are included with the equipment.

How to specify

For details of how to specify each part of your chosen system refer to individual TIS's listed in the Associated Equipment section.

Associated Equipment

M610	DP Transmitter Assembly	TI-P335-10 US
Gilflo 'B'	Pipeline Unit	TIS 8.006
Gilflo 'Spool'	Pipeline Unit	TIS 8.005
M750	Display Unit	TI-P332-08 US
F50C	Isolating Valve	TIS 8.401
M800	Steam Flow Computer	TI-P331-04-US
M800	Gas Flow Computer	TI-P333-24-US

Gilflo ILVA Flowmeters

Description
The Gilflo ILVA flowmeter operates on the spring loaded variable area principle and produces a differential pressure related to the rate of flow. It can be used with both saturated and superheated steam, gases and most industrial fluids.

Limiting Conditions
The maximum pressure and temperature limitations are the same as the specified flange ratings with an overall maximum temperature of 842°F. Minimum operating temperature -58°F. Minimum operating pressure 9 psig. Maximum viscosity 30 centipoise.

Turndown
The Gilflo ILVA will provide accurate measurement over a flow range of 100:1.

Accuracy
To achieve accuracy of a ± 1% of reading, all Gilflo ILVA meters must be used in conjunction with a device capable of performing electronic linearism such as:
- M750 Flow Computer
- Customer's EMS, DCS or equivalent
- M800 Steam Flow Computer
- M800 Gas Flow Computer

Note: When used with M800 flow computers, Gilflo ILVA accuracy is +/- 1% of reading from 5% to 100% of maximum rated flow. For flows from 1% to 5% of maximum rated flow, accuracy will be better than ± 1% FSD.

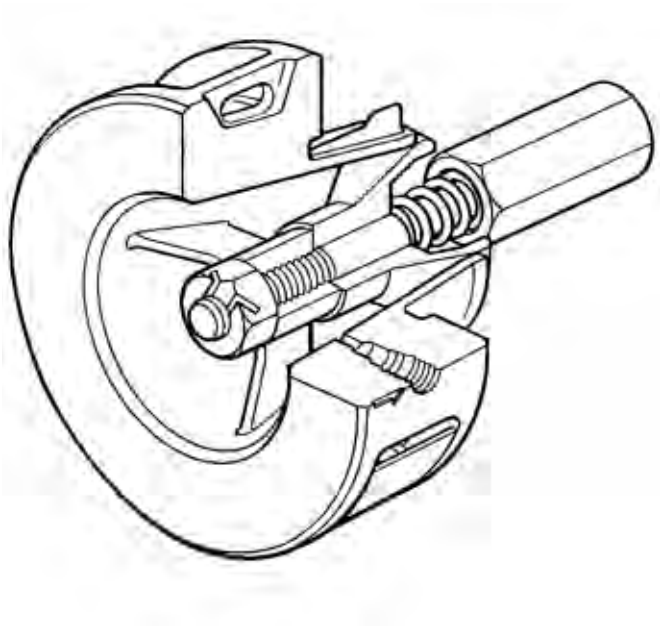
Repeatability
The Gilflo ILVA is repeatable to better than 0.25%.

Pressure Drop
The pressure drop across the Gilflo ILVA pipeline unit is 200 inches water gauge at maximum rated flow.

Flow Capacity
To determine the capacity of the Gilflo ILVA for different fluids, it is necessary to calculate the Equivalent Water Flowrate Qe (in U.S. gpm) as described under the section "sizing the Gilflo ILVA" then selecting the appropriate size of meter from the table.

Construction Materials

Body	Stainless Steel S.316
Internals	431 S29/S303/S304/S316
Spring	Inconel X750 or equivalent



Sizes and Pipe Connections
2", 3", 4", 6", and 8"
Suitable for fitting between the following flanges
ANSI B 16.5 class 150, 300, 600.

How to Specify
6" Gilflo ILVA flowmeter for installation between ANSI 150 flanges. Body material 316 stainless steel. Flow medium saturated steam at 150 psig, maximum flow 20,000 lb/h.

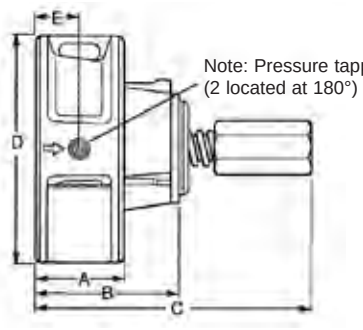
For a general description of the Gilflo ILVA metering system, see TIS 8.010 which also gives details of associated equipment.

Gilflo ILVA Flowmeters

Dimensions (approximate) in inches and lbs.

Size	A	B	C	D	E	Weight (lb)
2"	1.38	2.48	5.51	4.06	.69	4.4
3"	1.77	3.07	5.91	5.43	.89	8.6
4"	2.36	4.06	8.07	6.38	1.48	18.3
6"	2.95	5.28	11.81	8.58	1.48	31.3
8"	3.35	6.34	14.17	10.75	1.67	52.0

Note: Pressure tappings are threaded 1/4" NPT



Installation

A separate installation booklet is supplied with each Gilflo ILVA flowmeter. The following main points are given here for guidance:

1. The Gilflo ILVA should be mounted with a minimum of 6 straight pipe diameters upstream and 3 downstream. No valves, fittings or cross sectional changes are permitted within these pipe lengths. Where an increase in nominal pipe diameter is required upstream of the meter, the length of straight pipe should be increased to 12 diameters. Similarly, where a Gilflo ILVA is installed downstream of two 90 degree bends in two planes, a pressure reducing valve or a partially open valve, 12 upstream pipe diameters should be allowed.
2. Care should be taken to install the Gilflo ILVA concentrically in the line. If this is not done, flow measurement errors may occur.
3. The ILVA meter should be mounted horizontally. For vertical installations, consult your representative.
4. For steam applications, good basic steam engineering practices should be followed:
   Correct line drainage through adequate trapping.
   Good alignment and support of associated pipework.
   Line size changes achieved by the use of eccentric reducers.
5. See TIS 8.010 which provides an overview of the Gilflo ILVA metering system and further installation details.

Maintenance

There are no user serviceable parts in the Gilflo ILVA. A visual check together with confirmation that the orifice/cone reference dimension is within tolerance is possible. Full details are included in the manual that accompanies the meter.

Sizing the Gilflo ILVA for Saturated Steam - lb/h

Maximum flow rates in lb/h at different pressures (psig)

Note: Maximum steam flow rates are calculated at a differential pressure across the Gilflo ILVA pipeline unit of 200 ins H_2O.

Size		15 psig	50 psig	75 psig	100 psig	150 psig	200 psig	400 psig	600 psig
2"	Maximum flow	682	988	1153	1299	1549	1764	2451	3009
	Minimum flow	7	10	12	13	15	18	25	30
3"	Maximum flow	2677	3877	4528	5103	6081	6926	9627	11815
	Minimum flow	27	39	45	51	60	69	96	118
4"	Maximum flow	5492	7953	9288	10466	12473	14206	19747	24236
	Minimum flow	55	79	93	105	125	142	197	242
6"	Maximum flow	13273	19220	22448	25295	30144	34333	47723	58571
	Minimum flow	132	192	224	252	301	343	477	585
8"	Maximum flow	26088	37778	44121	49718	59249	67483	93801	115123
	Minimum flow	260	377	441	497	592	674	938	1151

Sizing the Gilflo ILVA Meter

In order to determine the flow capacity of a Gilflo ILVA pipeline unit, it is necessary to calculate the Equivalent Water Flowrate (Q_e) based on the anticipated actual flow.
Figure 2 is then used to select the appropriate unit.

1. Determine Equivalent Water Flowrate (Q_e) in U.S. gpm:

Liquids:

$$Q_e = \frac{m}{500}\sqrt{\frac{D_e}{D_l}} \quad \text{or} \quad Q_e = Q_l\sqrt{\frac{D_l}{D_e}}$$

Q_e = equivalent flow rate of water at 70°F (U.S. gpm)
m = maximum flow rate of service liquid (lb/hr)
D_e = density of water at calibration (62.305 lb/ft³)
D_l = density of service liquid (lb/ft³)
Q_l = maximum flow rate of service liquid (US gpm)

Gases:

$$Q_e = \sqrt{D \times \frac{P_f}{P_s} \times \frac{T_s}{T_f}}\ (0.0158) \times m$$

$$\text{or } Q_e = (0.948) \times Q_g \sqrt{D \times \frac{P_s}{P_f} \times \frac{T_f}{T_s}}$$

Q_e = water equivalent flow rate at 70°F (U.S. gpm)
m = maximum flow rate of gas (lb/hr)
D = gas density at 14.7 psia, 520°R (60°F) (lb/ft³)
P_f = flowing pressure of gas (psia)
P_s = standard atmospheric pressure (14.7 psia)
T_s = standard absolute temperature (520°R)
T_f = flowing temperature of gas (°R=°F + 460)
Q_g = maximum flow rate of gas (SCFM)

Steam:

$$Q_e = (0.0158) \times m \sqrt{v}$$

Q_e = water equivalent flow rate at 70°F (U.S. gpm)
m = maximum flow rate of steam (lb/hr)
v = specific volume of steam at normal pressure and temperature (ft³/lb)

2. Select from the table below the Gilflo ILVA meter with a maximum Q_e that closely matches (but exceeds) the application Q_e determined in step 1.

Meter size	Max. Q_e U.S. gpm	Max. DP ins Wg
2"	40	200
3"	158	200
4"	317	200
6"	781	200
8"	1,535	200

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Gilflo ILVA Flowmeter
10" and 12"

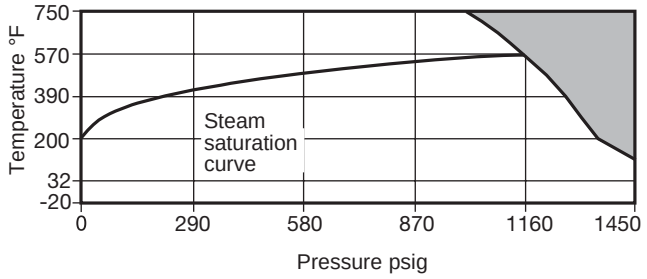
Description
The Gilflo ILVA flowmeter operates on the spring loaded variable area principle and produces a differential pressure related to the rate of flow. It can be used with most industrial fluids, gases and both saturated and superheated steam. A general description of the ILVA flowmetering system and its associated equipment is given in a separate TI sheet.

Sizes and pipe connections
10" and 12"
Suitable for fitting between the following flanges:
EN 1092 PN16, PN25 and PN40.
ASME (ANSI) B 16.5 Class 150, 300 and 600.
JIS 20.
KS 20.
The Gilflo ILVA flowmeter should be installed in pipework manufactured to BS 1600 or ASME (ANSI) B 36.10 Schedule 40. For different pipe standards/schedules, downstream spool pieces with an equivalent internal diameter to BS 1600 or ASME (ANSI) B 36.10 Schedule 40 should be used. If this is not possible, please contact Spirax Sarco Limited.

Materials

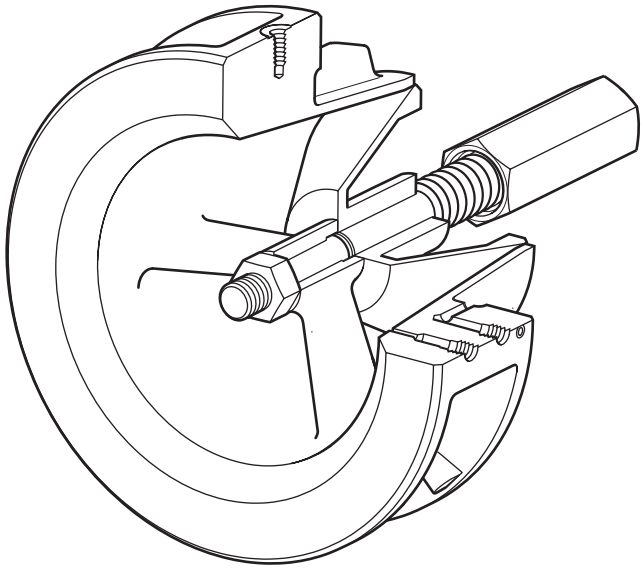
Part	Material
Body	Cast stainless steel S.316 (CF8M/1.4408)
Internals	431 S29/S303/S304/S316
Spring	Inconel X750

Pressure/temperature limits



The product **must not** be used in this region.

Body design conditions		ASME (ANSI) 600
PMA	Maximum allowable pressure	1450 psig @ 120°F
TMA	Maximum allowable temperature	750°F @ 1000 psig
Minimum allowable temperature		-20°F
PMO	Maximum operating pressure is dependant on the flange specification	
Minimum operating pressure		9 psig
TMO	Maximum operating temperature	750°F @ 1000 psig
Minimum operating temperature **Note:** For lower operating temperatures consult Spirax Sarco		-20°F
Maximum viscosity		30 centipoise
ΔPMX	Maximum differential pressure	200 in
Designed for a maximum cold hydraulic test pressure of 2248 psig		



Performance
The Gilflo ILVA is used in conjunction with linearising electronics such as the M800 flow computer or M750 display unit. Alternatively the output signal linearisation can be performed on an EMS/BEMS or equivalent.
Accuracy when used with M800 or M750:
±1% of measured value from 5% to 100% of maximum rated flow.
±0.1% FSD from 1% to 5% of maximum rated flow.
Repeatability better than 0.25%
Turndown: up to 100:1
Caution: The steam mass flow transmitters are uniquely configured at the factory to work with a single, specific Gilflo ILVA flowmeter. For correct operation the configured transmitter must always be installed with its allocated flowmeter. Labels on the packaging give the serial numbers of the matched products.

Pressure drop
The maximum pressure drop across the Gilflo ILVA pipeline unit is 498 m bar (200 ins water gauge) at maximum rated flow.

Flow capacity
To determine the capacity of the Gilflo ILVA for different fluids, it is necessary to calculate the equivalent water flowrate Q_E (in l/min) as described in Step 1, under the section 'sizing the Gilflo ILVA' then selecting the appropriate size of flowmeter from the Table under Step 2 overleaf.

How to order
Spirax Sarco 10" Gilflo ILVA flowmeter for installation between ANSI Class 300 flanges. The body material is to be 316 stainless steel. The flow medium will be saturated steam at 145 psig and the maximum flow will be 61,730 lbs/hr. For a general description of the Gilflo ILVA metering system, see TI-8-010-US which also gives details of associated equipment.

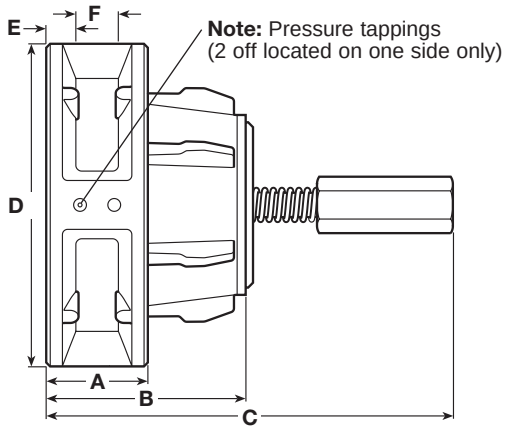
Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

Gilflo ILVA Flowmeter
10" and 12"

Dimensions/weights (approximate) in inches and pounds

Size	A	B	C	D	E	F	Weight
10"	4.1	8	17.5	13	1.4	1.4	91.5
12"	4.7	9.8	20.9	15.2	1.7	1.4	147.7

Note:- Pressure tappings are threaded ¼" NPT



Safety information, installation and maintenance

For full details see the Installation and Maintenance Instructions supplied with the product.

Installation note:
The following main points are given here for guidance:

1. The Gilflo ILVA should be mounted with a minimum of 6 straight pipe diameters upstream and 3 downstream. No valves, fittings or cross sectional changes are permitted within these pipe lengths. Where an increase in nominal pipe diameter is required upstream of the flowmeter, the length of straight pipe should be increased to 12 diameters. Similarly, where a Gilflo ILVA is installed downstream of two 90 degree bends in two planes, a pressure reducing valve or a partially open valve, 12 upstream pipe diameters should be allowed.
2. It is important that the internal upstream and downstream diameters of pipe are smooth. Ideally seamless pipes should be used. It is recommended that slip-on flanges be used to avoid any intrusive weld beads on the internal diameter of the pipe.
3. Care should be taken to install the Gilflo ILVA concentrically in the line. If this is not done, flow measurement errors may occur.
4. The Gilflo ILVA should be mounted horizontally. For vertical installations, consult Spirax Sarco.
5. For steam applications, good basic steam engineering practices should be followed:
   - Correct line drainage through adequate trapping.
   - Good alignment and support of associated pipework.
   - Line size changes achieved by the use of eccentric reducers.

Maintenance note:
There are no user serviceable parts in the Gilflo ILVA. A visual check together with confirmation that the orifice/cone reference dimension is within tolerance is possible.

Sizing the Gilflo ILVA for saturated steam - lb/h

Maximum flowrates in lb/h at different pressures (psig)
Note: Maximum steam flowrates are calculated at a differential pressure across the Gilflo ILVA pipeline unit of 200 ins H2O.

Size	Steam pressure psig	15	44	73	102	145	174	218	290	363	435	580
10"	Maximum flow	33786	47675	57708	66128	76959	83379	92162	105216	116909	127654	147172
	Minimum flow	344	476	578	661	769	833	919	1052	1168	1276	1473
12"	Maximum flow	48782	67514	81723	93646	108983	118075	130514	148999	165558	114638	208414
	Minimum flow	487	675	820	939	1091	1179	1303	1490	1658	1808	2083

Sizing the Gilflo ILVA Meter

In order to determine the flow capacity of a Gilflo ILVA pipeline unit, it is necessary to calculate the Equivalent Water Flowrate (Q_e) based on the anticipated actual flow.
Figure 2 is then used to select the appropriate unit.

1. Determine Equivalent Water Flowrate (Q_e) in U.S. gpm:

Liquids:

$$Q_e = \frac{m}{500}\sqrt{\frac{D_e}{D_l}} \quad \text{or} \quad Q_e = Q_l\sqrt{\frac{D_l}{D_e}}$$

Q_e = equivalent flow rate of water at 70°F (U.S. gpm)
m = maximum flow rate of service liquid (lb/hr)
D_e = density of water at calibration (62.305 lb/ft³)
D_l = density of service liquid (lb/ft³)
Q_l = maximum flow rate of service liquid (US gpm)

Gases:

$$Q_e = \sqrt{\frac{(0.0158) \times m}{D \times \frac{P_f}{P_s} \times \frac{T_s}{T_f}}}$$

$$\text{or } Q_e = (0.948) \times Q_g \sqrt{D \times \frac{P_s}{P_f} \times \frac{T_f}{T_s}}$$

Q_e = water equivalent flow rate at 70°F (U.S. gpm)
m = maximum flow rate of gas (lb/hr)
D = gas density at 14.7 psia, 520°R (60°F) (lb/ft³)
P_f = flowing pressure of gas (psia)
P_s = standard atmospheric pressure (14.7 psia)
T_s = standard absolute temperature (520°R)
T_f = flowing temperature of gas (°R=°F + 460)
Q_g = maximum flow rate of gas (SCFM)

Steam:

$$Q_e = (0.0158) \times m \sqrt{v}$$

Q_e = water equivalent flow rate at 70°F (U.S. gpm)
m = maximum flow rate of steam (lb/hr)
v = specific volume of steam at normal pressure and temperature (ft³/lb)

2. Select from the table below the Gilflo ILVA meter with a maximum Q_e that closely matches (but exceeds) the application Q_e determined in step 1.

Flowmeter type	Max. Q_E U.S. gpm	Maximum pressure drop Ins Wg
10"	2047	200
12"	2900	200

Gilflo ILVA Flowmeters
System Overview

Description

The Gilflo ILVA metering system consists of 2 major parts:

1. The Gilflo ILVA pipeline unit. This is installed in the line where the flow is to be measured. Using impulse pipework, this is connected to:

2. The M610 DP transmitter assembly. This measures the differential pressure across the Gilflo ILVA pipeline unit and converts it to a 4-20mA output signal. This output signal can be used in a number of ways:

    a- To act as a suitable input to an EMS/DCS which can be programmed by the user to carry out the linearizing of the output signal based on the calibration data that is supplied with each Gilflo ILVA meter. Additional inputs from the pressure and temperature transmitters can be used to carry out density compensation for compressible flow applications.

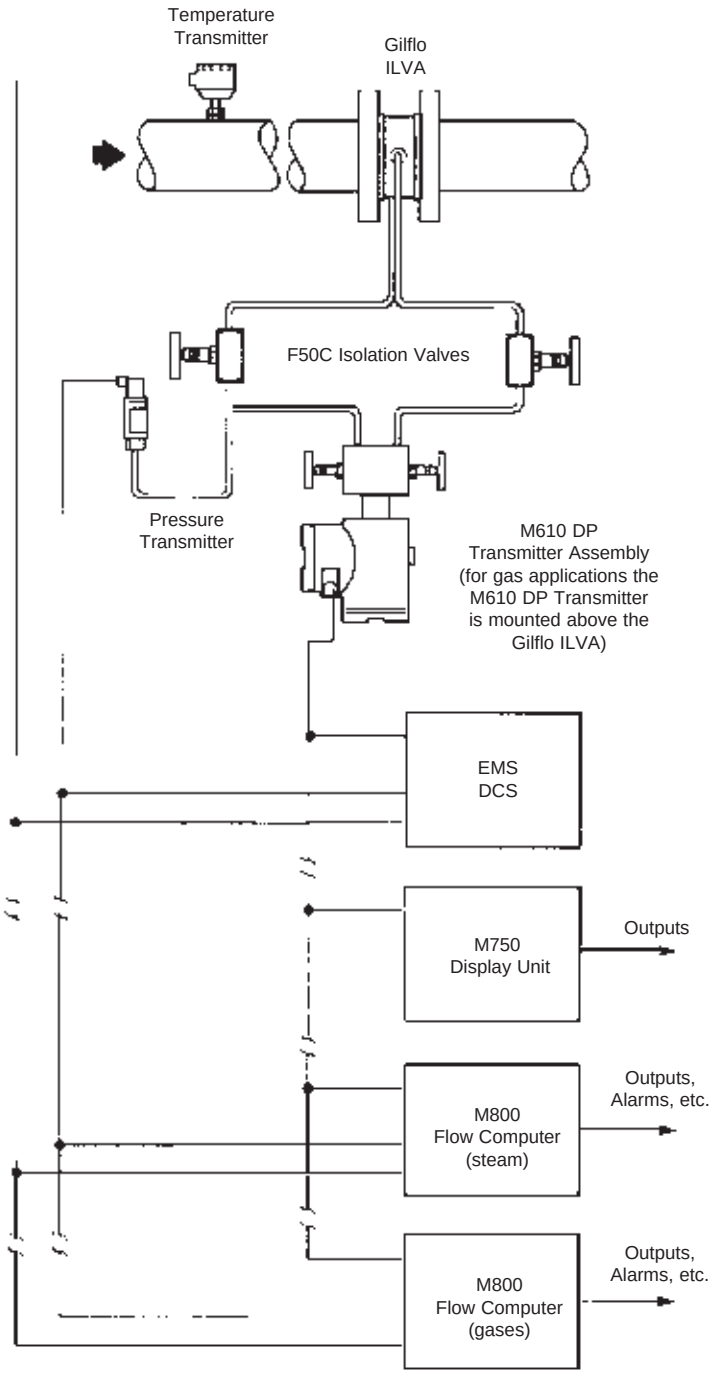
    b- To supply an M750 Display Unit. This gives a non-compensated display of rate of flow and totalized flow. It is suitable for liquid, gas and steam applications where density compensation is not required.

    c- To supply an M800 (steam) or (gas) Flow Computer. Use of the pressure and temperature transmitters enables automatic density compensation to be carried out for compressible flow applications. See relevant TIS's for details of pressure/temperature limits for M800 Flow Computers.

The Gilflo ILVA pipeline unit can be used to measure the flow of most industrial liquids, gases and vapors within the pressure and temperature limits detailed in the TIS's.

Installation

Care must be taken to meet all the requirements of the Installation and Maintenance Instructions that are included with the equipment.



Gilflo ILVA Flowmeters - System Overview

Installation points to watch:

1. Ensure that all pipework is adequately supported and properly aligned. Specialcare should be taken to ensure that the Gilflo ILVA pipeline unit is concentrically mounted in the line. (Special installation kits area available to order for sizes 2" to 8").
2. The Gilflo ILVA pipeline unit should be selected on capacity rather than line size. Where line size changes on steam systems are necessary, use eccentric reducers to avoid buildup of condensate.
3. The minimum recommended lengths of straight pipe upstream and downstream are 6D and 3D respectively. See TIS (ref TIS 8.009) for Gilflo ILVA for more details.
4. Take care to ensure the correct direction of flow as indicated by the arrow on the meter body.
5. Take care to avoid reverse flow through the meter.
6. Avoid installing the meter downstream of a pressure reducing valve (especially on steam systems) as this may cause inaccurate readings. Similarly, avoid installing the meter downstream of a partially open valve.
7. Remember that actuated valves may cause rapid pressure fluctuations which could cause damage.
8. On steam or liquid systems, the M610 DP transmitter assembly is mounted below the meter. Take care to ensure that all impulse lines remain full to prevent damage to the DP transmitter through contact with steam or high temperature liquid.
9. For steam applications, care should be taken to ensure adequate line drainage, trapping etc. so as to avoid condensate slugs impacting the meter. Where practical, steam separators should be fitted. These should be drained using a float trap set.
10. For gas applications, the M610 DP transmitter assembly is installed above the pipework. Ensure that the impulse lines allow free drainage of moisture away from the DP transmitter and back into the pipeline.

Electrical wiring

All electrical wiring must be carried out to the appropriate standards.
Full wiring interconnection details are included with the equipment.

Associated equipment

Item	Description	Technical literature
M610	DP transmitter assembly	TI-P335-10 US
Gilflo ILVA	Pipeline unit	TIS 8.009
M750	Display unit	TI-P332-08 US
F50C	Isolation valve	TIS 8.401
M800	Steam flow computer	TI-P331-04-US
M800	Gas flow computer	TI-P333-24-US

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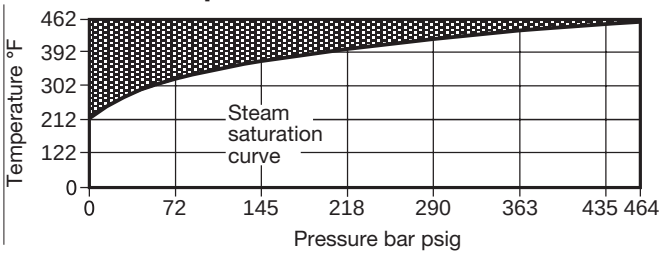
TVA
Flowmeter for Saturated Steam Service

Description
The Spirax Sarco TVA flowmeter is designed for use on saturated steam only and operates on the target principle, by measuring the force produced on a moving cone by the fluid flow. This strain is then converted into density compensated mass flowrate and is transmitted via a single loop powered 4-20 mA and pulsed output. TVA flowmeters also incorporate a totalised flow function and RS 232 Modbus communications.

Sizes and pipe connections
2", 3" and 4"
The TVA flowmeter is of wafer design, suitable for fitting between the following flanges: ASME (ANSI) B 16.5 Class 150 and Class 300

Note:
The Spirax Sarco TVA flowmeter should be installed in pipework manufactured to BS 1600 or ASME (ANSI) / ASME B 36.10 Schedule 40.
For systems with different standards/schedules, spool pieces manufactured from BS 1600 or ASME (ANSI) / ASME B 36.10 Schedule 40 pipe should be used. If this is not possible, please contact Spirax Sarco.

Pressure/temperature limits

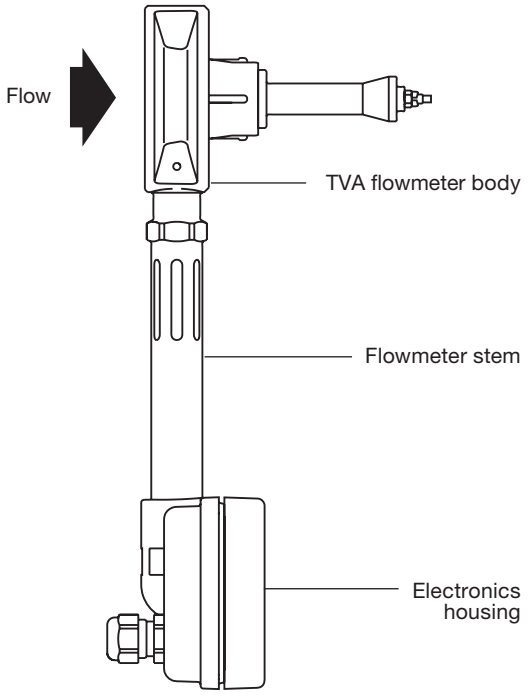


The product should not be used in this region due to software limitations.

Maximum design pressure		464 psig @ 462°F
Maximum design temperature		462°F
Minimum design temperature		32°F
Maximum operating pressure	Horizontal flow	464 psig @ 462°F
	Vertical flow	101 psig @ 338 F
Minimum operating pressure		9 psig
Maximum operating temperature (saturation)		462°F
Minimum operating temperature **Note:** For lower operating temperatures consult Spirax Sarco		32°F
Maximum electronics ambient temperature		131°F
Maximum electronics humidity level		90% RH (non-condensing)
Designed for a maximum cold hydraulic test pressure of 754 psig		

Materials

Flowmeter body	Stainless steel S.316 1.4408 CF8M
Internals	431 S29/S303/S304/S316
Spring	Inconel X750 or equivalent
Flowmeter stem	Stainless steel 300 series
Electronics housing	Aluminium LM25



Technical data

IP rating	IP65 with correct cable glands
Power supply	Loop powered nominal 24 Vdc
Outputs	4 - 20 mA (proportional to mass flow)
	Pulsed output (V_{max} 28 Vdc R_{min} 10 kΩ)
Communication port	Modbus EIA 232C (RS 232)

Performance
The TVA flowmeter has inbuilt electronics which give a density compensated output. An LCD display is incorporated within the electronics head. The M750 display unit can be used to provide a remote display function if required, utilising the 4 - 20 mA output.

System uncertainty, to 95% confidence (2 STD):
(in accordance with ISO 17025)

±2% of measured value from 10% to 100% of maximum rated flow.
±0.2% FSD, from 2% to 10% of maximum rated flow.
Turndown : up to 50:1

As the TVA flowmeter is a self contained unit, the uncertainty quoted is for the complete system. Many flowmeters claim a pipeline unit uncertainty and for a true system uncertainty, the individual uncertainty values of any associated equipment, such as DP cells, need to be added to the pipeline value.

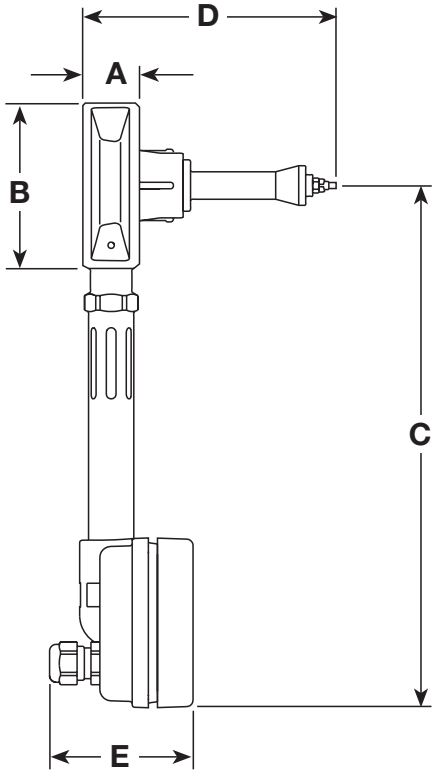
Pressure drop
The pressure drop across the TVA is nominally 300 ins water gauge at maximum rated flow for the 2", and 200 inches water gauge for the 3" and 4".

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

TVA
Flowmeter for Saturated Steam Service

Dimensions / weights (approximate) in inches and pounds

Size	A	B	C	D	E	Weight
2"	1.4	4.1	12.7	6.3	2.6	5.9
3"	1.8	5.4	13.1	6.3	2.6	9.7
4"	2.4	6.4	13.5	8.5	2.6	16.0



TVA flowmeter flow capacities and pressure drops

Flowmeter Type	Maximum QE US gal/min	Maximum DP Wg
2"	80	300
3"	203	200
4"	317	200

Sizing the TVA flowmeter for saturated steam (lb/hr)

(Horizontal orientation)

Maximum flowrates in lb/hr at different pressures (psig).

Notes:

1 - Maximum steam flowrates are calculated at maximum differential pressure.

2 - For vertical capacities please contact Spirax Sarco.

3 - The table below is a guide only.

Size	Steam pressure psig	15	44	73	102	145	174	218	290	363	435	464	psig
2"	**Maximum flow**	1,365	1,894	2,297	2,637	3,075	3,336	3,695	4,228	4,707	5,148	5,311	lb/hr
	Minimun flow	26	37	46	53	62	66	73	84	95	104	132	lb/hr
3"	**Maximum flow**	3,501	4,859	5,895	6,768	7,895	8,565	9,482	10,851	12,081	13,215	13,633	lb/hr
	Minimun flow	71	97	117	134	159	172	190	216	243	265	284	lb/hr
4"	**Maximum flow**	5,456	7,573	9,187	10,547	12,304	13,347	14,778	16,912	18,827	20,593	21,246	lb/hr
	Minimun flow	108	152	183	212	247	267	295	337	377	412	425	lb/hr

Safety information, installation and maintenance

For full details see the Installation and Maintenance Instructions (IM-P337-51 and IM-P337-52) supplied with the product.

The following main points are given for guidance only:

1. The TVA flowmeter should be mounted with a minimum of 6 straight pipe diameters upstream and 3 downstream. No valves, fittings or cross sectional changes are permitted within these pipe lengths. Where an increase in nominal pipe diameter is required, upstream of the flowmeter, the length of straight pipe should be increased to 12 diameters. Similarly, where a Spirax Sarco TVA is installed downstream of two 90 degree bends in two planes, a pressure reducing valve or a partly open valve, 12 upstream pipe diameters should be allowed.
2. It is important that the internal upstream and downstream diameters of pipe are smooth. Ideally seamless pipes should be used and there should be no intrusive weld beads on the internal diameter. It is also recommended that slip-on flanges are used to avoid this.
3. Care should be taken to install the TVA flowmeter concentrically in the line. If this is not done, flow measurement errors may occur.
4. The TVA flowmeter can be installed in any orientation up to a line pressure of 101 psig.
5. As for all steam flowmetering installations, good basic steam engineering practices should be followed:
   - Correct line drainage through adequate trapping.
   - Good alignment and support of associated pipework.
   - Line size changes achieved by the use of eccentric reducers.
   - Do not lag (insulate) the TVA body or the mating flanges.

How to order

Example: 1 off Spirax Sarco 4" TVA flowmeter for installation between ASME (ANSI) B 16.5 Class 150 flanges for use on saturated steam at 145 psig - Maximum flow 12,304 lb/hr.

Note: For details of the optional remote display see the relevant Spirax Sarco M750 literature.

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Orifice Plate Flowmeters
M410 Orifice Plate and Carrier Assembly

Description
The M410 Orifice Plate and Carrier assembly is a primary flow element consisting of a tab handled square edged orifice plate and optional carrier. The orifice plate is designed and manufactured to meet the requirements of ASME-MFC-3M in all respects and is suitable for the measurement of the rate of flow of most liquids, gases and steam. The tab handled orifice plate can be used:

a: on its own fitted between flanges with pressure tappings in the users pipework or flanges.
or
b: fitted into a carrier with integral flange tappings designed to fit between customer flanges.

Limiting Conditions
The pressure and temperature limitations of both the tab handled plate and the carrier assembly are the same as the specified flange ratings.

Performance
The performance of an orifice plate metering system can be greatly influenced by installation variables, so the figures given below are for guidance only:

Accuracy: typically +/- 3% of actual flow. (equivalent to +/- 1.5% full scale deflection at 50% of rated maximum flow).
Repeatability: typically +/- 0.3%.
Turndown: typically 4:1.

Pipe Sizes Available
Tab handled plates with or without carriers are available to suit the following pipe sizes:
1”, 1-1/2”, 2”, 2-1/2”, 3”, 4”, 5”, 6”, 8”, 10”, 12”, 14”, 16”, 18”, 20”, 24”

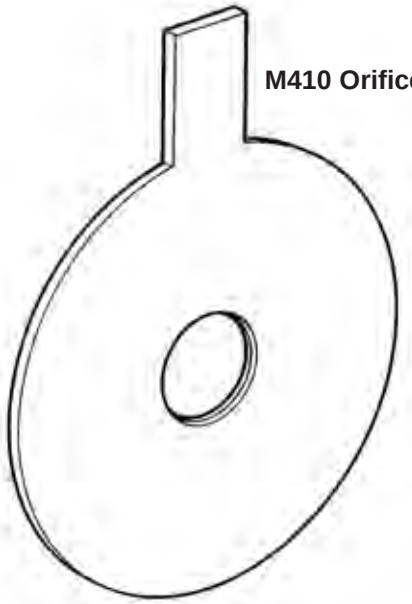
Connections
Tab handled plates and carriers are available to suit the following flange specifications:
ANSI B 16.5 class 150, 300, 600.

Construction Materials

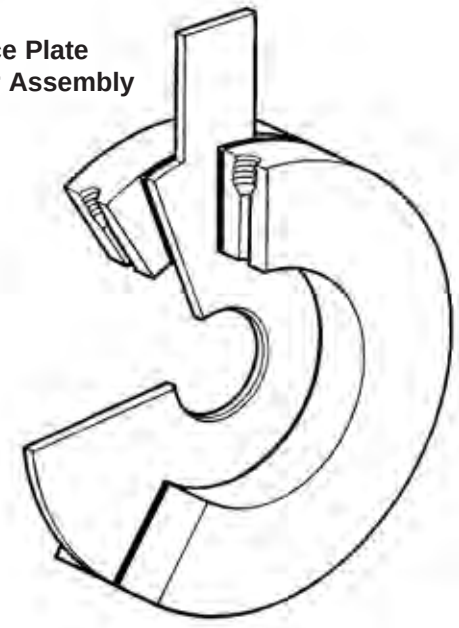
Tab handled orifice plate	Stainless Steel Grade 316
Carrier	passivated zinc plated carbon steel
Gaskets	exfoliated graphite

Pressure tappings
When the tab handled orifice plates are used without the optional carrier, it is the responsibility of the user to provide appropriate presssure tappings in either the flanges or upstream and downstream pipework in line with ASME-MFC-3M.
The optional carrier assembly incorporates upstream and downstream pressure tappings threaded 1/2” NPT. These tappings are 1 inch either side of the orifice plate face in line with the requirements of ASME-MFC-3M

M410 Orifice Plate



M410 Orifice Plate and Carrier Assembly



Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

Orifice Plate Flowmeters
M410 Orifice Plate and Carrier Assembly

Associated Equipment

M800 series steam flow computer	TI-P331-04-US
M800 series gas flow computer	TI-P333-24-US
M750 display unit	TI-P332-08 US
M610 DP transmitter assembly	TI-P335-10 US
F50C isolation valve	TIS 8.401
EL2270 temperature sensor	TIS 8.402
EL2271 temperature sensor & transmitter assy.	TIS 8.402
EL2810 temperature transmitter	TIS 8.402
EL2600 pressure transmitter	TIS 8.403

For a general description of orifice plate flowmetering systems, see TIS 8.202 (density compensated system) and TIS 8.201(non density compensated system).

Installation

It is important that all details of the installation conform to ASME-MFC-3M. Of special note, is the long, straight lengths of pipe that must be present upstream of the orifice plate. As an approximate guide, 20 to 30 pipe diameters upstream and 5 downstream should be adequate but it is recommended that reference is made to the relevant standard. A summary of the basic requirements is included with the M410 equipment.

Maintenance

A visual inspection of the orifice plate should be made at regular intervals to check for dirt buildup, damage or a loss of sharpness of the upstream edge of the plate. Replacement orifice plates and gaskets are available from Spirax Sarco.

How to Specify

M410 Orifice plate primary element with/without optional carrier assembly conforming to ASME-MFC-3M.

How to Order

1- Orifice plate and carrier assembly.

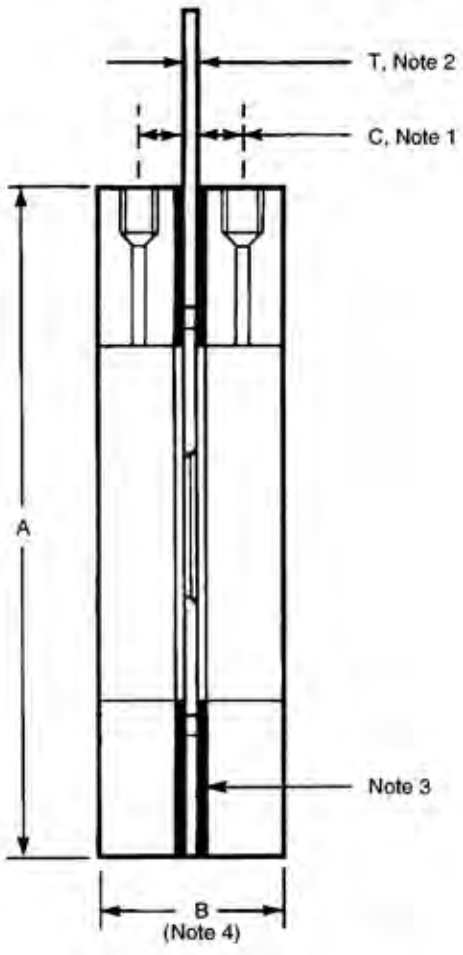
Important note: In order that a correctly sized orifice plate can be supplied, it is essential that full details of the installation and estimated flow rates are supplied. This is best done using an orifice plate customer data sheet (TIS 8.203) info available from your local representative.

Notes:

1: Dimension C is 1 inch for all sizes.
2: For line sizes 1" to 10", orifice plate thickness T is 3mm, 12" and above, T is 6mm.
3: Gaskets are 1.6 mm thick.
4: For line sizes up to 14", carrier assembly thickness B is 82mm, 16" and above, B is 85mm.
5: Maximum weights shown are based on ANSI 600 flanges.

Dimension (approximate) in inches

Inches	ANSI 150 A	ANSI 300 A	ANSI 600 A	Maximum Weight Lb
1	2.63	2.87	2.87	5.20
1-1/2	3.37	3.75	3.75	8.20
2	4.12	4.37	4.37	10.82
2-1/2	4.87	5.13	5.13	13.69
3	5.37	5.88	5.88	17.44
4	6.87	7.13	7.63	30.31
5	7.75	8.5	9.5	46.25
6	8.75	9.88	10.5	51.83
8	11	12.13	12.62	68.89
10	13.37	14.25	15.75	105.71
12	16.13	16.62	18	129.50
14	17.75	19.12	19.37	132.72
16	22.61	21.25	22.25	189.58
18	21.62	23.5	24.12	208.07
20	23.87	25.75	26.87	259.46
24	28.25	30.5	31.13	322.69



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Orifice Plate Flowmeters
Orifice Plate Flowmetering System (density compensated)

Description

The Orifice Plate Metering system is suitable for measuring the rate of flow of steam, liquids and most gases. For steam and gas flowmetering applications, it is important to take account of changes in flowing density due to flowing pressure and temperature variations. If ignored these changes in flow density will cause significant measurement errors. Liquids being non- compressible do not suffer from this problem and generally density compensation is not required. Compatible Flow Computers, Pressure and Temperature Transmitters are listed in the Associated equipment section.

Options available:

The Orifice Plate Metering package is available in a number of options to suit most requirements. For applications requiring density compensation, select one of the four basic options and add a flow computer and pressure/temperature measuring equipment as required:

Option 1	M410 orifice plate and gaskets
Option 2	M410 orifice plate, gaskets and M610 DP transmitter assembly
Option 3	M410 orifice plate, gaskets, carrier ring assembly and F50C isolation valves
Option 4	M410 orifice plate, gaskets, carrier ring assembly and F50C isolation valves and M610 DP transmitter assembly

M410 orifice plate. This is installed in the line at the point where the flow is to be measured. It produces a differencial pressure proportional to the rate of flow.

F50C isolation valves. These are used to isolate the impulse lines close to the orifice plate.

M610 DP transmitter assembly. This is installed close to the orifice plate and converts the differential pressure to a 4-20mA signal for retransmission to other equipment. The M610 is supplied ready fitted with a 3 way manifold which acts as secondary isolation and pressure equalization valve.

Associated Equipment

EL2600 Pressure transmitter. This is installed in the impulse piping (high pressure side) and provides a pressure signal for density compensation.

EL2271 Temperature sensor and transmitter assembly. This is installed in the line upstream of the orifice plate and provides a temperature signal for density compensation. (Suitable for temperatures up to 482°F).

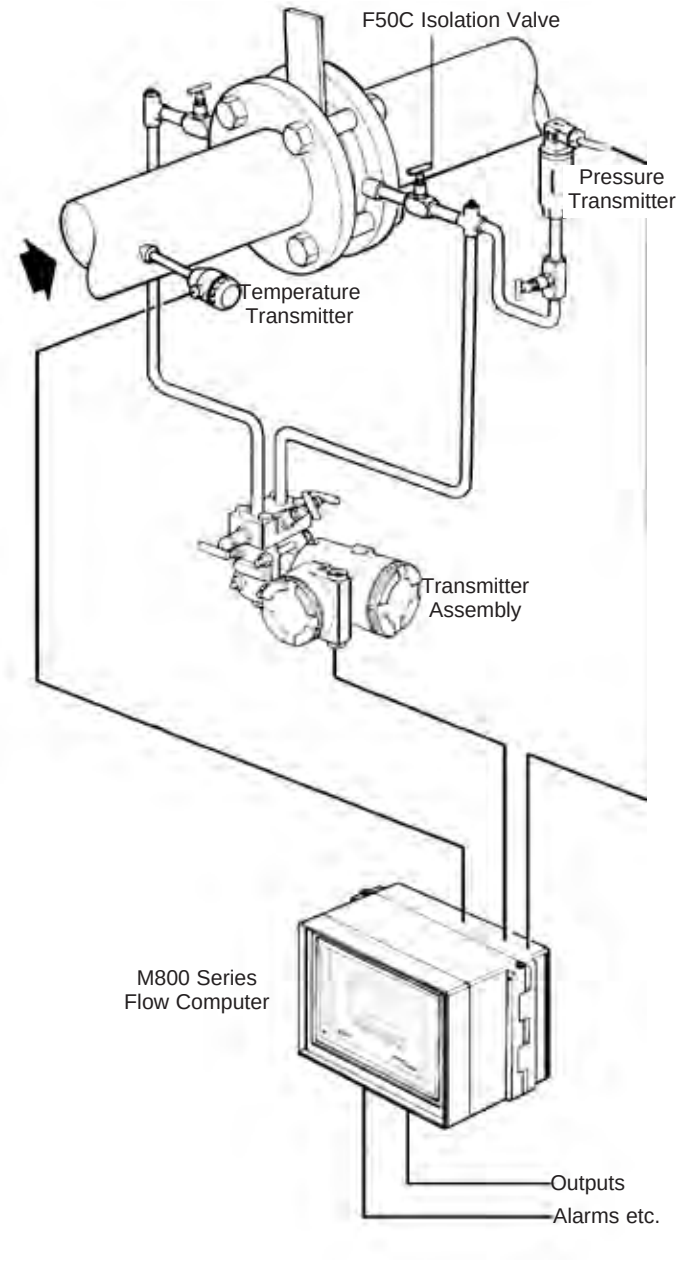
EL2270 Temperature sensor. This is a Pt100 temperature sensor that is installed in the line to provide a temperature signal to the remote M800 temperature transmitter. (Suitable for temperatures up to 932°F).

M800 Temperature transmitter. This is a remote temperature transmitter for use in conjunction with the EL2270 temperature sensor for applications with temperatures between 482°F and 932°F.

M800 Series Steam flow computer. This flow computer is suitable for use with orifice plates on saturated and superheated steam flow applications. It uses the flow, pressure and temperature signals to carry out necessary density compensation calculations for all steam conditions up to a maximum of 609 psig/932°F. Outputs to drive the DP, pressure and temperature transmitters are standard

M800 Series Gas flow computer. Details as for the M800 gas flow computer except that the M800 gas flow computer is for gas applications.

M410 Orifice plate and Carrier assembly



Typical configuration shown here is for a superheated steam application. Gas applications will differ slightly.

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

Orifice Plate Flowmeters
Orifice Plate Flowmetering System (density compensated)

Density Compensated System Requirements

In addition to a M410 assembly (Option 1 - 4), the following components are required:

Saturated Steam

Either a EL2600 pressure transmitter or a EL2271 temperature transmitter (substitute with EL2270 for temperatures above 482°F), and a M800 series steam flow computer.

Superheated Steam

Both a EL2600 pressure transmitter and a EL2271 temperature transmitter (substitute with EL2270 for temperatures above 482°F), and a M800 series steam flow computer.

Gases

Both a EL2600 pressure transmitter and a EL2271 temperature transmitter (substitute with EL2270 for temperatures above 482°F), and a M800 series gas flow computer.

Performance

The performance of an orifice plate metering system can be greatly influenced by installation variables, so the figures given below are for guidance only:

Accuracy:	typically +/- 3% of actual flow. (equivalent to +/- 1.5% full scale deflection at 50% of rated maximum flow).
Repeatability:	typically +/- 0.3%.
Turndown:	typically 4:1.

Installation

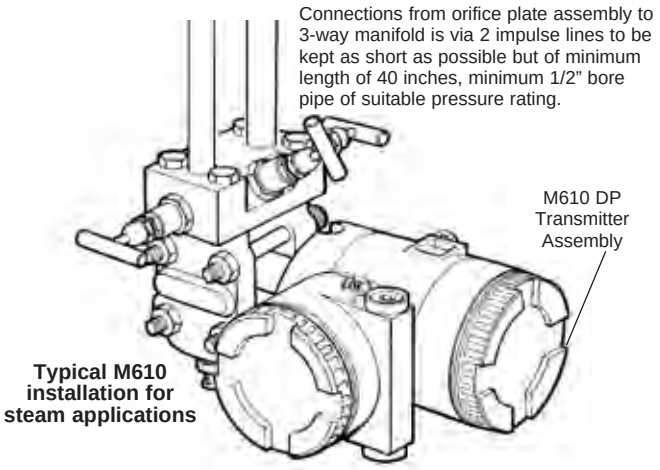
It is important that all details of the installation conform to ASME-MFC-3M. Of special note, is the long, straight lengths of pipe that must be present upstream of the orifice plate. As an approximate guide, 20 to 30 pipe diameters upstream and 5 downstream should be adequate but it is recommended that reference is made to the relevant standard. A summary of the basic requirements is included with the M410 equipment.

How to Specify

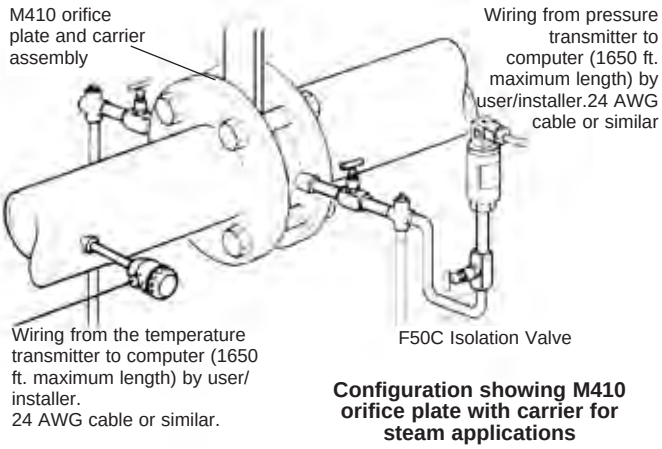
1- M410 Orifice plate flowmeter system with automatic density compensation to meet requirements of ASME-MFC-3M.

How to Order

1- M410 Orifice Plate Steam Metering System to include tab handled plate and carrier, F50C isolation valves, M610 DP transmitter assembly, EL2600 pressure transmitter and M800 Steam Flow Computer.



Typical M610 installation for steam applications



Configuration showing M410 orifice plate with carrier for steam applications

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Orifice Plate Flowmeters
Orifice Plate Flowmetering System (non-compensated)

Description
The Orifice Plate Metering system is suitable for measuring the rate of flow of steam, liquids and most gases. For steam and gas flowmetering applications where the operating pressure and temperature are steady, it is not necessary to incorporate any means of automatic density compensation. Liquids, being non compressible, are not significantly affected by pressure and temperature variations and so density compensation is not normally required.

Options Available:
The Orifice Plate Metering package is available in a number of options to suit most requirements. For non density compensated applications,the following options are available :

Option 1 M410 orifice plate and gaskets
Option 2 M410 orifice plate, gaskets and M610 DP transmitter assembly
Option 3 M410 orifice plate, gaskets, carrier ring assbembly and F50C isolation valves
Option 4 M410 orifice plate, gaskets, carrier ring assembly, F50C isolation valves and M610 DP transmitter assembly

Description
M410 orifice plate. This is installed in the line at the point where the flow is to be measured. It produces a differential pressure proportional to the rate of flow.
F50C isolation valves: These are used to isolate the impulse lines close to the orifice plate.
M610 DP transmitter assembly: This is installed close to the orifice plate and converts the differential pressure to a 4-20mA signal for retransmission to other equipment. The M610 is supplied ready fitted with a 3 way manifold which acts as secondary isolation and pressure equalization valve.

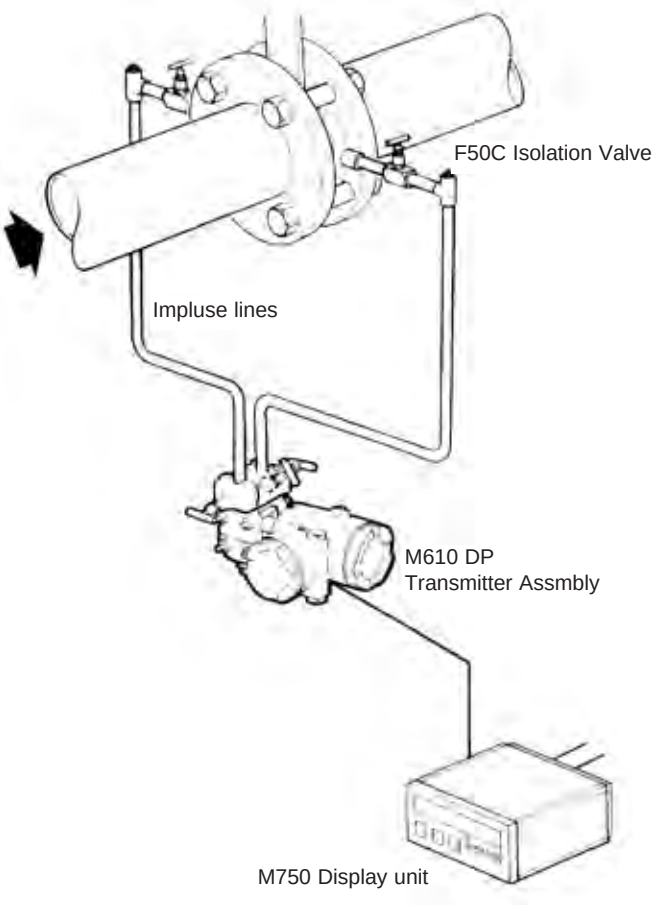
Associated Equipment
M750 Display Unit. This is a panel mounting flow indicator that displays flow rate and total flow, with analog and digital outputs available. The M750 supplies 19v DC to power the M610 DP transmitter.

Performance
The performance of an orifice plate metering system can be greatly influenced by installation variables, so the figures given below are for guidance only:

Accuracy: typically +/- 3% of actual flow (equivalent to +/- 1.5% full scale deflection at 50% of rated maximum flow).
Repeatability: typically +/- 0.3%.
Turndown: typically 4:1.

Installation
It is important that all details of the installation conform to ASME-MFC-3M. Of special note, is the long, straight lengths of pipe that must be present upstream of the orifice plate. As an approximate guide, 20 to 30 pipe diameters upstream and 5 diameters downstream should be adequate but it is recommended that reference is made to the relevant standard. A summary of the basic requirements is included with the M410 equipment.

M410 Orifice Plate and Carrier Assembly



How to Specify
1- M410 Orifice plate flowmeter system conforming to ASME-MFC-3M.

How to Order
1- M410 Orifice Plate Steam Metering System to include tab handled plate and carrier, F50C isolation valves, M610 DP transmitter assembly and M750 Display Unit. (Full details as specified on Customer Data Sheet TIS 8.203)

spirax sarco

Orifice Plate Flowmeters
Customer Data Sheet

This Customer Data Sheet is intended to gather together all relevant information necessary to size and specify an Orifice Plate Flowmetering System. All equipment will be supplied to the customer based on the information received.

Company Name	
Address	
Contact	
Project reference	
Notes	

Please complete all sections and supply drawings, sketches etc. where appropriate.

Section A: Working Fluid Details

Name of fluid (e.g. steam, water, air)				
State of fluid (e.g. liquid, vapor, gas)				
	Min value	**Normal value**	**Max value**	**Units**
Flowing Pressure				
Flowing Temperature				
Flowing Density				
Estimated rate of flow				

Notes:
The pressure drop at specified maximum rate of flow will be 100 inches water gauge unless otherwise stated. Below 25% of specified maximum rate of flow, system accuracy cannot be guaranteed due to turndown limitations of orifice plates.

Section B: Pipeline Details

	Value
Nominal pipe size (inches)	
Pipe inside diameter (inches)	
Pipe schedule	
Flange rating (ANSI)	
Number of straight pipe diameters upstream	
Number of straight pipe diameters downstream	
Pipe material	
DP Trapping position*	

*If ordering plate only (no carrier) specify tapping position (corner, flange, D & D/2, or 2.5D & 8D).

Please provide a sketch showing all details of pipework including any valves, bends, fittings etc in the area where the M410 orifice plate is to be fitted. This is important as the performance of all orifice plates can be affected greatly by installation factors. Using the information from sections A and B the correct orifice plate sizing will be accomplished.

Section C: M410 Kit Options

The Orifice Plate is available in 4 basic kits. To create a complete metering system, additional components should be selected. The composition of the system is dependent on whether or not density compensation is required.

Note: Check all items required.

Option		Check
1	M410 orifice plate and gaskets	
2	M410 orifice plate, gaskets, M610 DP transmitter assembly	
3	M410 orifice plate, gaskets, carrier rings and 2 F50C isolation valves	
4	M410 orifice plate, gaskets, carrier rings, 2 F50C isolation valves and M610 DP transmitter assembly	

Section D: Associated Transmitters Required for Density Compensated Systems

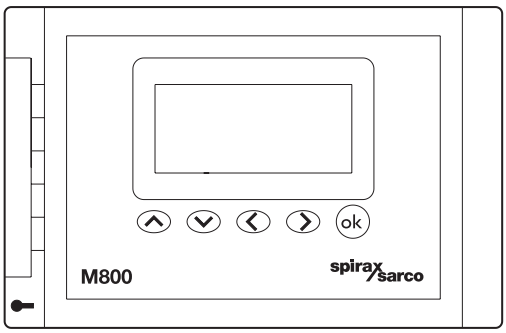
Item	**Range length**	**Insert**	**Check**	**See TIS #**
EI 2600 pressure transmitter				8.403
EL2270 temperature transmitter				8.402
EL2271 temperature sensor & transmitter				8.402
Temperature Sensor Pocket				8.402
M800 steam flow computer				TI-P331-04-US

Section E: Associated Flow Computers

Item	**Supply (volts)**	**Check**	**See TIS #**
M750 uncompensated panel mtd. display			TI-P332-08-US
M800 steam flow computer, wall mtd. *			TI-P331-04-US
M800 steam flow computer, panel mtd. *			TI-P331-04-US
M800 gas flow computer, wall mtd. *			TI-P333-24-US
M800 gas flow computer, panel mtd. *			TI-P333-24-US

*Provide density compensation

M800
Steam Flow Computer



Description

The M800 steam flow computer is available with either panel or wall mount connections that can operate with:

- Gilflo, ILVA, DIVA flowmeters.
- Vortex, Spiraflo and orifice plate pipeline units.

The M800 can provide density compensation for saturated and superheated steam with suitable inputs from pressure and / or temperature transmitters and will display:

- Totalized flow
- Flowrate
- Temperature
- Pressure

The M800 can also be used for heat metering applications to measure the mass and temperature of saturated steam flow into a process, and the temperature of condensate flowing out. The net energy consumed by the process can then be calculated and displayed in terms of net power.

Operator settable alarm limits are provided to give a warning when the flowrate, temperature or pressure goes above or below specified limits. These alarms are indicated on a graphic display and can be transmitted via 2 relays (see 'Options' below). A digital pulsed output is provided as standard to signal mass or energy (per pulse).

A 4-20 mA analogue output channel is also provided to enable re-transmission to a chart recorder or BMS system of the flowrate or net power.

The M800 also comes with four independent timers, which are capable of recording the total flow and peak flow with the time of occurrence within a settable period of time.

A customer selectable security code is provided to avoid casual tampering.

Options

As well as the above functions the M800 is easily expanded by the use of additional option boards, which can be simply retrofitted to the base unit.

Additional options available:

- 4-20mA analog output board – providing 2 x 4-20 mA outputs, which can be configured for pressure and temperature.
- Relay option board – providing 2 x volt free relays that can be configured for alarms.
- Modbus RTU communications option board – providing access to total, flowrate, power, temperature and pressure.

Display parameters

Totalized flow	lb, kg, or customer scaleable
Flowrate	lb/hr, kg/h, kW or Mbtu/h
Temperature	°F or °C
Pressure	psi g or bar g
Time	24 hour clock
Date	MM / DD / YY or DD / MM / YY
Trend graph	flowrate

Technical data - power

Supply voltage	99 V to 264 V at 50 - 60 Hz		
Power consumption	7.5 watts maximum		
Overvoltage category	II		
Pollution degree	3		
Calculation rate	10 / sec	(Orifice plates	2 / sec)

Technical data - input

4-20 mA input(s)	Input voltage	(maximum) 2.5 Vdc
	Input impedance	110 Ω
	Input current (maximum)	22 mAdc
	Termination	Screw terminals (supplied)
Current source(s)	Resolution	0.01%
	Current output (per channel)	30 mAdc ±15%
	Open circuit voltage (maximum)	32 Vdc
	Total voltage drop (maximum)	19 Vdc @ 22 mAdc
	Termination	Screw terminals (supplied)

Environmental information

Maximum operating relative humidity	80% up to 88°F (31°C) decreasing linearly to 50% at 104°F (40°C)
Maximum altitude	6 562 ft (2 000m) above sea level
Ambient temperature limits	0 - 131°F (55°C)
Enclosure rating	IP65 (with correct cable glands)
EMC: Emissions and immunity	EN 61326: A1 and A2 emissions Class A equipment Table 4 EN 61326: A1 and A2 immunity for industrial locations Annex A Table 1
Electrical safety	BS EN 61010-1
Enclosure colours and materials	Grey ABS

Output technical data

Pulse output	
Contacts	Volt free digital transistor (NPN or PNP)
Maximum supply voltage	28 Vdc
Maximum voltage in closed / on position	1 V
Minimum load resistor	$\geq$ 10 kΩ
Termination	Screw terminals (supplied)

4 - 20 mA output	
Range	4 - 20 mA
Minimum current	0 mA
Maximum current	22 mA
Open circuit voltage (maximum)	19 Vdc
Resolution	0.01%
Maximum output load	500 Ω
Isolation	100 V
Termination	Screw terminals (supplied)

Option board technical data

Dual relay alarm option board - Two independent mains rated relay outputs	
Contacts	2 x changeover relays with common
Maximum load	3 A resistive @ 250 Vac
	1 A inductive @ 250 Vac
Voltage rating	250 Vdc
Electrical life	3 x 10^5 or greater depending on load
Mechanical life	30 x 10^6
Termination	Screw terminals (supplied)

Isolated dual 4 - 20 mA re-transmission option board - Two independent 4 - 20 mA isolated re-transmission	
Range	4 - 20 mA
Minimum current	0 mA
Maximum current	22 mA
Open circuit voltage (maximum)	18 Vdc
Resolution	0.01%
Maximum output load	500 Ω
Isolation	100 V
Termination	Screw terminals (supplied)

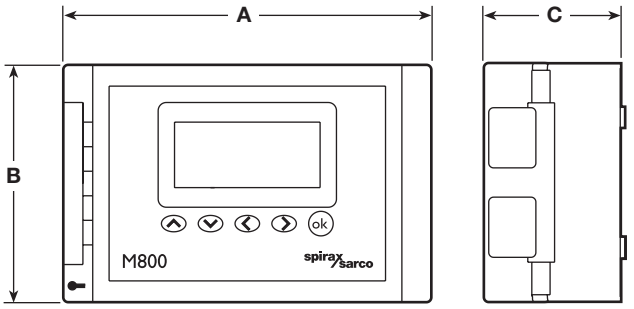
Communications option board	
RS485 Modbus communications	
Physical layer	4 wire full duplex or 2 wire half duplex RS485
Protocol	Modbus RTU format
Isolation	500 Vac / dc
Receiver unit load	1/8 (256 devices maximum)
Termination	Screw terminals (supplied)

For a general description of M800 steam flowmetering systems, see other literature.

Dimensions / weights (approximate) in inches (mm) and pounds (kg)

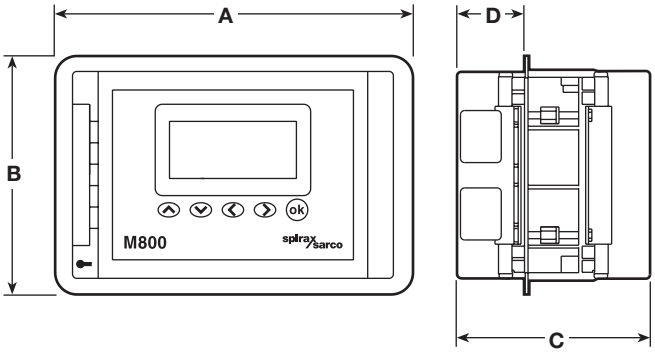
Wall mounting

A	B	C	Weight
9.3 (235)	5.8 (147)	3.3 (85)	2.4 (1.1)



Panel mounting

A	B	C	D	Weight
10 (255)	6.7 (170)	5.4 (137)	1.9 (48)	3.1 (1.4)



Safety information, installation and maintenance

For full details, see the Installation and Maintenance Instructions supplied with the product.

Installation notes:

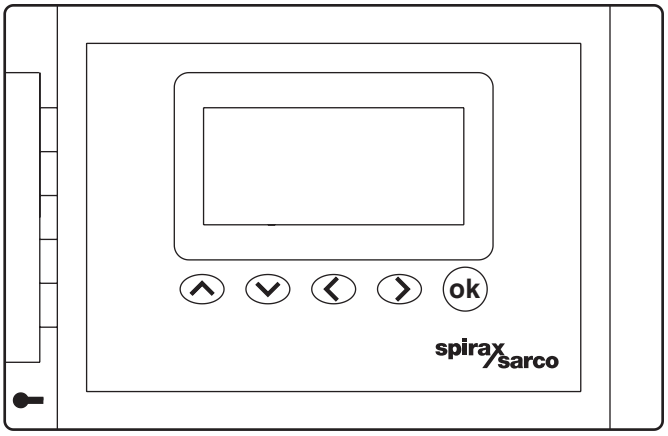
Wall mounting	4 off screw slots in corners.
Panel mounting	Screw in sub-assembly with back clamps.
Cable entries	Pre drilled knock-outs in positions shown in the IMI. Cable entry fittings and seals to suit appropriate regulations and IP rating to be supplied by the customer.
Wiring (supplied by installer)	Total length connecting between the M800 and pipeline transmitters must not exceed 1300'(feet) (400m). 24AWG Wire or equivalent (signal wiring).

How to order example:

1 off M800 wall mounted steam flow computer.

Note: If requested at the time of order placement option boards can be factory fitted prior to despatch. They can also be ordered separately and fitted to the M800 at anytime.

M800
Gas Flow Computer



Description

The M800 gas flow computer receives signals from various pipeline transmitters and converts them to display flowrate, total flow, pressure and temperature. The flow computer operates with Gilflo, ILVA, linear flowmeters, vortex and orifice plates. The M800 can provide density compensation for saturated and superheated steam with suitable inputs from pressure and/or temperature transmitters. Panel and wall mounting versions are available.

Operator settable alarm limits are provided to give a warning when the flowrate, temperature or pressure goes above or below specified limits. These alarms are indicated on a graphic display and can be transmitted via 2 relays (see 'Options' below). A digital pulsed output is provided as standard to signal mass or energy (per pulse).

A 4-20 mA analog output channel is also provided to enable re-transmission to a chart recorder or BMS system of the flowrate.

The M800 also comes with four independent timers, which are capable of recording the total flow and peak flow with the time of occurrence within a settable period of time.

A customer selectable security code is provided to avoid casual tampering.

Options

As well as the above functions the M800 is easily expanded by the use of additional option boards, which can be simply retrofitted to the base unit.

Additional options available:

- 4-20mA analog output board – providing 2 x 4-20 mA outputs, which can be configured for pressure and temperature.
- Relay option board – providing 2 x volt free relays that can be configured for alarms.
- Modbus RTU communications option board – providing access to total, flowrate, power, temperature and pressure.

Display parameters

Totalized flow	scf or Nm³
Flowrate	scfm or Nm³/h
Temperature	°F or °C
Pressure	psi g or bar g
Time	24 hour clock
Date	MM/DD/YY or DD/MM/YY
Trend graph	flowrate

Technical data - power

Supply voltage	99 V to 264 V at 50 - 60 Hz		
Power consumption	7.5 watts maximum		
Overvoltage category	II		
Pollution degree	3		
Calculation rate	10/sec	(Orifice plates	2/sec)

Technical data - input

4-20 mA input(s)	Input voltage (maximum)	2.5 Vdc
	Input impedance	110 Ω
	Input current (maximum)	22 mAdc
	Termination	Screw terminals (supplied)
Current source(s)	Resolution	0.01%
	Current output (per channel)	30 mAdc ±15%
	Open circuit voltage (maximum)	32 Vdc
	Total voltage drop (maximum)	19 Vdc @ 22 mAdc
	Termination	Screw terminals (supplied)

Environmental information

Maximum operating relative humidity	80% up to 88°F (31°C) decreasing linearly to 50% at 104°F (40°C)
Maximum altitude	6562 ft (2000 m) above sea level
Ambient temperature limits	0 - 131°F (55°C)
Enclosure rating	IP65 (with correct cable glands)
EMC: Emissions and immunity	EN 61326: A1 and A2 emissions Class A equipment Table 4
	EN 61326: A1 and A2 immunity for industrial locations Annex A Table 1
Electrical safety	BS EN 61010-1
Enclosure colours and materials	Grey ABS

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

Output technical data

Pulse output

Contacts	Volt free digital transistor (NPN or PNP)
Maximum supply voltage	28 Vdc
Maximum voltage in closed/on position	1 V
Minimum load resistor	≥ 10 kΩ
Termination	Screw terminals (supplied)

4 - 20 mA output

Range	4 - 20 mA
Minimum current	0 mA
Maximum current	22 mA
Open circuit voltage (maximum)	19 Vdc
Resolution	0.01%
Maximum output load	500 Ω
Isolation	100 V
Termination	Screw terminals (supplied)

Option board technical data

Dual relay alarm option board -

Two independent mains rated relay outputs

Contacts	2 x changeover relays with common
Maximum load	3 A resistive @ 250 Vac
	1 A inductive @ 250 Vac
Voltage rating	250 Vdc
Electrical life	3 x 10^5 or greater depending on load
Mechanical life	30 x 10^6
Termination	Screw terminals (supplied)

Isolated dual 4 - 20 mA re-transmission option board -

Two independent 4 - 20 mA isolated re-transmission

Range	4 - 20 mA
Minimum current	0 mA
Maximum current	22 mA
Open circuit voltage (maximum)	18 Vdc
Resolution	0.01%
Maximum output load	500 Ω
Isolation	100 V
Termination	Screw terminals (supplied)

Communications option board

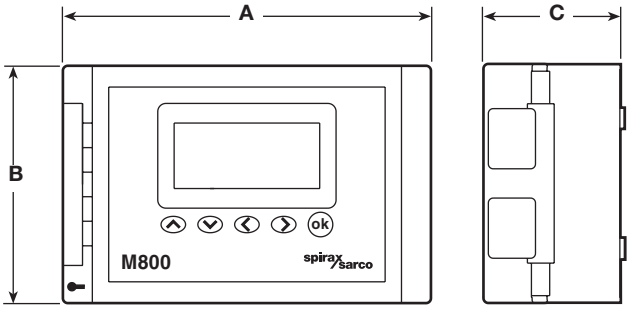
RS485 Modbus communications	
Physical layer	4 wire full duplex or 2 wire half duplex RS485
Protocol	Modbus RTU format
Isolation	500 Vac/dc
Receiver unit load	⅛ (256 devices maximum)
Termination	Screw terminals (supplied)

For a general description of M800 gas flowmetering systems, see other literature.

Dimensions/weights (approximate) in inches (mm) and pounds (kg)

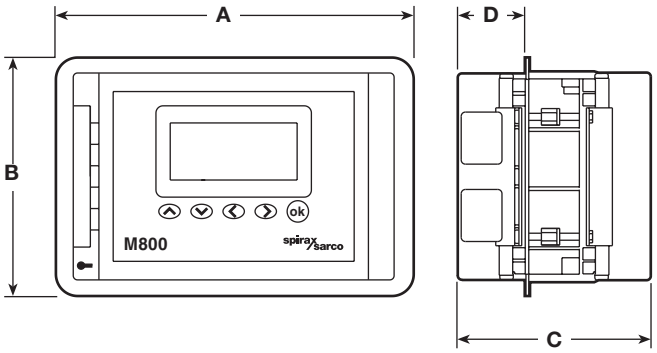
Wall mounting

A	B	C	Weight
9.3 (235)	5.8 (147)	3.3 (85)	2.4 (1.1)



Panel mounting

A	B	C	D	Weight
10 (255)	6.7 (170)	5.4 (137)	1.9 (48)	3.1 (1.4)



Safety information, installation and maintenance

For full details, see the Installation and Maintenance Instructions supplied with the product.

Installation notes:

Wall mounting	4 off screw slots in corners.
Panel mounting	Screw in sub-assembly with back clamps.
Cable entries	Pre drilled knock-outs in positions shown in the IMI. Cable entry fittings and seals to suit appropriate regulations and IP rating to be supplied by the customer.
Wiring (supplied by installer)	Total length connecting between the M800 and pipeline transmitters must not exceed 1300'(feet) (400 m). 24 AWG Wire or equivalent (signal wiring).

How to order example:

1 off M800 wall mountable gas flow computer.

M750 Display Unit

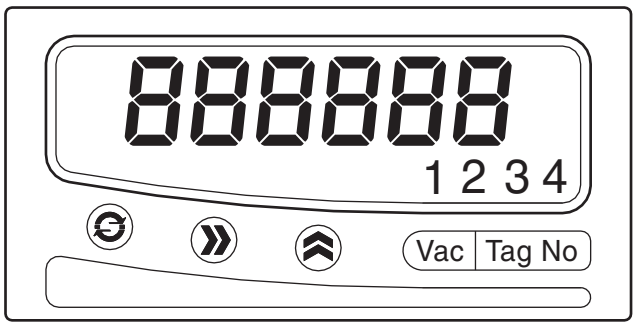
Description

The M750 is an intelligent digital panel display unit that can accept inputs from a wide variety of sensors and digitally process and display the signal. In addition, it has the facility to accept up to two 'Option pods', which can be either isolated 4-20 mA retransmission or two normally open alarm relays. The M750 is fully programmable for any specific application from the front panel.

The M750 totaliser function enables non-volatile storage of the integrated total to be maintained within the unit, even after loss of power. The output option pods can be selected to operate on either Process Variable (rate) or Total.

The M750 is ideally suited as a display unit for use with our flow-meters. It can provide an indication of flowrate and totalized flow for Gilflo, ILVA, DIVA, orifice plates and vortex flowmeters as well as providing a 19 Vdc loop power supply where required.

The unit can be used 'stand-alone' or, utilizing the Modbus serial communications, as part of a larger system.



Technical data

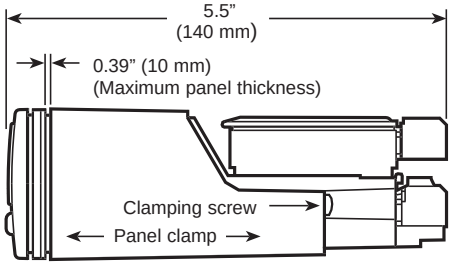
See overleaf.

Weight

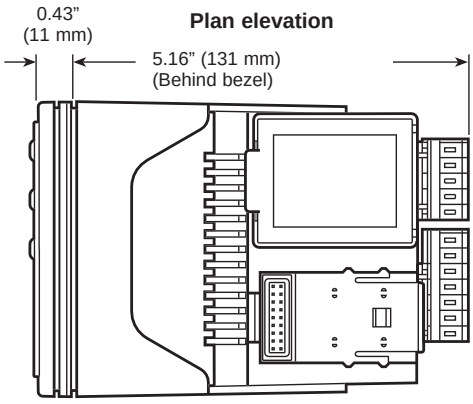
0.5 lbs (230 grams)

Dimensions approximate in inches (millimeters)

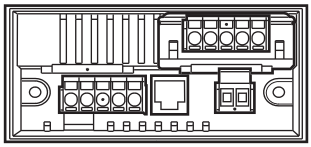
Side elevation



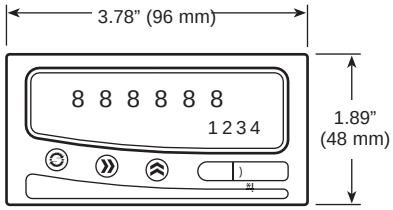
Plan elevation



Rear elevation



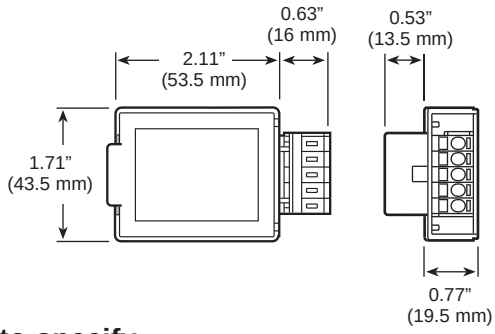
Front elevation



Panel cut out

3.62" (92 mm) x 1.77" (45 mm)

Option pod



How to specify:

M750 panel mounted digital display unit that accepts all commonly used process signals, designed to allow current retransmission or dual relay output option pods to be easily installed without the need for dismantling or recalibration.

How to order

Example: 1 off M750 display unit complete with dual relay and current retransmission option pods.

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

M750 Display Unit

Technical data at 68°F (20°C)

Power supply	90-264 Vac 50/60 Hz	
	90-253 Vac 50/60 Hz for compliance with LVD and UL	
	BS EN 61010-1 for connection to an installation over-voltage	
	Category II supply	
	Pollution degree 2	
Power consumption	10 VA (worst case)	
Isolation (tested to)	500 V	
	Supply to I/O 3750 V	
Relay supply	BS EN 61010-1 for connection to an installation over-voltage	
	Category II supply	
	Pollution degree 2	
Environmental	Sealing to panel	NEMA 4 (IP65)
	Ambient operating temperature	-22°F to +140°F (-30 to +60°C)
	Ambient storage	-58°F to +185°F (-50 to +85°C)
	Ambient humidity	10 to 90% RH
	EMC: Emissions and immunity	BS EN 61326
	Safety	BS EN 61010-1

Universal input types	**Sensor**	**Sensor range and linearisation**
Sensor and Sensor range and linearisation	**mA**	4-20 mA, 0-20 mA, 0-10 mA
	RTD	Pt 100, NI 120, custom
	T/C	K, J, T, R, S, B, N, L, B, E, Custom*
	mV	± 100 mV
	Volts	0-10v, 0-5v, 1-5v, 0-1v
	Minimum span	Any span within the range can be selected, but the recommended span is > 10% of range.
Current input	**Basic accuracy**	0.05% FS plus +/- 0.05% of reading
	Thermal drift	200 ppm/°C
	Input impedance	20 Ω
	Linearity	Linear, $X^{1/2}$, $X^{3/2}$, $X^{5/2}$,Custom*

A 19 V @ 25 mA isolated power supply is provided to power the current loop.

* Custom can be up to 60 co-ordinate pairs or up to 7 segments of 15th order polynomial.

Option pods

The M750 has interchangeable output pods that are automatically recognised by the unit. The dual relay pod has two independent mains rated relays that can be configured for high or low alarms or pulse output. The isolated re-transmission pod provides 0-10 mA, 0-20 mA or 4-20 mA active or passive outputs.

Output options

Dual relay alarm pod

Two independent mains rated relay outputs, which can operate as alarms or pulsed output

Contacts	2 x changeover relays with common	
Ratings	ac	dc
Maximum load	5 A@250 V	5 A@30 V (inductive load 2 A)
Maximum power	1 250 VA	150 W
Maximum switching	253 volts	125 volts
Termination	Standard 5 way tension clamp connector	

Isolated 4-20 mA re-transmission pod

Isolated analogue retransmission for use with chart recorders, Building Management Systems, etc.

Ranges	0-10 mA (Active or Passive),	0-20 mA (Active or Passive),	4-20 mA (Active or Passive)
Minimum current output	0 mA		
Maximum current output	23 mA		
Accuracy	0.07% FS		
Maximum output load	Active 1 K Ω Passive [(Vsupply - 2)/20] K Ω		
Maximum external supply voltage	30 V (Passive mode)		
Isolation	500 Vac		
Termination	5-way tension clamp connector		

Communications

RS485 Modbus communications	The M750 is available with RS485 serial communications using MODBUS RTU protocol as standard.
Physical layer	4 wire or 2 wire half duplex RS485
Protocol	Modbus RTU format
Isolation	500 Vac
Maximum fan out	32 units (this can be increased with repeaters)
Termination standard	RS485

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M610 Series II
DP Transmitter Assembly

Description

The M610 Series II DP transmitter assembly is designed to accept a differential pressure input from a primary flow element such as an orifice plate or Gilflo flowmeter and convert it into an analogue 4-20 mA output signal. The standard version comes with digital communications in the form of HART ® 5.2 which is superimposed on the 4-20 mA output. The 3-way manifold which is supplied already assembled to the DP transmitter acts as a means of secondary isolation and as a pressure equalisation valve to check the zero of the DP transmitter.

The M610 Series II DP transmitter assembly consists of two items:
- A high accuracy (0.1%) differential pressure transmitter.
- A 3-way carbon steel isolation manifold.

Note: These items are supplied already assembled.

Pipe connections

The process ports on the 3-way manifold are threaded 1/2" NPT at 2.126" (54mm) centers.

Electrical connections

M20 x 1.5 screwed terminals.

M610 Series II technical data

Span	0 - 52.2" H_2O (0 -13 kPa) minimum
	0 - 522" H_2O (0 -130 kPa) maximum
Output	4 - 20 mA dc and HART® protocol 5.2
Power supply	16 V to 45 Vdc (for non-certified application)
	16 V to 28 Vdc (for E Ex ia 11c T4 / T5)
Pressure limits	-14.5 to 2030 psig
Temperature limits	-40°F to +185°F (ambient for non-certified application)
	-40°F to +212°F (process)
Acuracy	± 0.1% of calibrated span to include effects of linearity, hysteresis and repeatability.
Materials of construction	Body - Stainless steel.
	Diaphragm - Austenitic stainless steel 316L
	3-way manifold - Carbon steel
	Fluid fill - Silicone oil
Intrinsic safety	ATEX Ex II 1GD - E EX ia 11c T4/T5
Enclosure rating	NEMA 6/6P (IEC IP67)
EMC emissions and immunity	To BS EN 61326:1997

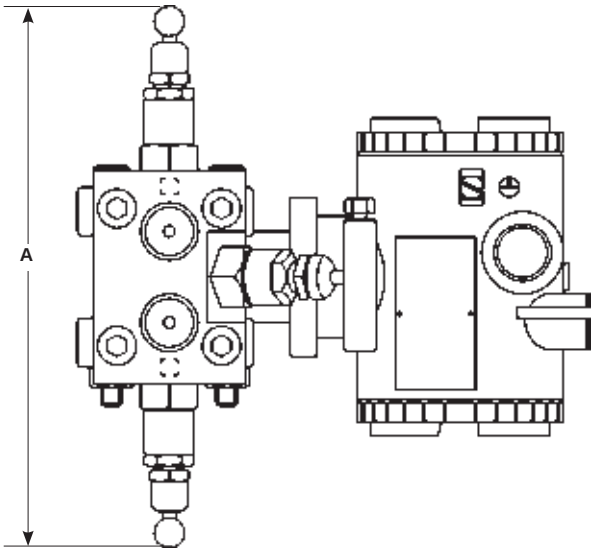
Note: If HART ® communications are required in intrinsically safe applications, barriers must be used which are designed to pass the HART ® signal.

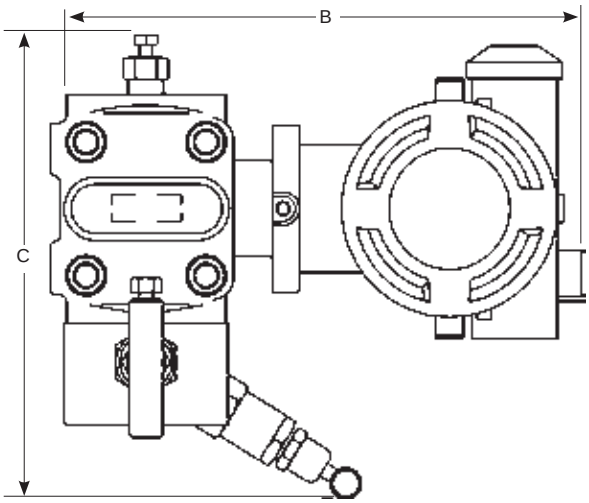
Calibration

The M610 Series II DP transmitter assembly is supplied with a span factor set to suit a particular application. However, should load conditions and/or details of actual installation change, the range of the M610 can be adjusted within the limits 0 - 52.2" H_2O (0 - 13 kPa) and 0 - 522" H_2O (0 - 130 kPa) as described in the Installation and Maintenance Instructions supplied with the product.

Installation

Full installation details are given in the literature that accompanies the M610 Series II DP transmitter assembly.





Dimensions / weights (approximate) in inches and lbs.

A	B	C	DP transmitter	3-Way manifold	M610 assembly
8.7"	7.6"	6.9"	14.3 lb	2.2 lb	16.5 lb

How to order

Example: 1 off M610 Series II DP transmitter assembly calibrated to give an output of 20 mA at an applied differential pressure of specified value.

Associated equipment

Orifice plate flowmeter.
Gilflo flowmeter system.

Scanner 2000
Steam Mass Flow Transmitter

Description
The Scanner 2000 steam mass flow transmitter takes its inputs from a primary flowmeter, (Gilflo or ILVA) through impulse lines. It converts the differential and static pressure into a corrected mass flowrate of saturated steam, which is accessible via the RS485 Modbus link or optionally via a 4 - 20 mA signal.

Configuration
Scanner 2000 steam mass flow transmitters are uniquely configured at the factory to work with a single, specific Gilflo or ILVA flowmeter, for a specific flow application.
For correct operation the Scanner 2000 transmitter must be installed with its allocated flowmeter. A label on the packaging gives the serial number of the matched product.
The Scanner 2000 can be configured using an RS485 equipped PC with the supplied configuration software.

Note:
A DB9 Serial RS232 to RS485 converter will otherwise be required to connect your PC to the Scanner 2000.
If your PC only has USB ports a USB to DB9 Serial port converter will be required. These are available from most electronic equipment suppliers.

Available types and approvals
Explosion proof types available:

CSA

- Class 1, Div 1, Groups B, C and D
- Type 4 Enclosure
- T6 Temperature Class

ATEX

- ATEX II 2 GD
- Ex d IIC T6 (-40°F to 158°F) or
- Ex td A21 IP68 T85C (-40°F to 158°F)
- All Scanner 2000's are compliant

Features
In head LCD providing local indication of density compensated rate and total saturated steam flow.
RS485 Modbus RTU slave functionality for remote indication, data logging and configuration.

Associated equipment
- Gilflo flowmeter
- ILVA flowmeter
- M750 flow indicator
- Optional local display

Materials

Enclosure	Cast aluminium (painted with epoxy and polyurethane)	
Body	Stainless steel	AISI 316
3-way manifold	Stainless steel	AISI 316
Fluid fill	Silicone oil	

Pipe connections
The process ports on the 3-way manifold are threaded ½" NPT connections at 2⅛" (54 mm) center.

Electrical connections

¾" NPT	Non approved and ATEX units
¾" NPT	CSA units

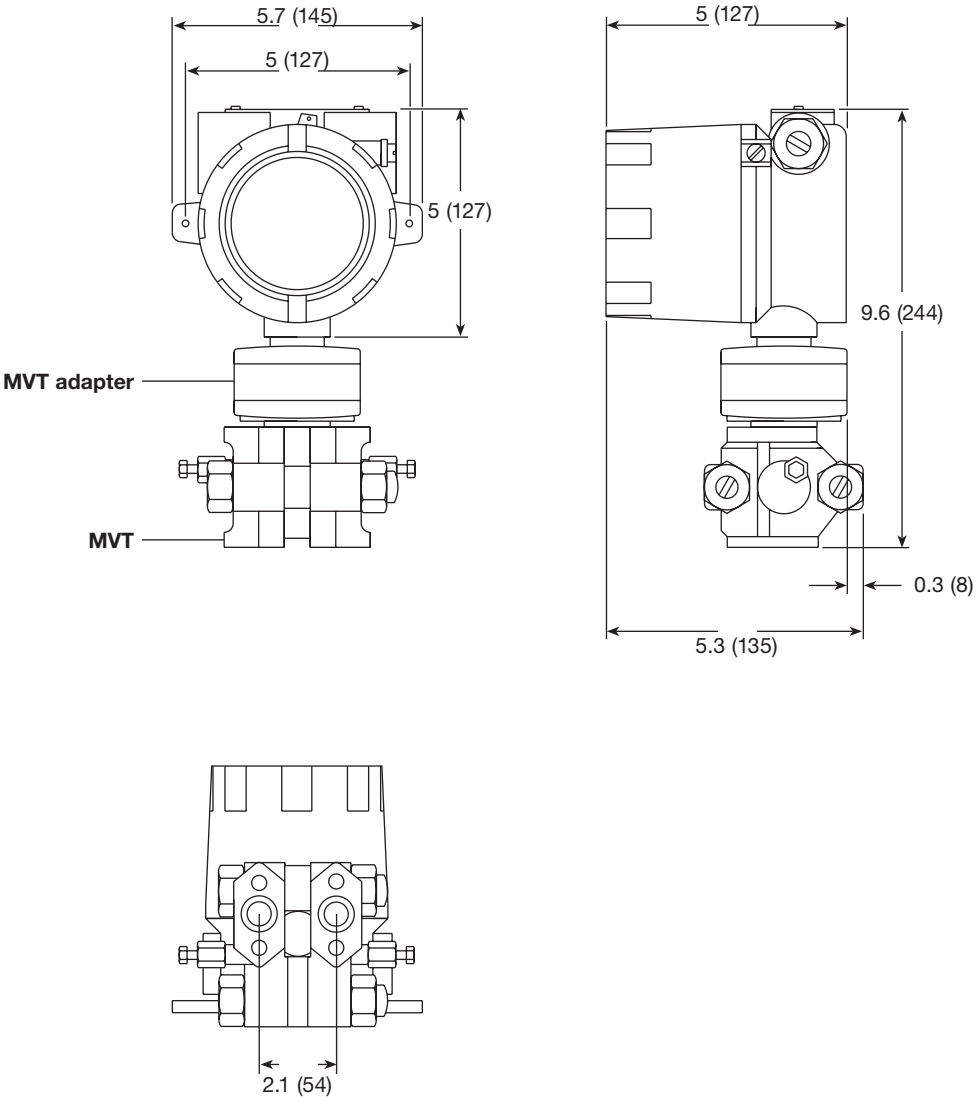
Technical data

Range	Minimum 2" H_20 (.498 KPa)
	Maximum 200" H_20 (49.8 KPa)
Outputs	4 - 20 mA (expansion board required)
	RS485 Modbus RTU slave (baud rate 300 to 38.4 K)
	Solid state relay, configurable as pulse or alarm
Power supply	6 V to 30 Vdc at 31 mA
Pressure limits	155 bar
Temperature limits	-40°F to 158°F (-40°C to 70°C)
	LCD contrast is reduced below -22°F (-30°C)
Accuracy	±0.05% for Spans >10% of the URL
	±0.005 (URL/SPAN) for Spans <10% of the sensor
Enclosure rating	IEC IP68

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

Scanner 2000
Steam Mass Flow Transmitter

Dimensions (approximate) inches (mm)



Weights (approximate) in lbs (kg)

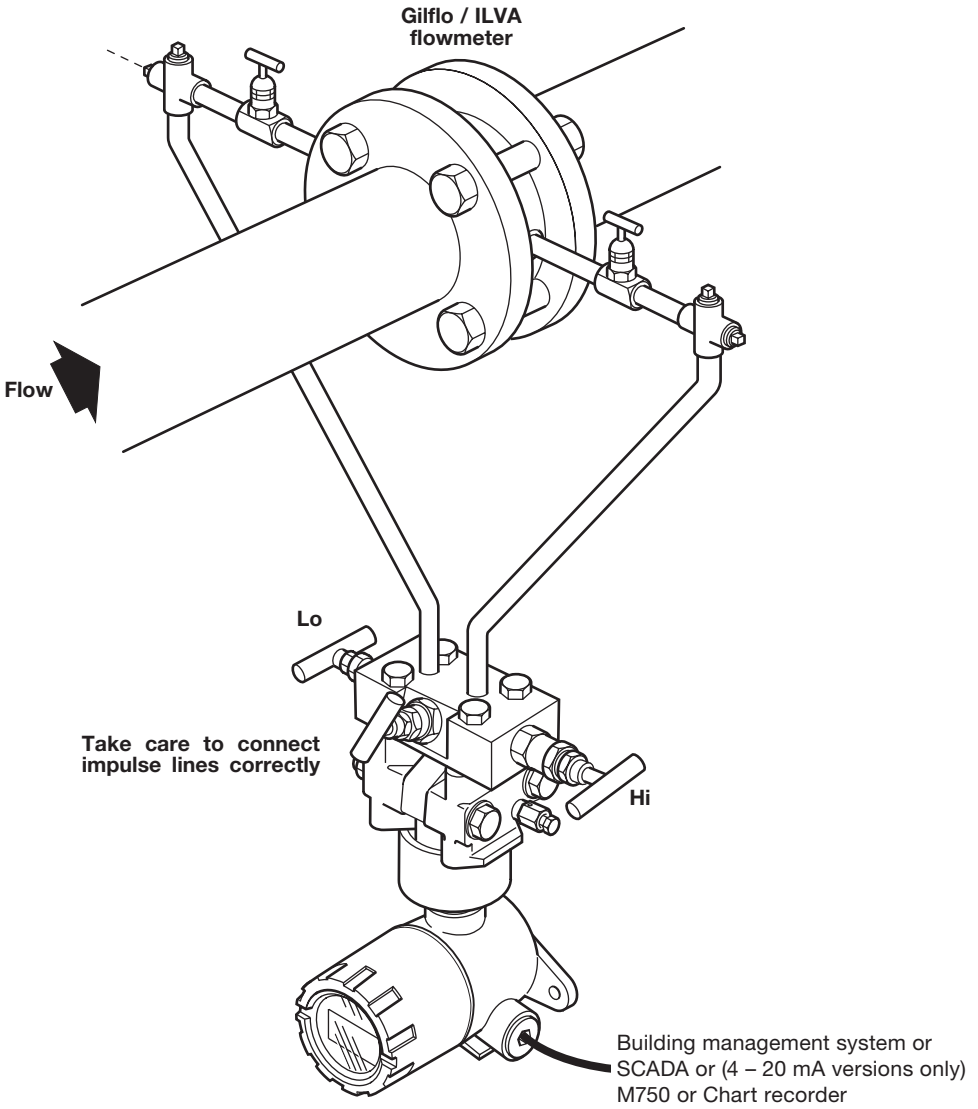
DP transmitter	3-way manifold	Scanner 2000 assembly
11 (5)	2.2 (1)	13.2 (6)

Safety information, Installation and Maintenance

Warning: This document does not give sufficient information for safe installation of the product.
Full details are given in the Installation and Maintenance Instructions supplied with the Scanner 2000.

Scanner 2000
Steam Mass Flow Transmitter

Typical installation



How to order

The following information will allow us to uniquely configure the Scanner 2000 for each application prior to despatch.

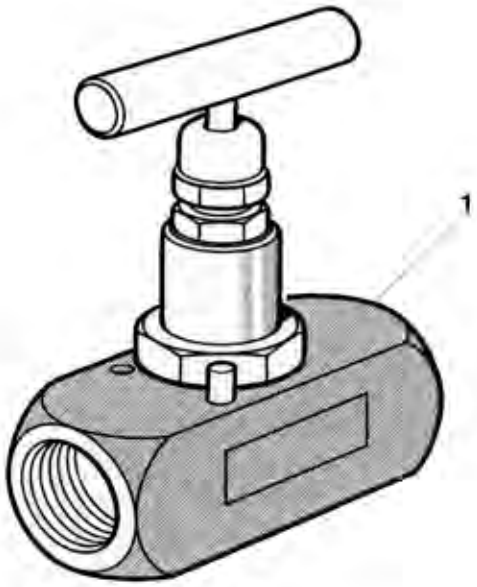
Parameter	Range of values	Customer requirement	Notes
Flowmeter type	Gilflo or ILVA		Specific flowmeter type
Gilflo / ILVA serial number	-		Required for existing flowmeters only
Analog output units	kg/h, lb/h, Btu/h, or kJ/h		Specific required units
Analog output scaling (4 mA)	kg/h, lb/h, Btu/h, or kJ/h		Normally zero
Analog output scaling (20 mA)	kg/h, lb/h, Btu/h, or kJ/h		Normally maximum required flowrate
Maximum range Δp	2" to 200" H_20 (0.498 to 49.8 KPa)		From Gilflo and ILVA sizing sheet
Steam quality (Dryness fraction)	60 to 100%		Set at 100% unless otherwise specified

Example: 1 off Scanner 2000 steam mass flow transmitter configured for use with a 3" (DN80) ILVA flowmeter passing 4400 lb/h of saturated steam at 101 psig.

Model F50C Isolating Valve

Description

The F50C is a needle type isolating valve designed for primary isolation in flow metering applications with steam and other industrial fluids.



Material

No	Part	Materials
1	Body	Carbon steel zinc plated and passivated
2	Seals	Graphoil (not shown)

Maximum operating pressure: 5990 psig
Maximum operating temperature: 806 degrees F

Dimensions (approximate) in inches

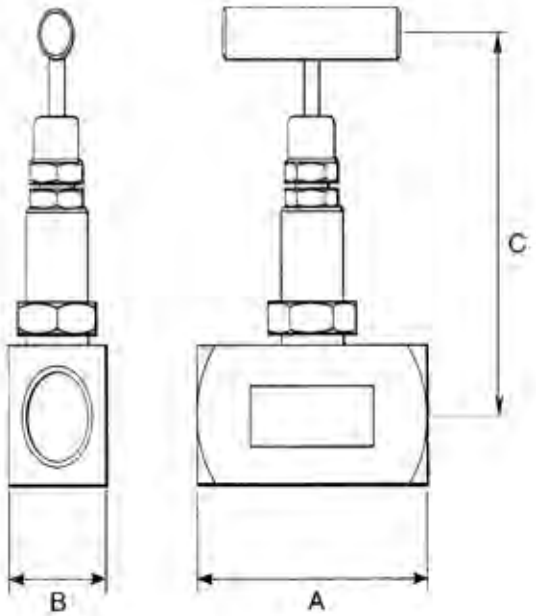
A	B	C	Weight
2.6	1.1	3	1.1 lb

Connections

0.5” NPT female (both ends).

How To Specify

Model F50C Isolating Valve.



EL2270 and EL2271 Temperature Probes

Description

EL2270

The EL2270 is a Pt100 platinum resistance temperature sensor for general industrial use. The sensing device is an RTD 3 wire device that meets EN 60751: Class A. This sensor can be connected directly to any temperature indicator or controller that has a 3 wire Pt100 input. A quick response version [1.5" (40 mm) insertion length only] is also available for applications such as plate heat exchanger control. A miniature version of the EL2270 may also be ordered. This has a ¼" BSP taper thread, and a tip length of 1.5" (39 mm).

EL2271

The EL2271 is a combined Pt100 sensor and transmitter assembly. The sensing element is a 3 wire device that meets EN 60751: Class A and the transmitter has a 4 - 20 mA output. The transmitter (only) meets ATEX II 1G EExia IIC/IIB T4/T5/T6. A comprehensive standard range is normally available from stock. Non-standard ranges can be obtained to special order, subject to a low limit of -58°F (-50°C), and a maximum of 932°F (+500°C). The 4 - 20 mA output can be connected directly to any temperature indicator, controller or flow computer that has a 4 - 20 mA input. Contact your local representative for further details. Transmitters with 3 point calibration are available to special order.

Pockets (thermowells)

General

Three types of pockets are available:

1. Thin wall with a ½" NPT process connection for non-flow applications only.
2. Drilled taper with a ½" NPT process connection.
3. Hygienic, to 3A sanitary standard, with a 1½" sanitary clamp connection (ASME BPE) electropolished to 0.4 µm (a Declaration of Conformity is available).

Note: No pocket is available for the miniature EL2270.

Material	316 stainless steel
Maximum temperature	932°F (500°C)

Selection

Pockets are sized to suit the probe tip length '**D**', and are specified as 'pocket to suit a __ inch (mm) probe'.

Note 1 - The pocket dimension '**F**' is 1" (25 mm) shorter than the probe length '**D**', which appears to be incorrect. The reason is that the threaded body of the pocket acts as a stand-off, and therefore allows adequate clearance between the probe tip and the end of the pocket.

Note 2 - Pockets to suit 8.86" (225 mm) and 28.5" (725 mm) probes **are for non-flow applications only** [maximum flow velocity 2.13 fps (0.65 m/sec)].

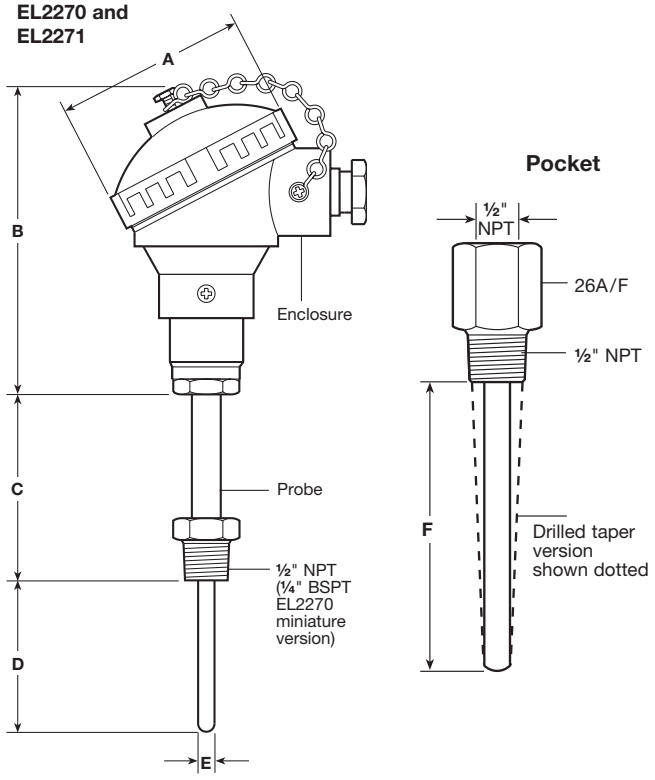
Dimensions (approximate) in *mm*

Product range	EL2270* Standard	EL2270* Miniature	EL2270* Quick repsonse and duplex quick response	EL2271
A	3.5" *(88)*	2.25" *(58)*	3.5" *(88)*	3.5" (88)
B	5" *(130)*	2.4" *(62)*	6" *(150)*	5" (130)
C	3" *(75)*	2.5" *(63)*	3" *(75)*	3" (75)
D	1.2", 3.5", 8.86", 28.5" *(25, 50, 75, 125, 225, 725)*	1.54" *(39)*	1.57" *(40)*	1", 2", 3", 4" *(25, 50, 75, 125)*
E	.25" *(6)*	.25" *(6)*	.18" *(4.5)*	.25" (6)

Notes: The quick response EL2270 is only available with an insertion length of 40 mm.

Pockets

Product range	Standard Fabricated	Standard Solid drilled	Hygenic 1½" sanitary clamp connector Fabricated
F	7.87", 27.6" *(200, 700)*	1", 2", 4" *(25, 50, 100)*	1", 2", 4", 7.87" *(25, 50, 100, 200)*



Mechanical data

	EL2270*	EL2271
Product range	**Note:** A quick response version of the EL2270 is also available to order	
Enclosure	KNE - aluminium alloy - epoxy coated	KNE - aluminium alloy - epoxy coated
Probe	316 stainless steel	316 stainless steel
Process connection	½" NPT	½" NPT
Electrical connection	M20 with cable gland fitted to BS 4568 Part 1	M20 with cable gland fitted to BS 4568 Part 1
Enclosure rating	IP65	IP65
Maximum ambient temperature	158°F (70°C)	Maximum 185°F (85°C) (dependant on ATEX requirement)

*** The EL2270 quick response sensor has a time constant of 1.7 seconds.**

Electrical data

Available ranges	-58°F (-50°C) to 932°F (+500°C)	-58°F (-50°C) to 932°F (+500°C) 46°F (0°C) to 212°F (+100°C) 212°F (100°C) to + 482°F (250°C)
Output	Pt100 to EN 60751: Class A	Loop powered 4 - 20 mA
Output on sensor failure	-	23 mA typical
Supply	-	10 to 30 Vdc
Maximum loop resistance	-	636 Ω at 24 Vdc 909 Ω at 30 Vdc
Transmitter - Thermal drift measuring deviation	-	± 0.1% / 10 K_{TAMB} per EN 60770 ± 0.2%

Approvals

Ex-protection per Directive 94/9/EC ATEX. Intrinsic Safety per EN 50020	-	ATEX II 1G EExia IIC/IIB T4/T5/T6 (Transmitter only)
Permissible ambient temperature	-	-58°F (-50°C) … 185°F (+85°C) with T4 -58°F (-50°C) … 158°F (+75°C) with T5 -58°F (-50°C) … 140°F (+60°C) with T6
Maximum values for connection of the current loop circuit (connections + and -)	-	U_o = 30 Vdc I_o = 120 mA P_i = 800 mW C_i = 6.2 µF L_i = 110 µH
Maximum values for connection of the sensor circuit (connections 1 up to 3)	-	U_o = 6.4 Vdc I_o = 42.6 mA P_o = 37.1 mW **Group II B:** C_o = 500 µF L_o = 50 mH **Group IIC:** C_o = 20 µF L_o = 10 mH
EMC emissions and susceptibility	-	EMC directive 89/336/EEC EN 61326:1997/A1, 1998/A2.2001

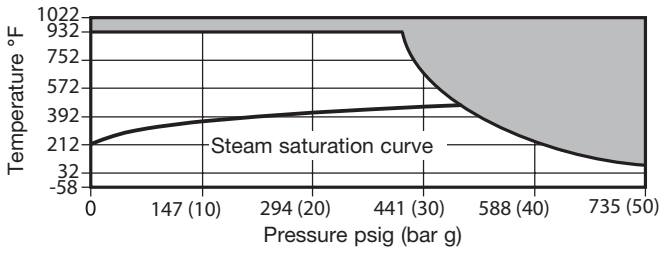
Pressure/temperature limits

The **EL2270** and **EL2271** temperature probes can be used in applications where the process temperature is within the following limits. Where greater temperatures and pressures are present, the temperature probe should be fitted with a pocket.

For air and steam applications, flow velocities must be below 147 fps (45 m/s) 105 fps (32 m/s for fabricated pockets).

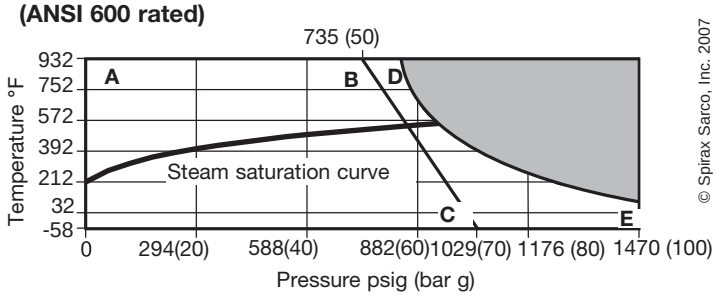
For liquids a recommended velocity is 16 fps (5 m/s) [27.5 in. (**700 mm) and 7.87 in. (200 mm)** non-flow applications only].

Pressure and temperature limits of temperature probe. (ANSI 300 rated)



The product **must not** be used in this region.

Pressure and temperature limits of standard pockets. (ANSI 600 rated)



The product **must not** be used in this region.

A-B-C Fabricated pocket
A-D-E Solid drilled pocket

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EL2600 Pressure Transmitter and 'U' Syphons

Safety
Your attention is drawn to Safety Information Leaflet IM-GCM-10.

Description
The EL2600 is a combined pressure sensor and transmitter which is designed for general industrial use.
It has a 2 wire 4-20 mA current loop, and a 1/4" NPT process connection. Two syphon tube and valve assemblies are available, one with a maximum design pressure of 362.5 psig and one with a maximum design pressure of 1160 psig.

Available Ranges psig

0-14.5	0-145	0-1450 *
0-23.2	0-232	0-2320 *
0-36.25	0-362.5	0-3625 *
0-58	0-870	
0-87	0-580	

*No 'U' syphon available for these ranges, therefore maximum operating temperature is limited to 158°F.
Note: High pressure 'spikes' above maximum overpressure, even of very short (milli-seconds) duration, could damage sensors. If pressure peaks are likely to occur in your application, we recommend the use of a pressure snubber. Alternatively, a higher range pressure transmitter could be used, though this would mean some loss of signal resolution.

Limiting conditions

Pressure/ temperature limits EL2600	
Minimum operating temperature	32°F
Maximum operating temperature (without syphon tube)	158°F
Low pressure syphon tube/ valve	
Maximum design pressure	362.5 psig
Maximum design temperature	500°F
Maximum working conditions	304.5 psig and 422.6°F
High pressure syphon tube	
Maximum design pressure	1160 psig
Maximum design temperature	842°F
Maximum working conditions	870 psig and 842°F

Process connection
For fluids below 158°F the EL2600 may be mounted directly via its 1/4" NPT connection.
Above 158°F, a 'U' syphon and isolating valve must be fitted between the EL2600 and the vessel or pipeline.

Technical data

Pressure range (psig)	Overpressure	Burst pressure (psig)	Accuracy (+/-%FSD at 68°F)
up to 29	3 x full scale	2900	≥ 0.5
29 - 362.5	3 x full scale	2900	≥ 0.5
362.5 - 362.5	3 x full scale	12.325	≥ 0.5

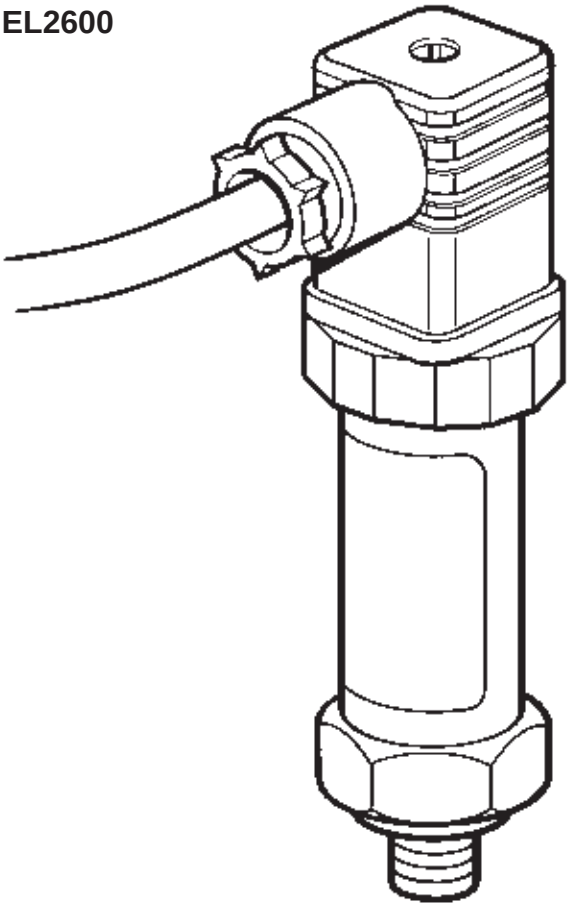
Supply voltage	9 to 33 V dc
Supply voltage influence	< 0.1% full scale
Enclosure rating	NEMA4

Approvals

EMC emissions	BS EN 50081 - 1
EMC susceptibility	BS EN 50082 - 2

Maximum loop resistance (ohms) $\frac{\text{Supply voltage - 9 Volts}}{\text{0.02 Amps}}$

EL2600



Materials

EL2600

Part	**Material**	
Body	Stainless steel	316L WS 1.4435
Connector	Moulded plastic	Polyamide PA 66

***Low pressure syphon tube assembly**

Part	**Material**
Tube	Carbon steel ASTM A106 Gr. B. Phosphated
Valve Body	Brass
Valve Handle	Phenolic

High pressure syphon tube assembly

Part	**Material**
Tube	Carbon steel BS 3602: Part.1 1987 CFS 360 (zinc plated/ passivated)
Valve Body	Carbon steel
Valve Seat	PEEK/ Polymain

* Valve ordered separately

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

EL2600 Pressure Transmitter and 'U' Syphons

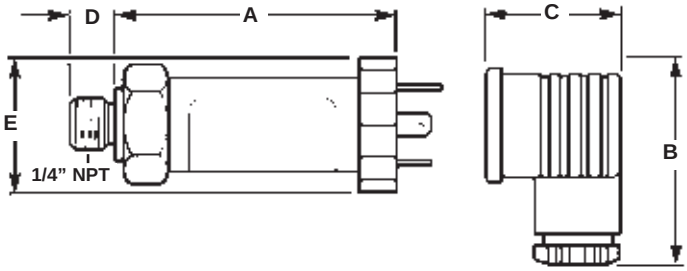
Dimensions/ weights (approximate) in inches and lbs.

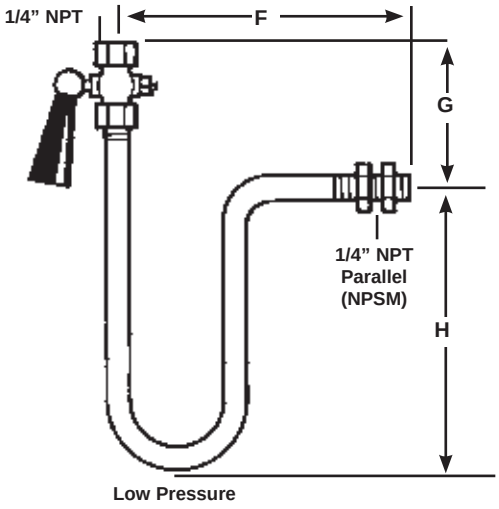
EL2600

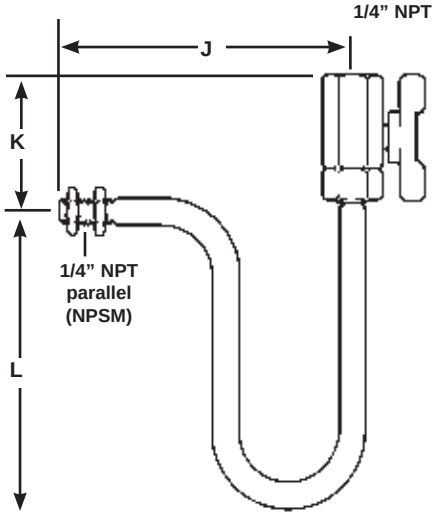
A	B	C	D	E	Weight
2.6"	1.9"	1.1"	0.5"	1.4"	0.2

'U' Syphon and isolating valve

F	G	H	J	K	L	Weight
6.3"	2"	5.9"	6.3"	2.3"	5.9"	1.1

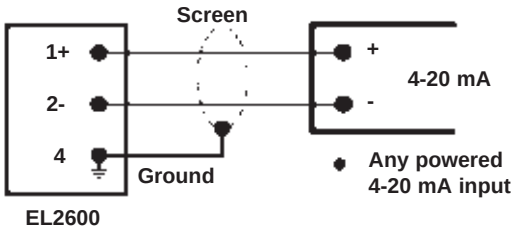




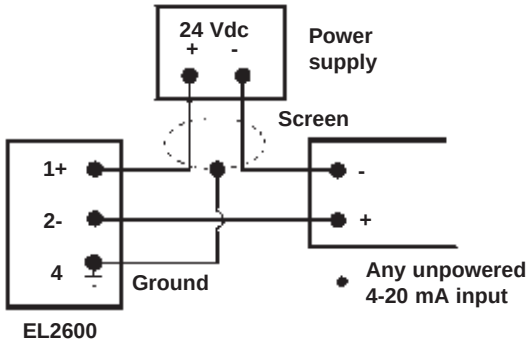


Wiring details

Powered current loop input:-



Unpowered current loop input:-



Installation

The EL2600 pressure sensor must be installed as described in the Installation and Maintenance Instructions supplied with each unit. It is essential to use a 'U' syphon and valve for temperatures above 158°F to avoid damage to the unit. **The syphon tube must be filled with water before fitting the EL2600.**

Maintenance

No specific maintenance is required, but we recommend inspection of the transmitter and its connector at least once a year. The EL2600 can be re-calibrated - see Installation and Maintenance Instructions.

Cable requirements

- 2 core cable with screen if noise expected.
- Maximum cable length is dependent upon the driving voltage and cable resistance.

How to order

1 - EL2600 pressure transmitter, range 0-232 psig with 'U' syphon and valve.

Spirax Sarco Inc. • 2150 Miller Drive • Longmont, CO 80501 • Telephone: (303) 682-7060 • Fax: (303) 682-7069

MassTracker™ Insertion Turbine Mass Flow Meter

Description

The masstracker insertion turbine utilizes multivariable electronics to provide a compensated mass flow rate of liquid, gas and steam from a single opening in the pipeline. The masstracker measures all process variables with a single device providing outstanding accuracy and reduces installation costs. Simplified commissioning through easy to use local display or internet accessible Web Server.

Masstracker M-TMP-600 and 900 are “hot-tappable” and can be installed and removed without process shutdown simplifying maintenance.

M-TMP-600 M-TMP-700 M-TMP-900

massTRACKER™ FLOW METERS

Features

- Volumeric or mass flow monitoring of liquid, gas, or steam
- Rugged insertion-style mounting in any pipe 3" to 80"
- Can be installed and removed under full flow conditions
- Interchangeable rotors for a wide variety of applications
- Process pressure up to 2000 psig (137.8 barg)
- Process temperatures up to 750°F (400°C)
- Modbus RTU, Modbus TCP/IP standard
- Industry standard pulse output 4 to 20 mA
- Field or remote configurable outputs, display and ranges
- Multi-variable electronics incorporates RTD for compensated mass flow reading
- Optional integral pressure measurement
- Field configurable via magnet wand
- Remote monitoring and programming via built in web server
- FM/CE Approval Pending

Application Guide

Model	Liquid	Gas	Steam	Hot Tap	Temperature Range °F	Maximum Pressure[1] psi	Seal Type	Line Sizes[2] inches
M-TMP-600	yes	yes	yes	yes	-40 to 400	125	E/P[3]	3 to 20
M-TMP-700	yes	yes	yes	no[5]	-40 to 600	2000[4]	Swagelok®	3 to 80
M-TMP-900	yes	yes	yes	yes	-40 to 750	flange rating	Grafoil®	3 to 80

Note:

1 Maximum pressure at maximum temperature with appropriate connection.
2 In some cases, especially in large pipe sizes, a one or two foot stem extension may be required (See dimensional outlines).
3 Ethylene-Propylene elastomer.
4 Rating listed is for NPT connection. For flange connections, use ANSI flange rating.
5 The M-TMP-700 is a fixed insertion meter; it cannot be removed or installed under pressure.

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

MassTracker™ Insertion Turbine Mass Flow Meter

Operating Specifications

Measurable Velocity Limits
See Rotor Selection Guide for linear and measurable ranges of available rotors. Continuous operation above the maximum velocity will shorten the life of the rotor and is not recommended.

Process Viscosity
Maximum 5 centipoise

Ambient Temperature Limit
Electronics
–5 to 140°F

Ambient Humidity Limit
5 to 95% relative humidity non-condensing

Power Requirements
12 to 32 VDC, 24 VDC nominal, 2 amps

Analog
3 each 4 to 20 mA output. Active or passive.

Scaled Pulse
Output can be scaled so that 1 pulse indicates a specific quantity of fluid passing through the pipe, up to 10 pulses/sec.

Relay Output
2 each SPDT, 350v/120mA
24v/50 mA in hazardous environment

Communications
Modbus RTU - Half duplex RS 485
Modbus TCP/IP - Full duplex, 10/100 Base T Ethernet
HTTP Web Interface

Remote Mount Electronics
Up to 100 feet with shielded twisted pairs

Performance Specifications

Process Variables	Liquids	Gas & Steam	Repeatability
Volumetric Flow Rate	+/- 1.0% of rate[1]	+/- 1.0% of rate[1]	+/- 0.25% of rate
Mass Flow Rate	+/- 1.5% of rate[2]	+/- 2.0% of rate[3]	+/- 0.35% of rate
Temperature	+/- 2.0°F (+/- 1°C)	+/- 2.0°F (+/- 1°C)	+/- 0.2°F (+/-0.1°C)
Pressure	+/- 0.25% of full scale	+/- 0.25% of full scale	+/- 0.05% of full scale
Density	+/- 0.3% of reading	+/- 0.3% of reading	+/- 0.1% of reading

All meters are calibrated to +/-1% on a 3" pipe line.

[1]G6 Rotor +/- 3.0% of rate

[2]G6 Rotor +/- 3.35% of rate

[3]G6 Rotor +/- 3.6% of rate

Physical Specifications

Materials	
Rotor	Blades: 17– 4 PH, ten blade, precision machined
	Housing: 316 stainless steel
	Pivots: tungsten carbide
Rotor Bearing Type	Liquid: CSJ stellite jewel
	Gas or Steam: DEV tungsten carbide
Wetted Parts	316L stainless steel stem and housing (bronze and carbon steel housing M-TMP-600)
External Parts	Aluminum, 316 stainless steel, carbon steel (bronze and carbon steel on M-TMP-600), M-TMP- 900
Electrical Connection	Junction box with terminal block for external wiring. ¾" NPT female connection for conduit.
Electrical Enclosure	383 aluminum. Approved for NEMA 4X for watertight and dust tight requirements
Sensor	Electromagnetic pick–up, 10 mVp–p minimum, 330 Ω nominal resistance.
Retractor Type	
M-TMP-600	Screw thread, rising stem
M-TMP-700	Not retractable
M-TMP-900	Acme thread, non-rising stem
Extended Length Stem (Optional)	
Use of the two foot extension is limited to gas or steam applications only.	Longer stems are available for large pipe sizes or when the mounting dimensions exceed the insertion capability. Extended stems are not available for the M-TMP-600.
Process Connection	
M-TMP-600	2" NPT
M-TMP-700	2" NPT
	2" 150#, 300#, 600#, 900#, ANSI raised face flange
M-TMP-900	2" 150#, 300#, 600#, 900#, ANSI raised face flange

MassTracker™ Insertion Turbine Mass Flow Meter

Isolation Valve (M-TMP-600)
2**"** full-port bronze gate valve, 125 psig (8.62 barg) maximum. For M-TMP-900, see Accessories.

Pressure Tap and Bleed Valve
Standard ¼**"** NPT pipe nipple with ¼**"** stainless steel bleed valve. Provides connections for mounting optional pressure transmitter (Model PT).

Temperature Sensor
A 100 Ω, platinum RTD mounted inside the stem of the flowmeter probe, eliminating the need for a separate temperature tap.

Accessories

Gate Valve (Model 2GV) - (for Use with M-TMP-900 Only)
Installation with a 2**"** double flanged, raised-face, full port gate valve enables the flow sensor to be inserted and removed from the pipe under full flow conditions. Both the valve and pipe tap must have a minimum 2**"** internal diameter clearance.

Straight Run Piping Requirements

	Upstream	Downstream
One 90° elbow before the meter	10 D	5 D
Two 90° elbows before the meter	15 D	5 D
Two 90° elbows out of plane before the meter	30 D	5 D
Reduction before the meter	10 D	5 D
Regulator or valve partially closed before the meter	30 D	5 D

D is equal to the internal diameter of the pipe.

If there is not sufficient straight run of pipe, a flow rectifier may be used to reduce the above diameter measurements.
Consult your local representative or the factory for your specific application.

Other Installation Considerations

Tap Size
2**"** minimum diameter.

Mounting Position
The insertion turbine meter may be installed in vertical, horizontal, or angled pipe sections. The meter is attached perpendicular to the axis of the pipe and should not be mounted “upside-down” (with its top section hanging below the pipe mount). For liquid service, the fluid must completely fill the pipe.

Site Selection
The flow measurement location should be selected to minimize turbulence and swirl. The extent of these flow disturbances depends upon the piping configuration. Valves, elbows, pumps, and other piping components may add disturbances to the flow.

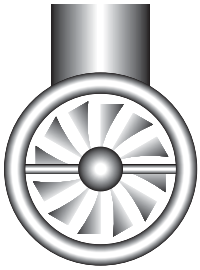
Hot Tap Comapatibility
The M-TMP-600 is hot tap compatible, which means that the sensor can be installed and removed under full flow conditions. The M-TMP-900 is hot tap compatible when installed with a 2**"** double flanged, full port ball or gate valve that adheres to the dimensions.

Bidirectional Flow (Option)
Turbine Rotor is calibrated for forward and reverse flow. **Calibration in both directions must be requested at time order is placed.**

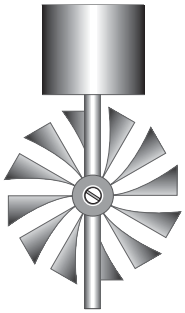
MassTracker™ Insertion Turbine Mass Flow Meter

Rotor Selection Guide

G6B (1" rotor)



G1B through G5B, L1 (1.5" rotor)



Selection of the turbine rotor model depends upon the fluid type and operating velocity range of the fluid.

- *For all liquids, the model L1B rotor, with a maximum velocity of 30 ft/sec, must be used.*
- *For gases and steam, six different rotors are available with maximum velocities ranging from 55 to 175 ft/sec. See Table for maximum velocity limits (Vmax.) for all rotors.*

The turbine rotor typically will respond linearly over the velocity range from Vlin to Vmax – within ±1.0% (±3.0% for G6 rotor). This is defined as the "linear" range of the rotor. The minimum "measurable" velocity (Vmin) can be considered the application minimum. Velocities from Vmin to Vlin are measurable and repeatable, but less accurate.

When determining the fluid velocity limits for a given rotor, the following equations can be used to compute fluid velocity.

Average Fluid Velocities	
Fluid	
Liquid	$0.4085 \frac{Q_1}{D^2}$
Gas	$3.056 \frac{Q_2}{D^2}$
Steam	$0.051 \frac{M}{\rho D^2}$
Where:	
V = average fluid velocity	ft/sec
D = pipe inside diameter	in
Q_1 = liquid volumetric flow	gal/min
Q_2 = gas actual volumetric flow	ft³/min
M = mass flow rate	lb/h
ρ = fluid density	lb/ft³

Liquid Minimum and Maximum Velocity Rates								
Rotor	**Flow Units**	**All Sizes**	**3 to 5"**		**6"**		**8+"**	
		Vmax	Vlin	Vmin	Vlin	Vmin	Vlin	Vmin
L1 *	ft/sec	30	1.4	0.5	1.5	0.6	1.6	0.7

Gas or Steam Minimum and Maximum Velocity Rates (ft/sec)							
Rotor	**All Sizes**	**3–5 in.**		**6 in.**		**8+ in.**	
	V max	V lin	V min	V lin	V min	V lin	V min
G1B 40° pitch	55	$3.19/\sqrt{\rho}$	$1.94/\sqrt{\rho}$	$2.00/\sqrt{\rho}$	$1.23/\sqrt{\rho}$	$1.50/\sqrt{\rho}$	$1.00/\sqrt{\rho}$
G2B 30° pitch	70	$3.98/\sqrt{\rho}$	$2.26/\sqrt{\rho}$	$2.27/\sqrt{\rho}$	$1.63/\sqrt{\rho}$	$1.90/\sqrt{\rho}$	$1.31/\sqrt{\rho}$
G3B 20° pitch	85	$4.52/\sqrt{\rho}$	$2.42/\sqrt{\rho}$	$2.52/\sqrt{\rho}$	$1.95/\sqrt{\rho}$	$2.18/\sqrt{\rho}$	$1.40/\sqrt{\rho}$
G4B 15° pitch	115	$5.84/\sqrt{\rho}$	$3.85/\sqrt{\rho}$	$3.78/\sqrt{\rho}$	$2.84/\sqrt{\rho}$	$3.00/\sqrt{\rho}$	$2.19/\sqrt{\rho}$
G5B 10° pitch	145	$6.91/\sqrt{\rho}$	$4.57/\sqrt{\rho}$	$4.78/\sqrt{\rho}$	$3.47/\sqrt{\rho}$	$3.54/\sqrt{\rho}$	$2.81/\sqrt{\rho}$
G6 B* 5° pitch	175	$6.10/\sqrt{\rho}$	N/A	$5.53/\sqrt{\rho}$	N/A	$5.00/\sqrt{\rho}$	N/A

*Bi-Directional calibration not available on G6B rotor.

Note: Rotors have moving parts that require periodic maintenance.

Note: All values in the above table are approximate and depend on the density of the fluid. Consult EMCO if your application falls outside the above limits.

Vmax = maximum velocity of fluid [ft/sec]
Vlin = minimum velocity of fluid at which rotor response is linear [ft/sec]
Vmin = minimum measurable velocity of fluid [ft/sec]
ρ = density of fluid [lb/ft³]
N/A = not applicable

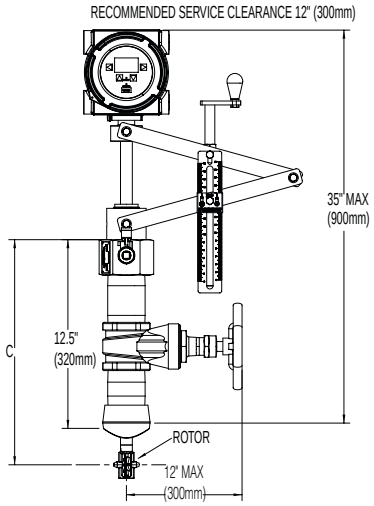
Note: Measurable flow rates for your specific application are available using EMCOSIZE (downloadable at www.spiraxsarco.com/us or www.emcoflow.com).

MassTracker™ Insertion Turbine Mass Flow Meter

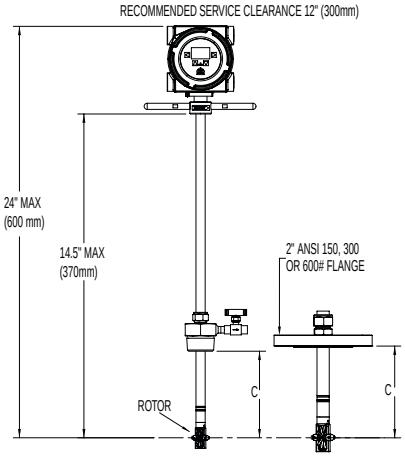
Dimensions and Weights

Dimensions are in inches (millimeters).

M-TMP-600

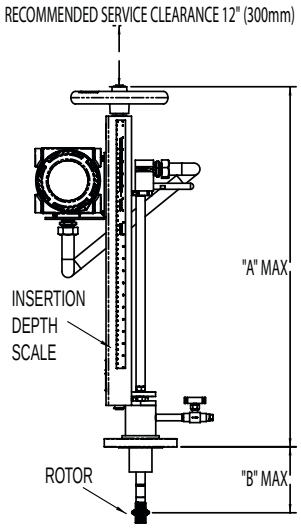


M-TMP-700



*Add 12" (300 mm) for each additional foot of stem length.

M-TMP-900



*Add 12" (300 mm) for each additional foot of stem length.

Dimensions			
		C	
Model	Connection	inches	mm
M-TMP-600	2" NPT	4.5 min 18 max	115 min 450 max
M-TMP-700	2" NPT	3 min 11.25 max	80 min 290 max
	2" 150#	3 min 12.75 max	80 min 325 max
	2" 300#	3 min 12.5 max	80 min 320 max
	2" 600#	3 min 12.25 max	80 min 310 max
	2" 900#	3 min 12 max	80 min 300 max

Dimensions					
		B		A	
Model	Stem Length	inches	mm	inches	mm
M-TMP-900	Standard	1.5 min 20 max	40 min 500 max	30	800

Weight			
		Weight	
Model	Connection	lb	kg
M-TMP-600	2" NPT	28 max	12.7 max
M-TMP-700[1]	2" NPT	9	4.1
	2" 150#	12	5.4
	2" 300#	14	6.3
	2" 600#	16	7.2
	2" 900#	20	9.1
M-TMP-900[2]	2" 150#	30	13.6
	2" 300#	35	15.8
	2" 600#	40	18.1
	2" 900#	47	21.3

[1]Add 2.5 lb (1.2 kg) for each additional foot of retractor or stem length.

[2]Add 5 lb (2.3 kg) for each additional foot of retractor or stem length.

MassTracker™ Insertion Turbine Mass Flow Meter

How To Order

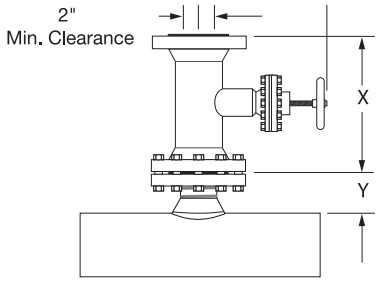
Category	Description	Suffix Code					
Model	Liquid, steam or gas service, 400°F (204°C)	M-TMP-600[4]					
	Liquid, gas, or steam service, 600°F (316°C)	M-TMP-700	H[2]				
	Liquid, gas, or steam service, 750°F (400°C)	M-TMP-900	H[2]				
Connection	2", male NPT (model 700)			2NPT			
	2", 150# flange (model 700, 900)			2F150			
	2", 300# flange (model 700, 900)			2F300			
	2", 600# flange (model 700, 900)			2F600			
	2", 900# flange (model 700, 900)			2F900			
	3", 150# flange (model 910, 960 extended stem)[6]			3F150			
	3", 300# flange (model 910, 960 extended stem)[6]			3F300			
Extended Stem	None (standard length)				XX		
	1' extension (not available for models 600)[6]				E1		
	2' extension (gas/steam applications only) (not available for models 600)[6]				E2		
Pressure Transmitter	No Pressure Transmitter					XX	
	PT for pressure range 0 to 50 psig (0 to 3.44 barg)					50	
	0 to 100 psig (0 to 6.89 barg)					100	
	0 to 150 psig (0 to 10.34 barg)					150	
	0 to 200 psig (0 to 13.79 barg)					200	
	0 to 250 psig (0 to 17.24 barg)					250	
	0 to 500 psig (0 to 34.47 barg)					500	
	Special scaling requests[5]					PXX	
Display Options	Local						LOC
	Remote						RMT

Example: M-TMP-900-2F150-XX-XX-RMT

1 The G6B is the only available 1" shrouded rotor. Not available for use with bidirectional calibrated meters.
2 High temperature option: Must be selected when liquid, gas or steam operating temperature exceeds 400°F (204°C) on the M-TMP-700 or M-TMP-900 only. Extended stems must be used for applications above 500°F
3 All meters require rotors. Select the proper rotor based on the information derived from the EMCOSIZE sizing program.
4 M-TMP-600 has a standard 2" full-port bronze 125 psig isolation valve. Select the proper thread-o-let connection.
5 Special transmitter scaling is available. Please note scaling range below model code with ordering. If no special scaling is indicated, transmitter will be scaled per model code.
6 A 3" flange and 3" hole tap size are recommended for meters with extended stems.

Please specify the following information with your order:
- Fluid type or composition
- Maximum, minimum, & normal operating flow rate
- Maximum, minimum, & normal operating temperatures
- Maximum, minimum, & normal operating pressures
- Specific weight & viscosity at normal operating conditions

Gate Valve



Type	X	Y	Z
	inches (mm)	inches (mm)	inches (mm)
150#	7 (180)	3.5 (90)	15.325 (390)
300#	8.5 (215)	3.75 (95)	16.325 (415)
600#	11.5 (290)	3.75 (95)	17.875 (455)

Type	Weight
	lb (kg)
2" 150#	46 (20.8)
2" 300#	58 (26.3)
2" 600#	84 (38.1)

Model 600 Optional Thread-o-let[4]	
TMP 600 THREAD-O-LET FOR 3" PIPE	EC060037
TMP 600 THREAD-O-LET FOR 4-6" PIPE	EC060038
TMP 600 THREAD-O-LET FOR 8-36" PIPE	EC060039
TMP 600 THREAD-O-LET FOR 38-80" PIPE	EC060040

Rotors[3]	
ROTOR 100-005-B-DEV (G6B)[1]	EC021124
ROTOR 150-010-B-DEV (G5B)	EC021122
ROTOR 150-015-B-DEV (G4B)	EC021222
ROTOR 150-020-B-DEV (G3B)	EC021322
ROTOR 150-030-B-DEV (G2B)	EC021422
ROTOR 150-040-B-DEV (G1B)	EC021522
ROTOR 150-040-B-CSJ (L1B)	EC021512
ROTOR 150-010-B-DEV (G5B) BI-DI	EC004447
ROTOR 150-015-B-DEV (G4B) BI-DI	EC004448
ROTOR 150-020-B-DEV (G3B) BI-DI	EC004449
ROTOR 150-030-B-DEV (G2B) BI-DI	EC004450
ROTOR 150-040-B-DEV (G1B) BI-DI	EC004451
ROTOR 150-040-B-CSJ (L1B) BI-DI	EC004452

Optional Gate Valve for Model 900	
DOUBLE FLANGED GATE VALVE - 2" 150" RAISED FACE FLANGE	1693040
DOUBLE FLANGED GATE VALVE - 2" 300" RAISED FACE FLANGE	1693041
DOUBLE FLANGED GATE VALVE - 2" 600" RAISED FACE FLANGE	EC004250
Optional Mounting Kit for Gate Valve	
MOUNTING KIT FOR ANSI 150 3" PIPE	EC004254
MOUNTING KIT FOR ANSI 150 4-6" PIPE	EC004255
MOUNTING KIT FOR ANSI 150 8-36" PIPE	EC004256
MOUNTING KIT FOR ANSI 150 38-80" PIPE	EC004257
MOUNTING KIT FOR ANSI 300 3" PIPE	EC004276
MOUNTING KIT FOR ANSI 300 4-6" PIPE	EC004277
MOUNTING KIT FOR ANSI 300 8-36" PIPE	EC004278
MOUNTING KIT FOR ANSI 300 38-80" PIPE	EC004279
MOUNTING KIT FOR ANSI 600 3" PIPE	EC004280
MOUNTING KIT FOR ANSI 600 4-6" PIPE	EC004281
MOUNTING KIT FOR ANSI 600 8-36" PIPE	EC004282
MOUNTING KIT FOR ANSI 600 38-80" PIPE	EC004283

PhD Inline Vortex

Description

The Vortex PhD vortex shedding flowmeter measures process fluid flow by detecting the frequency at which vortices are shed from an obstruction in the process fluid line (the bluff body). A piezo-electric sensor mounted outside the flow line acts as the transducer, converting vortex pulses into electrical signals.

The 'Smart' electronics provide excellent noise immunity while the wide range of wetted materials provide outstanding compatibility with most process fluids. The transmitter provides a frequency output, scaled frequency output, totalizer pulse or a 4-20 mA DC signal proportional to the flow rate.

Features

- Reliable–no moving parts, no fluid to sensor contact
- In-process removable sensor, below 750 psig (52 barg) pressure
- Simple, rugged, all welded construction, no internal gaskets, no leak paths
- High accuracy with wide rangeability
- Line sizes from 1" to 12"
- High temperature operation up to 750°F
- EZ Logic™ menu-driven user interface
- 'Smart' electronics provide excellent noise immunity
- Compatible with HART Protocol

Performance Specifications

Accuracy

Liquid	± 0.7% of flow rate
Gas and Steam	± 1.0% of flow rate
Analog Output Version	Add ± 0.1% of full scale

Repeatability
± 0.15% of flow rate

Response Time
Adjustable from 1 – 100 seconds (analog output version)

K-factor – Temperature Correction
The K-factor of the flowmeter decreases by 0.29% for each 100°F increase in temperature above 70°F. The converse is true below 70°F. By programming the operating fluid temperature in the electronics, the change in the K-Factor is automatically corrected for.

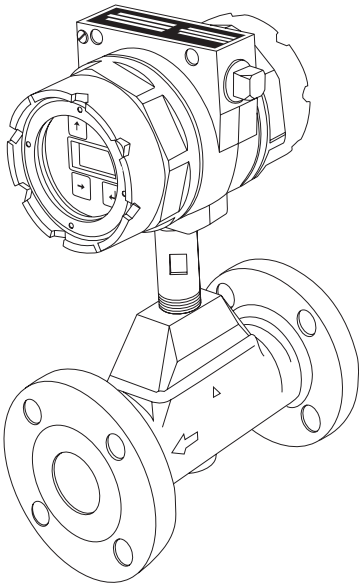
Operating Specifications

Fluid Types
Liquid, gas or steam

Line Sizes
1" – 12"

Process Temperature Limit
–40 to 750°F

Process Pressure
Flange
ANSI Class 150, 300 or 600
Wafer
All wafer bodies are rated based on appropriate flange rating to a maximum of ANSI Class 600



Enclosure Specifications
Approved for NEMA 4X watertight and dust tight requirements.

Ambient Temperature Limit
Normal
– 20 to 140°F

Display Option
32 – 140°F

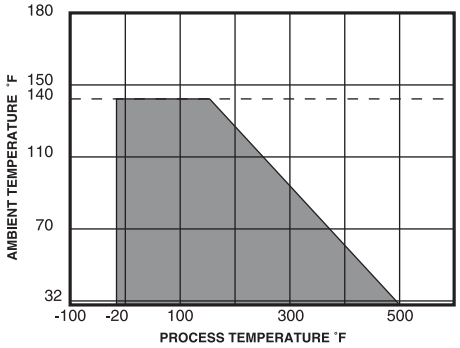


Figure 1.
Ambient Temperature Range for Locally Mounted Electonics.

Ambient Humidity Limit
5 – 100% RH non-condensing

Power Requirements
18 – 40 VDC; max power consumed: 1 watt

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

PhD Inline Vortex

Operating Specifications continued

Output

Analog

4 – 20 mA, loop powered 2 wire system, digitally adjusted span

Frequency

Voltage pulses, 3 wire system, 1 to 10 kHz square wave, open collector FET output with selectable pull-up resistors. The pulse output can be scaled so that 1 pulse represents a specific quantity of fluid passing through the flowmeter. For typical applications, the amplitude of the squarewave can be determined by:

$$V_{pulse} = V_s - (I \bullet R_{load})$$

For other options refer to the Vortex PhD manual

Span Setting

For analog outputs the span setting can be adjusted without the use of electronic test equipment by programming the full scale rate using the EZ Logic™ kepyad.

HART Protocol

In addition to using the keypad for field configuration, the Vortex PhD is also compatible with a laptop PC using a Hart Modem and EZ Comm communications software. This can be used to calibrate the 4-20 mA settings, set the 20 mA point, assign a tag or descriptor, display flowrate, output level, total, velocity and shedding frequency.

Cable Conduit Connection

ANSI 3/4" female NPT.
DIN PG 13.5.

Signal Cable

18, 20 or 22 gauge, shielded instrumentation cable.

Measurable Flow Velocities

Liquid

1.5 to 32 ft/sec

Gas/Steam $\sqrt{\frac{50}{\rho}}$ to 260 ft / sec

Where: $\rho = \text{density in } \frac{\text{lb}}{\text{ft}^3}$

Process Viscosity

For minimum linear flow velocities at varying viscosities. (See Figure 2)

Linear Range

Reynolds Numbers of 20,000 to 7,000,000

Flowmeter Sizing

Selecting the appropriate size flowmeter can be critical. If the flowmeter is over-sized, the signal strength could be weak – limiting rangeability. If the flowmeter is undersized, excessive pressure drop or cavitation may occur – affecting accuracy. Use the minimum linear flow velocity curves and Tables 1 through 5 (minimum and maximum flow rates for various types of applications) for general sizing. For more detailed information, contact your representative or go to www.emcoflow.com for sizing program.

Pressure Loss

If a differential pressure transducer were connected between pressure taps up and downstream of a vortex flowmeter, the measured differential pressure would be the pressure loss for the device. This value can be calculated using the following equations:

$\Delta P = 2.67 \times 10^{-4} \bullet p \bullet V^2$

or $\Delta P = 2.50 \times 10^{-3} \bullet p \bullet (Q_1)^2 / D^4$

or $\Delta P = 4.47 \times 10^{-5} \bullet p \bullet (Q_2)^2 / D^4$

Where:

ΔP = Pressure loss psi
p = Density at operating conditions lb/ft³
V = Flow velocity in ft/s
Q_1 = Volumetric flow rate in ACFM
Q_2 = Volumetric flow rate in U.S. GPM
D = Flowmeter internal diameter in inches

Minimum Back Pressure (Liquid Service Only)

The line pressure must be sufficiently high so that no cavitation occurs. The minimum required line pressure can be obtained from the equation:

$PG \geq (1.3 \bullet P_v) + (2.7 \bullet \Delta P) - P_{ATM}$

Where:

P_G = Line pressure required psig
ΔP = Maximum pressure loss psig
P_v = Saturation liquid vapor pressure at operating temperature psia
P_{ATM} = Atmospheric pressure psia (bara)

Example:

Water flow rate: 0 to 200 US GPM
Operating temperature: 100°F
Operating pressure: 10 psig
Atmospheric pressure: 14.7 psia
Flowmeter size: 1.939" I.D.
Specific weight: 61.96 lb/ft³

Solution:

$\Delta P = 4.47 \times 10^{-5} \cdot 61.96 \cdot (200)^2 / (1.939)^4 = 7.84$
$P_G = [(1.3) \cdot (0.951)] + [(2.7) \cdot (7.84)] - 14.7$
$P_G = 7.70$ psig

Since the operating pressure of 10 psig is higher than 7.70 psig, no cavitation occurs.

For meter sizing, download "emcosize" program at www.emcoflow.com

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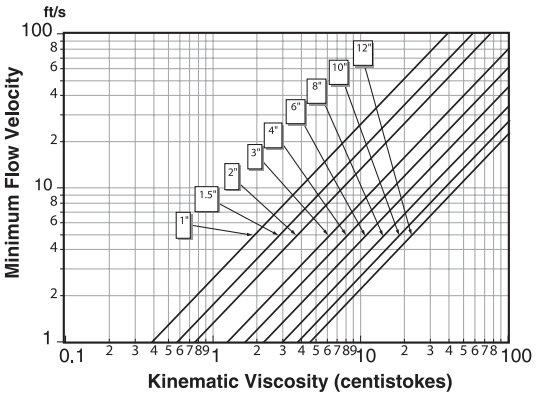

Figure 2. Minimum Linear Flow Velocity vs. Kinematic Viscosity.

Nominal Size	Nominal pulse rate	Nominal Meter Factor	
inch	Hz/ft/s	pulses/gal	pulses/ft³
1	12.0	321.2	2,403
1.5	7.5	81.7	611
2	6.0	39.1	293
3	4.0	11.7	87.2
4	3.0	11.7	87.2
6	2.0	1.5	11.0
8	1.3	0.6	4.2
10	1.2	0.3	2.2
12	1.0	0.2	1.3

Table 1. Nominal Pulse Rate and Flowmeter Factor.

Notes:

1 Water values are determined at standard conditions of 60°F.
2 The minimum flow rate for the 1", and 1.5" flowmeters are below the linear range (the Reynolds number < 20,000).
3 The velocities used to calculate the minimum and maximum flow rates were 1.5 ft/sec and 32 ft/sec respectively.

Nominal Size	Flow Range in GPM		Flow Range in L/s	
inch	min	max	min	max
1	3.4	72	0.2	4.5
1.5	8.3	176	0.5	11.1
2	13.8	295	0.9	18.6
3	30.9	659	1.9	41.6
4	53.8	1,147	3.4	72.3
6	121.9	2,600	7.7	163.9
8	213.5	4,555	13.5	287.2
10	358.7	7,653	22.6	482.5
12	508.3	10,843	32.0	683.7

Table 2. Water Flow Rates.

Physical Specifications

Materials

Wetted Parts

Wing and Shedder Bar
- Stainless steel and Carbon steel Models 316L or the cast equivalent, CF3M

Body
- Stainless steel Model (all sizes) 316L or the cast equivalent, CF3M
- Carbon Steel Model (flanged), 6" and larger ASTM A105, A06 Grade C, and A108 Grade 1018

Electronics Enclosure
383 Aluminum

All Other Parts
Stainless Steel

Flowmeter Classification

Standard
Designed to meed NEMA 4X watertight and dust tight specifications

Explosion Proof version
FM and CSA approved

Remote Mount Electonics (RMT)
Signal cable is provided to mount the electronics enclosure up to 30 ft (optional 50 ft) from the flowmeter body, and must be installed within proper electrical conduit.

Local Indicator and Totalizer (LOC-TOT)
The indicator displays flowrate and total in user-selectable, engineering units. It is a two line, 8 character per line, LCD display. The totalizer enables a pulse output providing a 5 – 999 msec pulse each time the totalizer increments.

Note: This option changes the lower, ambient temperature limit to 32°F. Below 32°F, the display intensity begins to fade but does not affect the transmitter output.

Material of Construction
All models are available in stainless steel; some models can be ordered in carbon steel.

FM Approval (Explosion Proof)
Class I, Div. I, Groups B, C, D
Class II, Div. I, Groups E, F, G
Class I, Div. II, Groups A, B, C, D
Class II, III, Div. 2, Groups F, G

CSA Approval (Explosion Proof)
Class I, Div. I, Groups B, C, D
Dust-ignition Proof for Class II, Div. 1 Groups E, F, G
Class III Hazardous locations

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Accesssories

Flow Processor
A microprocessor-based flow processor can be used to significantly increase the accuracy and functionality of any flowmetering application. See the FP-93 TIS for complete details.

Straight Run Piping Requirements

Typical 10 diameters upstream, 5 diameters downstream. In certain applications where multiple bends or butterfly valves are present, more straight run may be required.

	Upstream	Downstream
One 90° elbow before the meter	10 D	5 D
Two 90° elbows before the meter	15 D	5 D
Two 90° elbows out of plane before the meter	30 D	5 D
Reduction before the meter	10 D	5 D
Regulator or valve partially closed before the meter	30 D	5 D

Other Installation Considerations

Installation
Flowmeter can be installed vertically, horizontally, or at any angle. For liquid service, the flow line must be full during flowmeter operation – flow up in vertical lines is recommended.

Site Selection
The flow measurement location should be selected to minimize turbulence and swirl. The extent of these flow disturbances depends upon the piping configuration. Valves, elbows, pumps and other piping components may add disturbances to the flow.

Servicability
The sensor element can be removed, and replaced, without removing the flowmeter body from the process line, and without process shut down for process pressures below 750 psig. The flowmeter K-factor is not affected by sensor or electronics servicing.

Pressure and Temperature Taps
Pressure tap should be mounted 3.5 to 7 pipe diameters downstream from the flowmeter. The temperature tap should be mounted an additional 3.5 to 7 pipe diameters downstream of the pressure tap. See Figure 3.

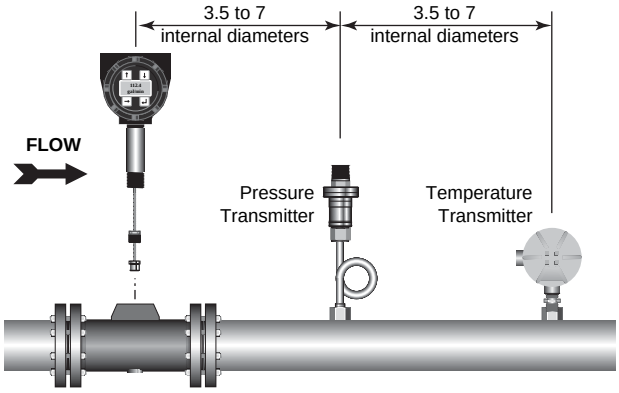

Figure 3. Pressure and Temperature Tap Dimensions.

	1"		1.5"		2"		3"		4"		6"		8"		10"		12"	
Pres PSIG	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**
10	31	283	77	697	129	1164	288	2604	501	4534	1135	10277	1988	18000	3341	30258	4733	42860
15	34	337	84	828	140	1383	313	3094	546	5387	1237	12213	2167	21390	3642	35955	5160	50930
20	37	390	90	958	151	1600	337	3580	587	6233	1331	14129	2331	24746	3918	41597	5550	58923
30	41	494	102	1214	170	2029	380	4539	661	7903	1498	17915	2624	31377	4412	52742	6249	74710
40	45	597	112	1468	187	2453	417	5486	727	9552	1647	21655	2885	37927	4850	63753	6870	90307
50	49	699	121	1719	202	2872	452	6424	786	11186	1783	25357	3122	44412	5249	74654	7435	105748
60	53	801	129	1968	216	3289	483	7356	841	12807	1908	29033	3341	50849	5616	85474	7955	121075
70	56	901	137	2215	229	3702	513	8281	893	14419	2024	32686	3545	57248	5959	96231	8441	136312
80	59	1002	145	2462	242	4114	541	9202	941	16022	2134	36321	3737	63614	6282	106932	8898	151470
90	62	1102	152	2707	253	4524	567	10120	987	17619	2237	39942	3919	69956	6587	117593	9331	166572
100	64	1201	158	2952	265	4933	592	11034	1031	19211	2336	43550	4092	76275	6878	128214	9743	181617
120	70	1399	171	3439	286	5747	639	12855	1112	22382	2522	50740	4417	88868	7424	149382	10517	195065
140	74	1597	183	3925	305	6559	683	14670	1188	25543	2694	57904	4718	101416	7931	166214	11235	197804
160	79	1794	194	4409	323	7369	723	16482	1260	28697	2855	65054	5001	113938	8407	168295	11908	200281
180	83	1991	204	4893	341	8177	762	18291	1327	31846	3008	72193	5268	126441	8856	170158	12545	202498
200	87	2188	214	5377	357	8986	799	20099	1391	34994	3153	79330	5523	132583	9283	171911	13150	204584
220	91	2385	223	5861	373	9795	834	21908	1452	38143	3292	86469	5766	133935	9692	173664	13729	206670
250	96	2680	237	6588	395	11009	884	24624	1540	42873	3490	97191	6113	135625	10275	175855	14555	209278
300	105	3175	257	7803	430	13040	962	29166	1676	50781	3798	104535	6653	138329	11183	179362	15841	213450
350	113	3672	277	9025	463	15082	1035	33734	1802	58735	4085	106259	7155	140610	12027	182320	17036	216971
400	120	4173	295	10256	493	17140	1103	38337	1921	66748	4355	107855	7627	142723	12821	185059	18161	220231
450	127	4679	313	11498	522	19215	1168	42978	2034	72657	4611	109388	8076	144751	13575	187689	19229	223360
500	134	5189	329	12751	550	21310	1230	47665	2142	73548	4856	110729	8505	146525	14296	189990	20251	226098
600	147	6225	361	15299	602	25568	1348	57016	2346	75244	5523	117628	9316	149906	15659	194372	22182	231314

Table 3. Saturated Steam Flow Rates at Selected Process Pressures [1,2] (Minimum and Maximum Operating Flow Rates in lb/hr)

Notes: 1. Maximum flow velocity is 260 ft/sec or Reynolds number limit or 7,000,000 whichever is less.

2. Minimum flow velocity is $\sqrt{\frac{50}{\rho}}$ ft/sec, where ρ = density in $\frac{lb}{ft^3}$ or Reynolds number limit of 20,000 whichever is greater.

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	1"		1.5"		2"		3"		4"		6"		8"		10"		12"	
Pres PSIG	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**
0	711	4675	1130	11486	1888	19194	4224	42934	7352	74730	16669	169433	29201	296813	49087	498888	69532	706680
10	711	7858	1465	19306	2448	32260	5476	72160	9531	125601	21611	284772	37857	498864	63722	838268	90263	1187415
20	711	11043	1737	27129	2902	45332	6491	101403	11299	176499	25618	400174	44877	701024	75490	1177647	106933	1668149
30	802	14229	1971	34957	3294	58412	7369	130661	12826	227425	29080	515637	50942	903292	85473	1517027	121073	2148884
40	888	17417	2181	42789	3645	71499	8152	159934	14190	278378	32173	631161	56360	1105667	94572	1856406	133962	2629619
50	966	20606	2372	50624	3964	84593	8868	189223	15435	329357	34995	746746	61304	1308148	102870	2195786	145716	3065336
60	1038	23798	2550	58464	4260	97693	9529	218527	16587	380363	37607	862390	65880	1510734	110546	2535166	156590	3066018
70	1105	26990	2715	66308	4537	110800	10149	247845	17665	431394	40050	978094	70160	1713422	117723	2576801	166756	3066539
80	1169	30185	2871	74156	4798	123914	10732	277179	18681	482452	42354	1093855	74196	1916212	124487	2577147	176337	3066950
90	1229	33381	3020	82008	5046	137034	11286	306527	19645	533534	44540	1209674	78025	1981748	130782	2572706	185254	3061665
100	1287	36578	3161	89863	5282	150160	11814	335889	20564	584642	46625	1325549	81677	1981748	136902	2573347	193923	3062428
120	1395	42978	3426	105586	5725	176433	12806	394656	22291	686931	50539	1497292	88534	1981748	148387	2574344	210192	3063615
140	1495	49384	3673	121323	6137	202729	13728	453478	23894	789315	54175	1497292	94903	1981748	158946	2571893	225149	3060698
160	1589	55795	3904	137075	6523	229050	14592	512354	25398	891794	57584	1497292	100876	1981748	168847	2570006	239173	3058452
180	1678	62213	4122	152840	6888	255394	15408	571282	26819	994362	60805	1497292	106519	1981748	177936	2560955	252048	3047681
200	1762	68635	4330	168619	7235	281760	16184	630260	28169	994383	63867	1497292	111882	1981748	187249	2571876	265241	3060678
220	1843	75063	4528	184411	7566	308148	16925	689287	29459	994383	66791	1497292	117004	1981748	195325	2560024	276680	3046573
250	1958	84715	4810	208123	8038	347770	17980	753714	31295	994383	70955	1497292	124299	1981748	207975	2573422	294599	3062517
300	2136	100825	5248	247701	8769	413905	19615	753714	34141	994383	77408	1497292	135604	1981748	226127	2558874	320311	3045204
350	2301	116963	5652	287347	9445	480154	21127	753714	36772	994383	83373	1497292	146053	1981748	243566	2561760	345014	3048639
400	2454	133125	6030	327054	10076	503949	22539	753714	39231	994383	88947	1497292	155818	1981748	259241	2552194	367217	3037255
450	2599	149310	6386	366814	10671	503949	23870	753714	41547	994383	94199	1497292	165018	1981748	274584	2555165	388951	3040791
500	2737	165512	6724	389852	11235	503949	25132	753714	43743	994383	99179	1497292	173741	1981748	288580	2548126	408777	3032414
600	2993	197961	7353	389852	12287	503949	27485	753714	47840	994383	108466	1497292	190010	1981748	315201	2545390	446486	3029158

Table 4. Air Flow at Selected Process Pressures at 60°F [1,2,3]
(Minimum and Maximum Operating Flow Rates in SCFH))

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Notes:

1 At standard conditions of 60°F and 14.7 psia, SCFH: standard cubic feet per hour.

2 Maximum flow velocity is 260 ft/sec (79 m/s) or Reynolds number limit or 7,000,000 whichever is less.

3 Minimum flow velocity is $\sqrt{\frac{50}{\rho}}$ ft/sec, where ρ = density in $\frac{lb}{ft^3}$ or Reynolds number limit of 20,000 whichever is greater.

	1"		1.5"		2"		3"		4"		6"		8"		10"		12"	
Pres PSIG	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**
0	772	4665	1444	11460	2413	19149	5397	42834	9395	74557	21300	169041	37314	296126	64968	511367	93181	733432
10	772	7851	1873	19289	3130	32231	7002	72096	12188	125490	27634	284520	48410	498422	84286	860683	120888	123441
20	905	11048	2222	27142	3713	45354	8307	101452	14458	176585	32781	400368	57426	701364	99983	1211101	143401	1737031
30	1028	14255	2524	35021	4218	58520	9436	130901	16423	227844	37236	516588	65230	904957	113570	1562626	162889	2241207
40	1138	17472	2795	42925	4670	71728	10446	160445	18182	279268	41225	633180	72217	1109202	125733	1915261	180334	2746978
50	1238	20700	3042	50855	5083	84978	11370	190084	19791	330857	44871	750146	78605	1314104	136853	2269014	196283	2746978
60	1332	23938	3271	58810	5466	98271	12227	219818	21282	382611	48253	867489	84530	1519664	147166	2623888	211075	3254350
70	1419	27187	3486	66791	5825	111606	13030	249648	22680	434533	51423	985209	90083	1725887	156833	2890521	224938	3461702
80	1502	30446	3689	74797	6165	124985	13789	279575	24001	486622	54418	1103309	95329	1932775	165965	2890521	238036	3461702
90	1580	33715	3882	82829	6487	138407	14511	309597	25257	538879	57265	1221791	100317	2140331	174647	2890521	250488	3461702
100	1655	36995	4067	90887	6795	151872	15200	339717	26457	591305	59986	1340656	105084	2152958	182943	2890521	262387	3461702
120	1797	43587	4414	107082	7376	178933	16499	400250	28718	696667	65112	1579542	114062	2152958	198569	2890521	284500	3461702
140	1929	50222	4738	123382	7917	206171	17710	461176	30826	802714	69892	1626648	122436	2152958	213142	2890521	305701	3461702
160	2053	56900	5043	139789	8427	233585	18851	522500	32812	909452	74394	1626648	130323	2152958	226866	2890521	325384	3461702
180	2171	63622	5333	156302	8911	261179	19933	584223	34696	1016887	78665	1626648	137805	2152958	239886	2890521	344058	3461702
200	2283	70388	5609	172924	9373	288953	20967	646350	36494	1080291	82742	1626648	144947	2152958	252312	2890521	361881	3461702
220	2391	77198	5874	189654	9816	316909	21957	708885	38219	1080291	86652	1626648	151797	2152958	264230	2890521	378973	3461702
250	2546	87496	6254	214956	10450	359188	23376	803456	40688	1080291	92252	1626648	161606	2152958	281293	2890521	403446	3461702
300	2787	104888	6847	257682	11442	430583	25594	818830	44549	1080291	101005	1626648	176940	2152958	307963	2890521	441698	3461702
350	3013	122567	7402	301115	12369	503159	27667	818830	48157	1080291	109186	1626648	191271	2152958	332885	2890521	477442	3461702
400	3226	140539	7926	345267	13245	547487	29626	818830	51567	1080291	116917	1626648	204815	2152958	356431	2890521	511214	3461702
450	3430	158808	8426	390150	14079	547487	31493	818830	54816	1080291	124284	1626648	217720	2152958	378865	2890521	543389	3461702
500	3625	177379	8905	423533	14880	547487	33284	818830	57933	1080291	131350	1626648	230098	2152958	400376	2890521	574242	3461702
600	3995	215439	9814	423533	16398	547487	36681	818830	63846	1080291	144757	1626648	253585	2152958	441178	2890521	632763	3461702

Table 5. Natural Gas Flow Rates at Selected Process Pressures at 60°F [1,2,3,4]
(Minimum and Maximum Operating Flow Rates in SCFH))

Download "emcosize" at www.emcoflow.com

Notes:

1 At standard conditions of 60°F and 14.7 psia, SCFH: standard cubic feet per hour

2 Maximum flow velocity is 260 ft/sec (79 m/s) or Reynolds number limit or 7,000,000 whichever is less.

3 Specific Gravity of natural gas = 0.61 and 0.8% N_2.

4 Minimum flow velocity is $\sqrt{\frac{50}{\rho}}$ ft/sec, where ρ = density in $\frac{lb}{ft^3}$ or Reynolds number limit of 20,000 whichever is greater.

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PhD Inline Vortex

Dimensions and Weights

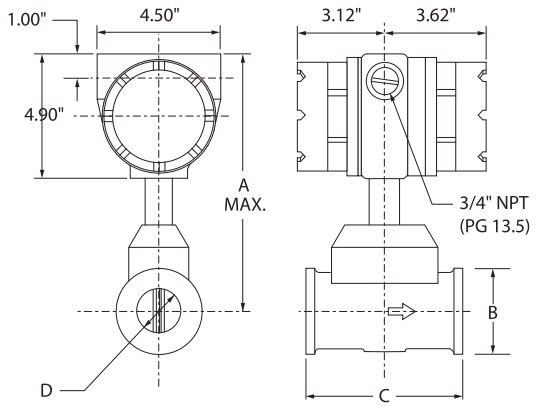


Figure 4. Dimensions: Wafer Connection Type, Integral Mounting.

Wafer Connection

Wafer connection is available in stainless steel sizes 1 – 4" only. The schedule of the mating pipe's internal diameter ≥ dimension "D".

Size (in)	A (in)	B (in)	C (in)	D (in)	Approx Wt (lb)
1	10.8	2.2	4.1	0.957	13
1.5	10.5	3.1	4.1	1.500	14
2	10.8	3.6	5.0	1.939	17
3	11.5	5.0	7.0	2.900	32

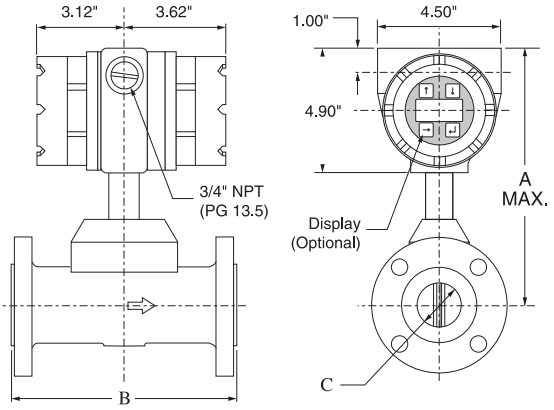


Figure 6. Dimensions: Flange Connection, Integral Mounting.

Table 6. Weights & Dimensions: Wafer

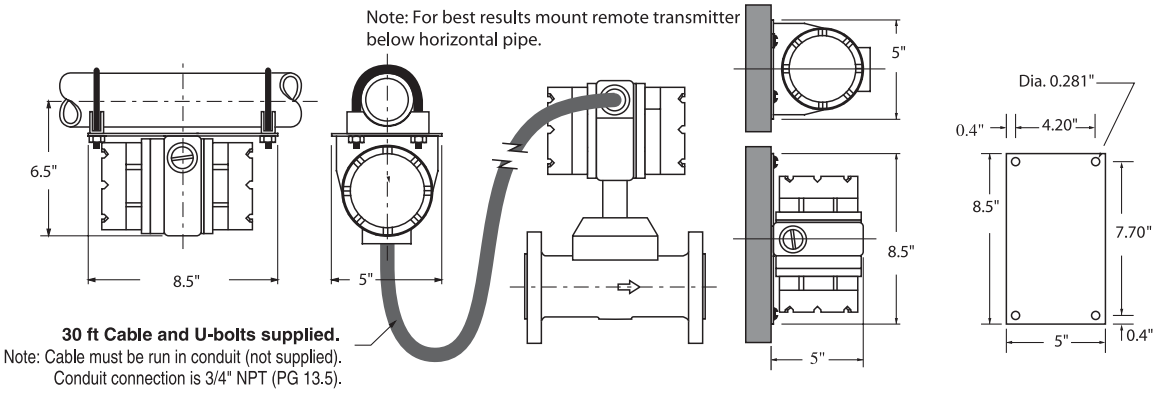
all in inches	A	B	C				Approx. Wt.(lb)		
			Stainless Steel		Carbon Steel				
size			150# 300#	600#	150# 300#	600#	150#	300#	600#
1	10.7	7.6	0.957	0.957	N/A	N/A	18	20	20
1.5	10.7	8.1	1.500	1.500	N/A	N/A	22	28	28
2	13.2	8.5	1.939	1.939	N/A	N/A	31	36	36
3	13.8	9.0	2.900	2.900	N/A	N/A	51	60	60
4	14.3	9.5	3.826	3.826	N/A	N/A	55	72	99
6	15.3	13.6	5.761	5.761	5.761	5.761	92	116	140
8	16.3	18.5	7.625	7.625	7.625	7.625	144	182	220
10	17.4	18.5	10.020	9.750	10.020	9.750	180	260	440
12	18.4	18.5	12.000	11.750	11.938	11.374	265	365	535

Table 7. Weights & Dimensions: Flange.

Notes:
1. The schedule of the mating pipe's internal diameter ≥ dimension 'C'.
2. N/A = Not Available.

REMOTE MOUNTING

Pipe Mount Electronics | **Wall Mount Electronics**



Approximate Weight (lb)				
size (in)	150# Flange	300# Flange	600# Flange	Wafer
1	24	26	26	19
1.5	28	34	34	20
2	37	42	42	23
3	57	66	66	38
4	72	89	105	57
6	98	122	146	N/A
8	150	188	226	N/A
10	186	266	556	N/A
12	271	371	541	N/A

Figure 5. Dimensions weights: Remote Mounting

Wiring

Figures 7- 9 represent typical field wiring applications for the Vortex PhD.

Analog Output
The Vortex PhD may be operated using a 24 VDC power supply. The 4-20 mA output is scalable (2 wire principle.) The load resistor may be installed on supply or return line. Permissible load resistance values are shown in Figure 7.

Pulse Output
This is an open collector pulse output using a high impedance electronic counter. V_{pulse} will vary from:

$$0\text{-}1\text{VDC to } V_{pulse} = V_S\left(\frac{R_C}{R_C + R_{pulse}}\right)$$

$$\text{Note: } R_{pulse} \geq \left(\frac{V_S}{0.16}\right)$$

Where:

V_{pulse} = pulse output amplitude
R_c = counter impedance
V_s = power supply voltage
V_c = minimum required voltage to trip counter
R_{pulse} = pull-up resistance

Cenelec Approved–Power & Signal Wiring
The Vortex PhD flowmeter may be operated using a 24 VDC power supply. The wiring schematic shown (Figure 9) is for the areas defined by the Cenelec approval (see approval description in options section). I. S. zener barriers must have the following specifications:

V_{max}	=	29 VDC	=	Maximum voltage which may be connected to barrier terminals
J_{max}	=	110 mA	=	Maximum current which may be connected to barrier terminals
C_{int}	=	1.5 nF	=	Maximum equivalent internal capacitance across barrier terminals
L_{at}	=	0 H	=	Maximum equivalent internal inductance across barrier terminals

The 4-20 mA output is scalable (2 wire principle.) The 4-20 mA loop resistor should be 250 Ω; and the pulse output is to be connected to a high impedance, electronic counter.
V_{pulse} varies from: 0 -1 VDC to $V_{pulse} = V_s$ $\frac{R_c}{R_c+R_{pulse}}$) (

Note: Rpulse ≥ $\frac{V_s}{0.16}$

Where:

V_{pulse} = Pulse output amplitude
V_s = Power supply voltage (18 to 29 VDC)
R_{load} = Load resistance
R_c = Counter impedance
R_{pulse} = Pull–up resistance

110/220 VAC–Power & Signal Wiring
The Vortex PhD flowmeter may be operated using a 110/220 VAC power supply. The power supply board converts the 110/220 VAC to 24 VDC. The 4-20 mA output is scalable (2 wire principle.) The 4-20 mA loop resistor should be 250 Ω; and the pulse output is to be connected to a high impedance, electronic counter. (Figure 10)
V_{pulse} varies from 0 –1 VDC to V_{pulse} = 24 VDC – (I • R_{load})
Where:

V_{pulse} = Pulse output amplitude
R_{load} = Load resistance (250 Ω)
I = Current (4-20 mA)

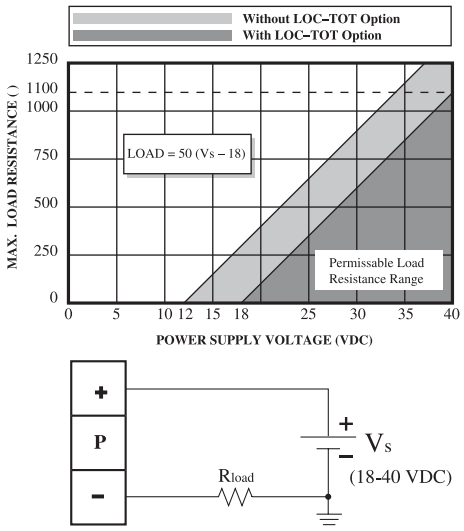


Figure 7. 4-20 mA Output.

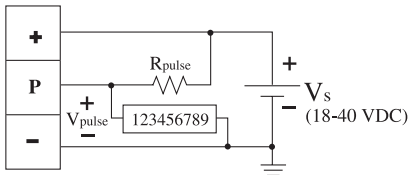


Figure 8. Pulse Output.

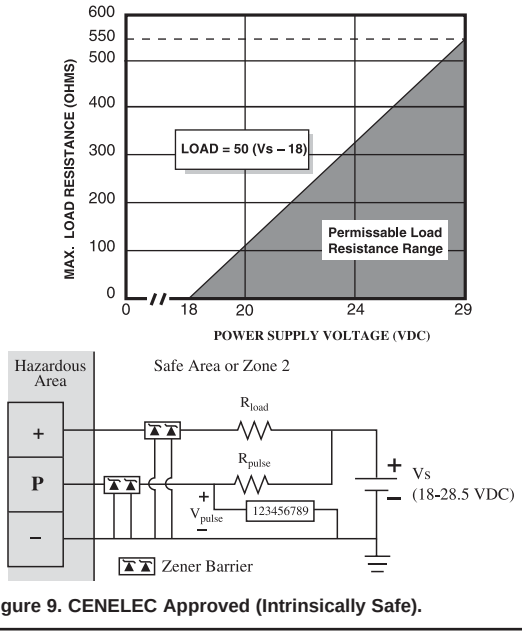


Figure 9. CENELEC Approved (Intrinsically Safe).

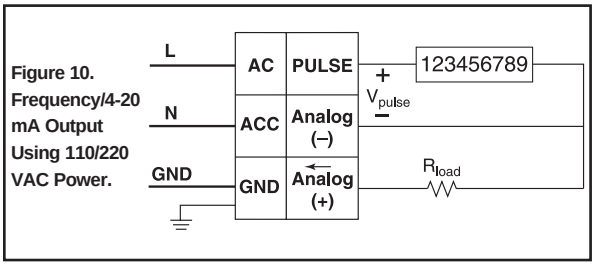


Figure 10. Frequency/4-20 mA Output Using 110/220 VAC Power.

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PhD Inline Vortex

Model and Suffix Codes

Category	Description	Suffix Codes						
Model	Stainless Steel (sizes 1 – 12”)	PhD-90	. . .	. . .	. . .	. . .	. . .	. . .
	Carbon Steel (Stainless steel wing) (sizes 6 – 12”)	PhD-92	. . .	. . .	. . .	. . .	. . .	. . .
Fluid Type	Steam or gas	. . .	S	. . .	. . .	. . .	. . .	. . .
	Liquid	. . .	L	. . .	. . .	. . .	. . .	. . .
Line Size	1”	. . .	. . .	10	. . .	. . .	. . .	. . .
	1.5”	. . .	. . .	15	. . .	. . .	. . .	. . .
	2”	. . .	. . .	20	. . .	. . .	. . .	. . .
	3”	. . .	. . .	30	. . .	. . .	. . .	.
	4”	. . .	. . .	40	. . .	. . .	. . .	. . .
	6”	. . .	. . .	60	. . .	. . .	. . .	. . .
	8”	. . .	. . .	80	. . .	. . .	. . .	. . .
	10”	. . .	. . .	100	. . .	. . .	. . .	. . .
	12”	. . .	. . .	120	. . .	. . .	. . .	. . .
Connection Type	Wafer[6]	. . .	. . .	. . .	W	. . .	. . .	. . .
	Flange	. . .	. . .	. . .	F	. . .	. . .	. . .
Connection Rating	ANSI Class 150	. . .	. . .	. . .	. . .	150	. . .	. . .
	ANSI Class 300	. . .	. . .	. . .	. . .	300	. . .	. . .
	ANSI Class 600	. . .	. . .	. . .	. . .	600	. . .	. . .
Options	No indicator/totalizer option[1]	. . .	. . .	. . .	. . .	. . .	STD	. . .
	FM approved[2]	. . .	. . .	. . .	. . .	. . .	FM	. . .
	CSA approved	. . .	. . .	. . .	. . .	. . .	CSA	. . .
	Local Indicator and Totalizer[3]	. . .	. . .	. . .	. . .	. . .	LOC-TOT	. . .
	Remote Mount Electronics[4]	. . .	. . .	. . .	. . .	. . .	RMT	. . .
	Integral 110 VAC input[5]	. . .	. . .	. . .	. . .	. . .	110	. . .
	Integral 220 VAC input[5]	. . .	. . .	. . .	. . .	. . .	220	. . .
Sensor Wires (Internal)	Teflon, –40° to 400°F	. . .	. . .	. . .	. . .	. . .	. . .	T
	Fiberglass, 150° to 750°F	. . .	. . .	. . .	. . .	. . .	. . .	F

Example → **PhD-90-S-60-F-300-LOC-TOT-RMT-T**

Table 8. PhD Vortex Shedding Flowmeter.

Notes:

1 Has 4-20 mA and/or 50% duty cycle frequency output. A 50% duty cycle frequency can be scaled.

2 FM approved option meters come with a magnet wand. For all other meters the wand can be ordered as an option.

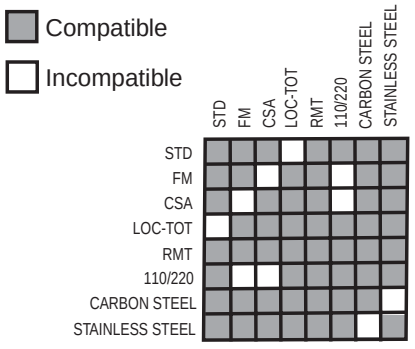
3 At least one local indicator is recommended at each site. If one display will be used on many meters, it should be purchased separately.

4 Remote mount electronics are requried for high process temperatures (refer to the general specification). The standard remote mount option comes with 30’ of cable.

5 Not available with FM and CSA approvals.

6 Wafer style meters available in stainless steel sizes 1 – 3” only.

Compatibility Chart



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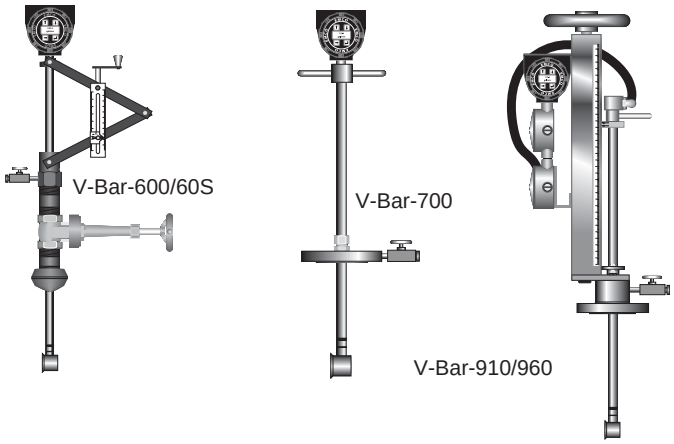
V-Bar Insertion Vortex
Models V-Bar-600/60S • V-Bar-700 • V-Bar-910/960

Description

V-Bar insertion flow meters have three main components: the retractor, the sensor, and the electronics. The retractor serves to position the sensor within the pipe. The sensor detects the pattern of vortices as a frequency signal. The “Smart,” microprocessor-based EZ-Logic electronics conditions the signal and provides a frequency output, a scaled pulse output, or a 4 to 20 mA DC signal proportional to the average pipe flow rate.

Most V-Bar flow meters can be installed on an isolation valve, which permits installation and removal without process shut-down. Integral pressure and/or temperature measurement may be combined with the V-Bar to provide mass flow measurement from a single pipe tap. In addition, a flow processor may be used to increase the accuracy and functionality of the metering system.



Features

- Fluid types: liquid, gas, or steam
- Pipe sizes: 3 to 80”
- Rugged construction
- Reliability: no moving parts
- Process pressure up to 2000 psig (138 barg)
- Process temperatures up to 500°F
- Industry standard frequency and/or 4 to 20 mA output signals
- Optional integral pressure and/or temperature measurement
- Negligible head loss
- Compatible with HART® protocol
- EZ-Logic™ menu-driven user interface (microprocessor-based)
- Local programming via EZ-Logic keypad or magnet wand through explosion-proof enclosure

Performance Specifications

Accuracy (Linear Ranges)	
Liquid	±1.0% of flow rate Test conditions: Water at 60°F, 50 psig (3.4 barg) with a flow rectifier and 10 pipe diameters upstream.
Gas and Steam	±1.5% of flow rate Test conditions: Air at 68°F, 26 psia with a flow rectifier and 10 pipe diameters upstream.
Analog Output	Add ±0.1% of full scale
Repeatability	±0.15% of flow rate
Response Time	Adjustable from 1 to 100 seconds

Application Guide

Model	Liquid	Gas	Steam	Hot Tap	Temperature Range	Maximum Pressure[1]	Seal Type	Line Sizes inches
600	yes	yes	no	yes	-40 to 400°F	125 psig	Viton®	3 to 80
60S	no	no	yes	yes	-40 to 400°F	125 psig	E/P[2]®	3 to 80
700	yes	yes	yes	no	-40 to 500°F	2000[3] psig	Swagelok™	3 to 80
910	yes	yes	yes	yes	-40 to 400°F	flange rating	Teflon®	3 to 80
960	yes	yes	yes	yes	-40 to 500°F	flange rating	Grafoil®	3 to 80

1 Maximum pressure at maximum temperature with appropriate connection.
2 Ethylene-Propylene elastomer.
3 Rating listed is for NPT connection. For flange connections, use ANSI flange rating.

Operating Specifications

Linear Range

Reynolds number from 20,000 to 7,000,000

Measurable Flow Velocities

Liquid Flow

V_{min} 1.5 ft/sec

V_{max} 32 ft/sec

Gas and Steam Flow

V_{min} $\sqrt{\frac{50}{P}}$ ft/3

V_{max} 300 ft/sec

Where: p = density (lb/ft^3)

Operating Range

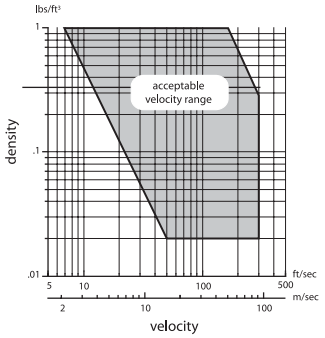
Average Fluid Velocities

Liquid	0.4085	$\frac{Q_1}{D^2}$
Gas	3.056	$\frac{Q_2}{D^2}$
Steam	0.051	$\frac{M}{\rho \cdot D^2}$

Where:

V =	average fluid velocity	ft/sec
D =	pipe inside diameter	inches
Q_1 =	liquid volumetric flow	gal/min
Q_2 =	gas actual volumetric flow	ft^2/min
M =	mass flow rate	lb/h
p =	fluid density	lb/ft^3

Gas Flow Operating Range:



Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

V-Bar Insertion Vortex
Models V-Bar-600/60S • V-Bar-700 • V-Bar-910/960

Process Viscosity

Reynolds number must be > 20,000. Figure 1 translates the minimum Reynolds number, 20,000, to the minimum measurable pipe velocity.

Kinematic Viscosity

$$\upsilon = \frac{\mu(cP)}{S.G.}$$

$$Re = \frac{124pVD}{\mu}$$

where p = Fluid density
V = Average velocity (lb/ft³)
D = Pipe inside diameter (inches)
μ = Fluid viscosity (cP)
S.G. = Specific gravity

Ambient Temperature Limit
32° to 140°F

Ambient Humidity Limit
5 to 100% relative humidity non-condensing

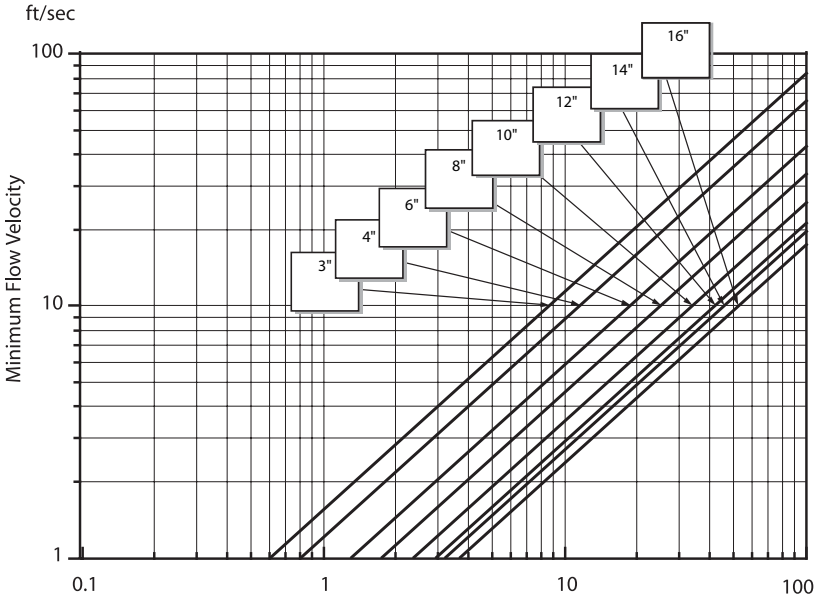


Figure 1. Kinematic Viscosity, centistokes

Power Requirements

Standard	Isolated 18 to 40 VDC, 35 mA maximum Maximum voltage with pressure transmitter option is 30 V.	
Optional	110/220 VAC All power wiring must be enclosed in rigid conduit, and a watertight and/or explosion-proof seal must be applied at the condulet entry.	
Output Signals		
Analog	4 to 20 mA, 2-wire system, digitally adjusted span	
Frequency	Voltage pulses, 3-wire system, 0 to 3000 Hz square wave, 50% duty cycle.	Low Level: 0 to 1 V High Level: power supply voltage-load
Pulse	3-wire system. Output can be scaled so that 1 pulse indicates a specific quantity of fluid passing through the pipe.	
Hart®	Communications protocol	
Display (LOC-TOT)	2-line by 8-character LCD digital display alternately show flow rate and totalized flow in user-selectable engineering units. Four buttons (up, down, right, enter), operatable either directly on the display panel or with a hand-held magnetic wand through the explosion-proof enclosure, enable programming. Local programming follows the EZ-Logic menu-driven user interface.	
Zero & Span Setting (Analog Output Only)	Zero and span calibration can be performed without a frequency source by programming the flow rate using the EZ-Logic interface.	

Physical Specifications

Materials	
Wetted Parts	316L stainless steel or the cast equivalent, CF3M (bronze & carbon steel on V-Bar-600/60S)
External Parts	Aluminum, 316 stainless steel, carbon steel (bronze & carbon steel on V-Bar-600/60S)
Electrical Enclosure	383 aluminum. Approved for NEMA 4X watertight and dust-tight requirements.
Retractor Type	
V-Bar-600/60S	Screw thread, rising stem
V-Bar-700	Not retractable
V-Bar-910/960	Acme thread, non-rising
Process Connection	
V-Bar-600/60S	2" NPT
V-Bar-700	2" NPT 2" 150#, 300#, 600# or 900# ANSI raised face flange
V-Bar-910/960	2" 150#, 300#, 600# or 900# ANSI raised face flange

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V-Bar Insertion Vortex
Models V-Bar-600/60S • V-Bar-700 • V-Bar-910/960

Isolation Valve (V-Bar-600/60S only)
2" full-port, bronze gate valve, 125 psig (8.62 bar) maximum.
For V-Bar-910/960, see Accessories.

Pressure Tap and Bleed Valve
Standard 0.25" NPT pipe nipple with 0.25" stainless steel bleed valve (bleed valve is bronze for V-Bar-600/60S only). Provides connections for mounting optional pressure transmitter (Model PT).

Model PT Pressure Transmitter (Optional)
A pressure transmitter can be mounted using the 0.25" NPT connection on the bleed valve supplied with the meter, eliminating the need for a separate pressure tap. A 4 to 20 mA output, scaled to the desired pressure range, is provided. All pressure transmitters include a siphon tube, bleed valve, plug, nipple, and tee. A pressure transmitter is not available with 110/220 VAC power. See the PT TIS General Specifications for complete details.

Temperature Sensor (RTD Option)
A 1000, 2-wire, platinum RTD can be mounted inside the stem of the flow meter probe, eliminating the need for a separate temperature tap.

Temperature Transmitter (TXX option)
Includes the RTD option with an additional 4 to 20 mA output, scaled to the desired temperature range. A temperature transmitter is not available with 110/220 VAC power.

Remote Mount Electronics (RMT Option)
30' (9.144 m) signal cable and U-bolts are provided with remote-mount electronics. Cable must be run in conduit (conduit not supplied). Conduit connection is 0.75" NPT Female (PG 13.5).

Approvals
FM Approval (FM Option)
Certified by FM for Class I, Division 2, Groups A, B, C and D; Class II, III, Division 2, Groups F and G.

FM option is not available when using a 4 to 20 mA temperature transmitter or a 110/220 VAC power supply option. Use the RTD option only for temperature selection, if FM is required.

CSA Approval (CSA Option)
Certified by CSA for Hazardous Locations Class I, Division 2, Groups A, B, C and D; Class II, Division 2, Groups F and G; Class III.

CSA option is not available when using a 4 to 20 mA temperature transmitter or a 110/220 VAC power supply option. Use the RTD option only for temperature selection, if CSA is required.

FM or CSA are not available when using a pressure transmitter scaled 0 to 1000 psig or with a special scaling.

Accessories

Gate Valve (Model 2GV) (For use with V-Bar-910/960 only)
Installation with a 2", double-flanged, raised-face, full-port gate valve enables the flow sensor to be inserted and removed from the pipe under full flow conditions. Both the valve and pipe tap must have a minimum 1.875" internal diameter clearance.

Flow Rectifier
A flow rectifier is recommended when there is insufficient straight pipe run or flow disturbance. When using a flow rectifier, the straight pipe run can be a combination of 5 pipe diameters upstream and 2 pipe diameters downstream, instead of the standard 10 and 5.

Flow Processors (FP-93)
A microprocessor-based flow processor can be used to significantly increase the accuracy and functionality of any flowmetering application. See the FP-93 TIS for complete details.

Measurable Flow Rates

The following tables are for reference only. Measurable flow rates for your specific application are available using EMCOSIZE (downloadable at www.emcoflow.com).

Water Minimum and Maximum Flow Rates[1]

	3"	4"	6"	8"	12"	16"	24"
gpm	35	60	135	234	523	826	1,879
	737	1,270	2,882	4,990	11,164	17,625	40,096

Air Minimum and Maximum Flow Rates (SCFM)[1]

pressure — psig (density lb/ft³)	3"	4"	6"	8"	12"	16"	24"
0	79	136	308	533	1,193	1,883	4,284
(0.0764)	924	1,591	3,611	6,253	13,991	22,089	50,250
50	165	285	646	1,119	2,504	3,954	8,995
(0.3368)	4,073	7,015	15,916	27,561	61,665	97,355	221,469
100	220	380	861	1,491	3,337	5,268	11,984
(0.5979)	7,229	12,452	28,253	48,923	109,461	172,814	393,129
150	264	455	1,033	1,789	4,002	6,318	14,373
(0.8600)	9,449	16,272	36,927	63,943	143,067	225,869	513,823
200	302	520	1,180	2,043	4,571	7,216	16,415
(1.1219)	10,792	18,589	42,175	73,030	163,400	257,971	586,851
300	366	630	1,430	2,476	5,540	8.746	19,896
(1.6480)	13,080	22,530	51,117	88,514	198,044	312,667	711,276
400	420	724	1,643	2,845	6,365	10,050	22,862
(2.1760)	15,030	25,889	58,736	101,709	227,567	359,276	817,305
500	469	807	1,832	3,172	7,098	11,206	25,491
(2.7054)	16,759	28,866	65,493	113,408	253,742	400,602	911,316

1 Standard conditions of 60°F and 14.7 psia in schedule 40 pipe.

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V-Bar Insertion Vortex
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Saturated Steam Minimum and Maximum Flow Rates (lb/h)[1]

pressure — psig (density lb/ft³)	3”	4”	6”	8”	12”	16”	24”
0	252	435	987	1,709	3,823	6,034	13,729
(0.0373)	2,069	3,563	8,087	14,004	31,333	49,468	112,534
50	506	871	1,976	3,421	7,654	12,085	27,491
(0.1496)	8,297	14,287	32,425	56,148	125,627	198,336	451,189
100	663	1,141	2,589	4,483	10,031	15,837	36,027
(0.2570)	14,250	24,538	55,688	96,431	215,758	340,632	774,893
150	787	1,356	3,078	5,327	11,919	18,817	42,805
(0.3630)	20,116	34,640	78,613	136,129	304,577	480,858	1,093,889
200	894	1,540	3,494	6,051	13,539	21,3774	48,624
(0.4682)	25,957	44,698	101,439	175,654	393,013	620,477	1,411,504
300	1,077	1,855	4,209	7,289	16,309	25,748	58,574
(0.6794)	37,667	64,862	147,200	254,895	507,308	900.386	2,048,260
400	1,235	2,127	4,826	8,357	18,698	29,520	67,154
(0.8930)	44,149	76,024	172,024	298,759	668,452	1,055,332	2,400,742
500	1,377	2,371	5,381	9,318	20,849	32,916	74,879
(1.1102)	49,228	84,770	192,380	333,129	745,351	1,176,739	2,676,927

1 Standard conditions of 60°F and 14.7 psia in schedule 40 pipe.

Natural Gas Minimum and Maximum Flow Rates (SCFM)[1]

pressure — psig (density lb/ft³)	3”	4”	6”	8”	12”	16”	24”
0	102	175	398	690	1,543	2,437	5,543
(0.0457)	924	1,588	3,611	6,253	13,991	22,089	50,250
50	217	368	848	1,468	3,284	5,185	11,795
(0.2067)	4,184	7,044	16,352	28,315	63,352	100,019	227,529
100	290	492	1,133	1,962	4,390	6,931	15,768
(0.3695)	7,478	12,588	29,223	50,603	113,221	178,750	406,634
150	341	588	1,334	2,309	5,166	8,157	18,555
(0.5350)	10,590	18,236	41,384	71,662	160,338	253,137	575,854
200	400	679	1,563	2,707	6,056	9,561	21,749
(0.7030)	14,227	23,945	55,600	96,279	215,417	340,094	773,669
300	488	829	1,908	3,304	7,392	11,671	26,550
(1.475)	17,455	29,623	68,212	118,117	264,278	417,235	949,156
400	565	959	2,209	3,824	8,557	13,510	30,732
(1.4036)	2,204	34,286	78,958	136,725	305,912	482,965	1,098,683
500	635	1,077	2,481	4,297	9,613	15,177	34,526
(1.7715)	22,698	38,513	88,705	153,603	343,676	542,586	1,234,312

1 Standard conditions of 60°F and 14.7 psia in schedule 40 pipe.
Note: Approximate specific gravity of natural gas = 0.61 and 0.8% N_2

Straight Run Piping Requirements

	Upstream	Downstream
One 90° elbow before the meter	10 D	5 D
Two 90° elbows before the meter	15 D	5 D
Two 90° elbows out of plane before the meter	30 D	5 D
Reduction before the meter	10 D	5 D
Regulator or valve partially closed before the meter	30 D	5 D

D is equal to the internal diameter of the pipe.

If there is not sufficient straight run of pipe, a flow rectifier can be used to reduce the above lengths. Consult your local representative or the factory for your application.

V-Bar Insertion Vortex
Models V-Bar-600/60S • V-Bar-700 • V-Bar-910/960

Other Installation Considerations

Tap Size
1.875" minimum diameter.

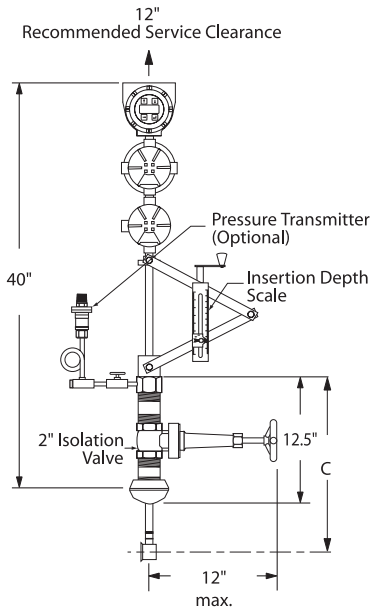
Mounting Position
V-Bar probes may be installed in vertical, horizontal, or angled pipe sections. The meter is attached perpendicular to the axis of the pipe and should not be mounted "upside-down" (with its top section hanging below the pipe mount). For liquid service, the fluid must completely fill the pipe.

Site Selection
The flow measurement location should be selected to minimize turbulence and swirl. The extent of these flow disturbances depends upon the piping configuration. Valves, elbows, pumps, and other piping components may add disturbances to the flow.

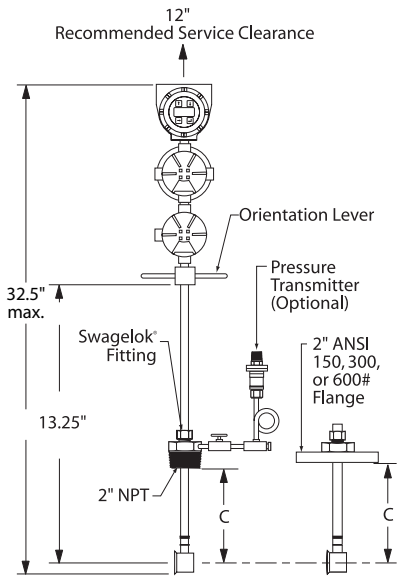
Hot Tap Compatibility
The V-Bar-600/60S is hot tap compatible, which means that the sensor can be installed and removed under full flow conditions. The V-Bar-910/960 is hot tap compatible when installed with a 2", double-flanged, full-port ball or gate valve that adheres to the dimensions of the gate valve on page 6.

Dimensions and Weights

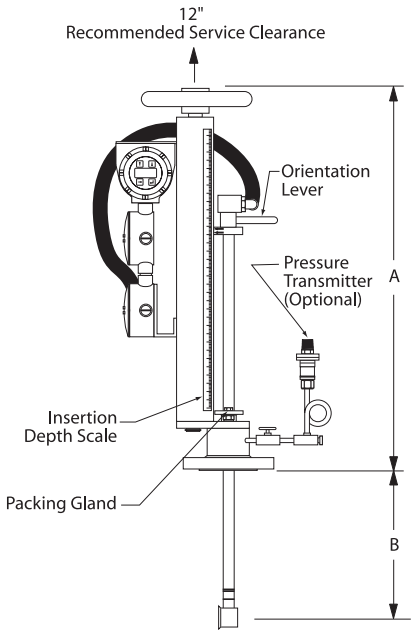
V-Bar-600/60S



V-Bar-700



V-Bar-910/960



Dimensions	A	B	C
Model 600/60S			
2" NPT Connection	---	---	4.5" min 18" max
Model 700			
2" NPT Connection	---	---	3" min 10" max
2" 150# Connection	---	---	3" min 11.5" max
2" 300# Connection	---	---	3" min 11.25" max
2" 600# Connection	---	---	3" min 11" max
2" 900# Connection	---	---	3" min 10.75" max
Model 910/960			
Standard Stem Length	30"	1.5" min 20" max	---

Weight	
Model 600/60S	
2" NPT Connection	28 lb max
Model 700	
2" NPT Connection	9 lb
2" 150# Connection	12 lb
2" 300# Connection	14 lb
2" 600# Connection	16 lb
2" 900# Connection	20 lb
Model 910/960	
2" 150#	30 lb
2" 300#	35 lb
2" 600#	40 lb
2" 900#	47 lb

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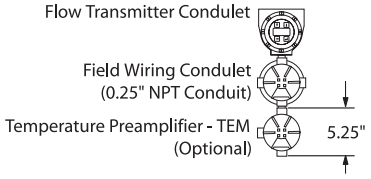
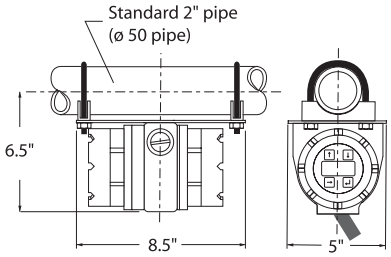
V-Bar Insertion Vortex
Models V-Bar-600/60S • V-Bar-700 • V-Bar-910/960

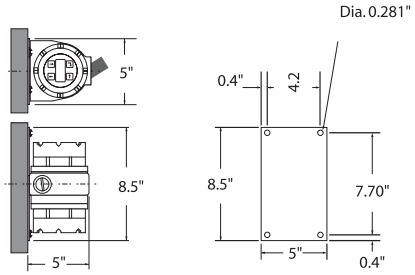
Integral Electronics



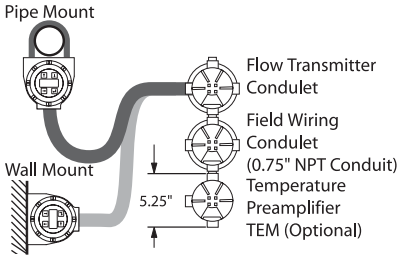
Pipe Mount Remote Electronics



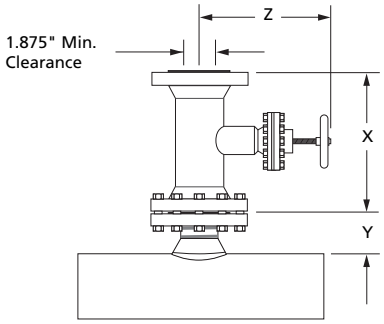
Pipe Mount Remote Electronics



Remote Electronics Configuration



Gate Valve



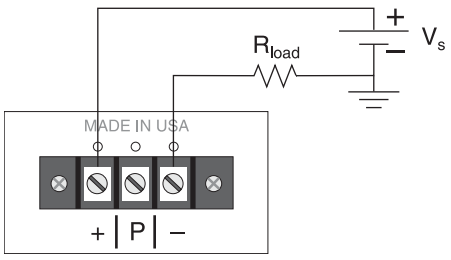
Gate valve is intended for use with the V-Bar-910/960 only.

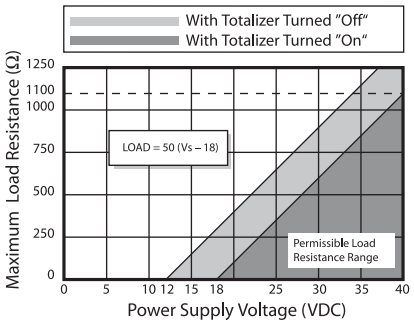
Gate Valve Dimensions	X	Y	Z
2" 150#	7"	3.5"	15.325"
2" 300#	8.5"	3.75"	16.325"
2" 600#	11.5"	3.75"	17.875"

For flange kit, add 14 lb (6.4 kg) to weight.

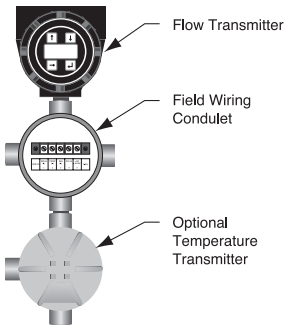
Wiring Diagrams

VDC Power: Analog Output
Scalable 4 to 20 mA output, 2-wire principle. Load resistor may be installed on supply or return line. Vs = 18 to 40 VDC. See graph below for permissible R_{load} values.





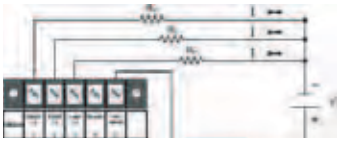
VAC Power: Analog Output
Scalable 4 to 20 mA output, 2-wire principle. Load resistor may be installed on supply or return line.
V_s = 110/220 VAC. R_{load} must be less than 300 Ω.



VDC Power: Pressure and Temperature Transmitter Wiring
Remove the field wiring condulet cap to access the field wiring terminal block for power and signal wiring. Flow, pressure, and temperature output wiring connects to the terminal block. Refer to the previous section on 24 VDC power and signal wiring for appropriate load resistance and power supply values. Pressure and temperature transmitters are scaled to the appropriate ranges at the factory.

Maximum voltage with optional pressure transmitter is 30 VDC, and 110/220 VAC power supply is not available with pressure and/or temperature transmitters.

Wiring with Analog Output:



where:
V_s = 18 to 30 VDC
R_p = Pressure measuring resistance
R_T = Temperature measuring resistance
R_F = Flow rate measuring resistance

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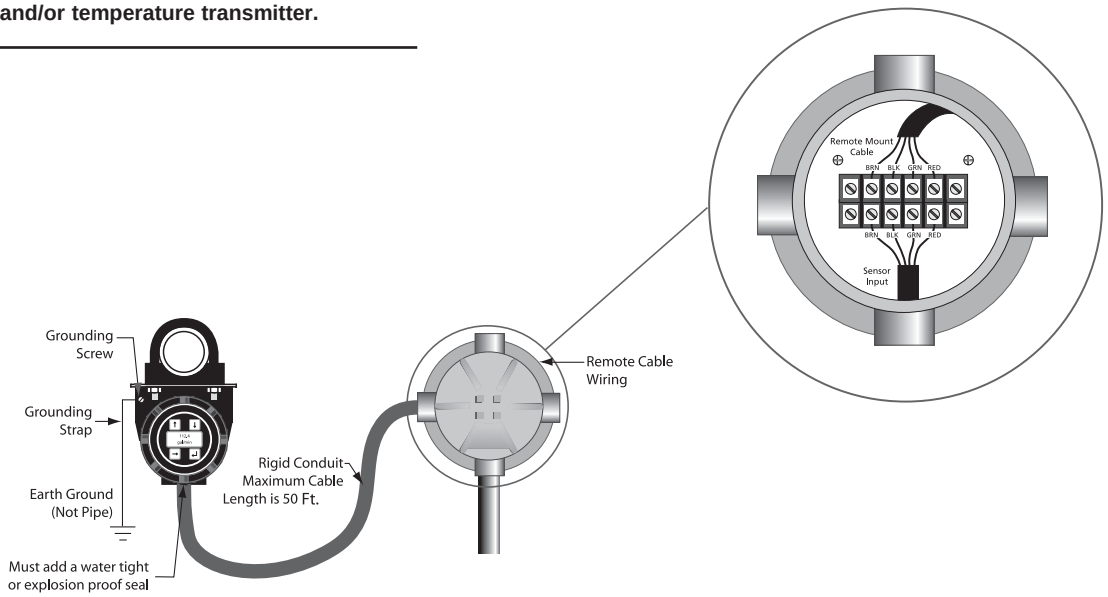
V-Bar Insertion Vortex
Models V-Bar-600/60S • V-Bar-700 • V-Bar-910/960

Remote-Mount Wiring Diagram
Output wiring from remote electronics is identical to output wiring from integral electronics. Wiring from the remote electronics condulet to the electrical junction box must be performed in the field. Connect the remote cable to the terminal block in the junction box as shown. If non-conductive conduit is used, attach a ground strap from the ground screw on the remote electronics condulet. If the remote cable is cut to a shorter length, insulate shield with tape at electrical junction box.

If remote mounting is required with a pressure and/or temperature transmitter, two power supplies are required for operation: one for the remote flow transmitter and one for the pressure and/or temperature transmitter.



1 Special transmitter scaling is available. Please note scaling range below model code when ordering. If no special scaling is indicated, transmitter will be scaled per model code.

2 Unidirectional only. Unit has 4 to 20 mA and frequency output.

3 The standard remote option comes with 30' of cable.

4 Not available for use with pressure and temperature transmitters.

5 Certified by FM for Class I, Div. 2, Groups A, B, C, & D; Class II, III, Div. 2, Groups F & G; NEMA 4X. Not approved by FM when using a 4 to 20 mA temperature transmitter or a 110/220 VAC power supply option. If FM is required, use RTD option only for temperature selection. Pressure Transmitter 0 to 1000 psig or with special scaling not available with FM or CSA.

6 Certified by CSA for Class I, Div. 2, Groups A, B, C, & D; Class II, Div. 2, Groups F & G; Class III; Type 4X. Not approved by CSA when using a 4 to 20 mA temperature transmitter or a 110/220 VAC power supply option. If CSA is required, use RTD option only for temperature selection. Pressure Transmitter 0 to 1000 psig or with special scaling not available with FM or CSA.

Please specify the following information with your order:
- Fluid type or composition
- Maximum, minimum, and normal operating flow rate
- Maximum, minimum, and normal operating temperatures
- Maximum, minimum, and normal operating pressures
- Specific weight and viscosity at normal operating conditions

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V-Bar Insertion Vortex
Models V-Bar-600/60S • V-Bar-700 • V-Bar-910/960

Models and Suffix Codes

Category	Suffix Codes				
Model					
Liquid or gas service, 400°F (204°C)	V-Bar-600				
Steam service, 400°F (204°C)	V-Bar-60S				
Liquid, gas, or steam service, 500°F (260°C)	V-Bar-700				
Liquid, gas, or steam service, 400°F (204°C)	V-Bar-910				
Liquid, gas, or steam service, 500°F (260°C)	V-Bar-960				
Connection					
2", male NPT (model 700)		2NPT			
2", 150# flange (model 700, 910, 960)		2F150			
2", 300# flange (model 700, 910, 960)		2F300			
2", 600# flange (model 700, 910, 960)		2F600			
2", 900# flange (model 700, 910, 960)		2F900			
Thread-o-let, xx = 03 to 80 inches (models 600, 60S) includes 2" isolation valve		VXX			
Pressure Transmitter					
No pressure transmitter			XX		
PT for pressure range 0 to 50 psig (0 to 3.44 barg)			50		
0 to 100 psig (0 to 6.89 barg) (model 600, 60S, 700, 910, 960)			100		
0 to 150 psig (0 to 10.34 barg) (model 600, 60S, 700, 910, 960)			150		
0 to 200 psig (0 to 13.79 barg) (model 600, 60S, 700, 910, 960)			200		
0 to 250 psig (0 to 17.24 barg) (model 700, 910, 960)			250		
0 to 500 psig (0 to 34.47 barg) (model 700, 910, 960)			500		
0 to 1000 psig (0 to 68.95 barg) (model 700, 910, 960)			1000		
Special scaling requests[1]			PXX		
Temperature Sensor or Transmitter					
No temperature transmitter				XXX	
Temperature sensor without preamplifier (RTD only)					
Teflon RTD internal wires - 40 to 400°F (- 40 to 204°C)				RTD-T	
Temperature sensor without preamplifier (RTD only)					
Fiberglass RTD internal wires 150 to 500°F (65 to 260°C) (models 700 and 960 only)				RTD-F	
Temperature sensor with preamplifier scaled from 32 to 68°F (0 to 20°C) (liquid/gas)				T09	
0 to 250°F (-18 to 121°C) (liquid/gas)				T10	
-40 to 150°F (-40 to 66°C) (liquid/gas)				T11	
212 to 400°F (100 to 204°C) (liquid/gas)				T12	
212 to 500°F (100 to 260°C) (steam) (model 700, 910, 960 only)				T14	
0 to 250°F (-17.7 to 121.1°C) (liquid/gas)				T20	
-40 to 149°C (-40 to 65°C) (liquid/gas)				T21	
212 to 400°F (100 to 204°C) (steam)				T22	
212 to 500°F (100 to 260°C) (liquid/gas) (model 700, 910, 960 only)				T24	
Special scaling requests[1]				TXX	
Electronics					
EZ-Logic with local rate and total[2]					LOC-TOT
Remote mount electronics[3]					RMT
FM Approval[5]					FM
CSA Approval[6]					CSA
Integral 110 VAC input[4]					110
Integral 220 VAC input[4]					220
	V-Bar-600-	**2NPT-**	**XX-**	**XXX-**	**LOC-TOT**

1 Special transmitter scaling is available. Please note scaling range below model code when ordering. If no special scaling is indicated, transmitter will be scaled per model code.
2 Unidirectional only. Unit has 4 to 20 mA and frequency output.
3 The standard remote option comes with 30' of cable.
4 Not available for use with pressure and temperature transmitters.
5 Certified by FM for Class I, Div. 2, Groups A, B, C, & D; Class II, III, Div. 2, Groups F & G; NEMA 4X. Not approved by FM when using a 4 to 20 mA temperature transmitter or a 110/220 VAC power supply option. If FM is required, use RTD option only for temperature selection. Pressure Transmitter 0 to 1000 psig or with special scaling not available with FM or CSA.
6 Certified by CSA for Class I, Div. 2, Groups A, B, C, & D; Class II, Div. 2, Groups F & G; Class III; Type 4X. Not approved by CSA when using a 4 to 20 mA temperature transmitter or a 110/220 VAC power supply option. If CSA is required, use RTD option only for temperature selection. Pressure Transmitter 0 to 1000 psig or with special scaling not available with FM or CSA.

Please specify the following information with your order:
- Fluid type or composition
- Maximum, minimum, and normal operating flow rate
- Maximum, minimum, and normal operating temperatures
- Maximum, minimum, and normal operating pressures
- Specific weight and viscosity at normal operating conditions

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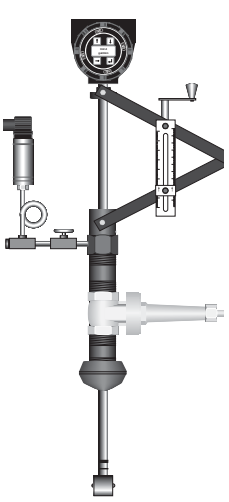
Turbo-Bar Insertion Turbine
Models TMP-600/60S • TMP-700 • TMP-910/960

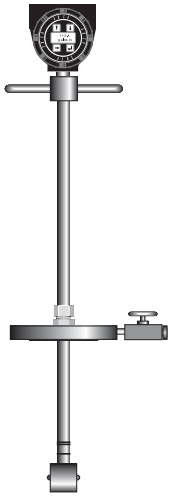
Description

Turbo-Bar insertion flow meters have three main components: the retractor, the rotor, and the electronics. The retractor positions the rotor within the pipe and houses a pick-up assembly, which detects the rotation of the turbine rotor. The electronics converts the rotational frequency, which is proportional to the velocity of the fluid, to industry standard electrical output signals.

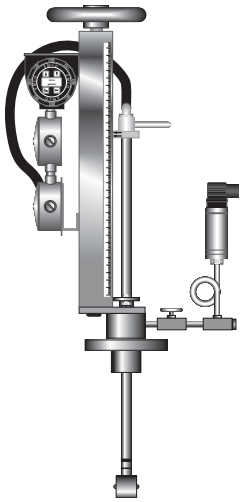
Most Turbo-Bar flow meters can be installed on an isolation valve, which permits installation and removal without process shutdown. Integral pressure and/or temperature measurement may be combined with the Turbo-Bar and flow processor to provide mass or energy flow measurement from a single pipe tap.



TMP-600/60S



TMP-700



TMP-910/960

Features

- Fluid types: liquid, gas, or steam
- Pipe sizes: 3 to 80”
- Rugged construction
- Interchangeable rotors for a wide variety of applications
- Process pressure up to 5000 psig (345 barg)
- Process temperatures up to 750°F
- Industry standard frequency and/or 4 to 20 mA output signals
- Optional integral pressure and/or temperature measurement
- Negligible head loss
- EZ-Logic™ menu-driven user interface (microprocessor-based)
- Linearization with EZ-Logic for enhanced accuracy at low velocities
- Local programming via EZ-Logic keypad or magnet wand through explosion-proof enclosure

Application Guide

Model	Liquid	Gas	Steam	Hot Tap	Temperature Range °F	Maximum Pressure[1] psi	Seal Type	Line Sizes[2] inches
600	yes	yes	no	yes	-40 to 400	125	Viton®	3 to 20
60S	no	no	yes	yes	-65 to 400	125	E/P[3]	3 to 20
700	yes	yes	yes	no[5]	-200 to 600	2000[4]	Swagelok®	3 to 80
910	yes	yes	yes	yes	-200 to 400	flange rating	Teflon®	3 to 80
960	yes	yes	yes	yes	-200 to 750	flange rating	Grafoil®	3 to 80

Note:

1 Maximum pressure at maximum temperature with appropriate connection.
2 In some cases, especially in large pipe sizes, a one or two foot stem extension may be required (See dimensional outlines).
3 Ethylene-Propylene elastomer.
4 Rating listed is for NPT connection. For flange connections, use ANSI flange rating.
5 The TMP-700 is a fixed insertion meter; it cannot be removed or installed under pressure.

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

Turbo-Bar Insertion Turbine
Models TMP-600/60S • TMP-700 • TMP-910/960

Operating Specifications

Measurable Velocity Limits
See Rotor Selection Guide, p. 4, for linear and measurable ranges of available rotors. Continuous operation above the maximum velocity will shorten the life of the rotor and is not recommended.

Process Viscosity
Maximum 5 centipoise

Ambient Temperature Limit
EZ-Logic Electronics
- 32 to 140°F

All Other Electronics
- –20 to 140°F

Ambient Humidity Limit
0 to 100% relative humidity non-condensing

Power Requirements
EZ-Logic Electronics
- 18 to 40 VDC (with totalizer on), 24 VDC nominal
- 12 to 40 VDC (with totalizer off), 24 VDC nominal

Output Signals
EZ-Logic Electronics (LOC-TOT Option)

Analog
4 to 20 mA, 2-wire system, digitally adjusted span

Frequency
3-wire system, 1 to 10,000 Hz square wave, 50% duty cycle.
- Low Level: 0 to 1 volts
- High Level: power supply voltage-load

Pulse
3-wire system. Output can be scaled so that 1 pulse indicates a specific quantity of fluid passing through the pipe.

Hart® Communications Protocol
Display
2-line by 8-character LCD digital display alternately show flow rate and totalized flow in user-selectable engineering units.

Performance Specifications

Accuracy (Linear Ranges)	
L1, G1–G5 Rotors	±1.0% of reading
G6 Rotor	±3.0% of reading
Repeatability (Linear Range)	±0.25% of reading
Rotor Velocity Calibration	Each rotor is factory calibrated in either water or air. Calibration is traceable to NIST.
Accuracy of the Calibration Standard (Linear Range)	
Water	±0.25% of reading
Air	±0.8% of reading

Physical Specifications

Materials	
Rotor	Blades: 17– 4 PH, ten blade, precision machined
	Housing: 316 stainless steel
	Pivots: tungsten carbide
Rotor Bearing Type	Liquid: CSJ stellite jewel
	Gas or Steam: DEV tungsten carbide
Wetted Parts	316L stainless steel stem and housing (bronze and carbon steel housing TMP-600/60S)
External Parts	Aluminum, 316 stainless steel, carbon steel (bronze and carbon steel on TMP-600/60S, TMP- 910/960)
Electrical Connection	Junction box with terminal block for external wiring. 0.75” female NPT connection for conduit.
Electrical Enclosure	383 aluminum. Approved for NEMA 4X for watertight and dust tight requirements
Sensor	Electromagnetic pick–up, 10 mVp–p minimum, 330 Ω nominal resistance.
Retractor Type	
TMP-600/60s	Screw thread, rising stem
TMP-700	Not retractable
TMP-910/960	Acme thread, non-rising stem
Extended Length Stem (Optional)	
Use of the two foot extension is limited to gas applications only.	Longer stems are available for large pipe sizes or when the mounting dimensions exceed the insertion capability. Extended stems are not available for the TMP-600/60S.
Process Connection	
TMP-600/60S	2” NPT
TMP-700	2” NPT
	2” 150#, 300#, 600# or 900# ANSI raised face flange
TMP-910/960	2” 150#, 300#, 600# or 900# ANSI raised face flange

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Turbo-Bar Insertion Turbine
Models TMP-600/60S • TMP-700 • TMP-910/960

Isolation Valve (TMP-600/60S only)
2" full-port bronze gate valve, 125 psig (8.62 barg) maximum. For TMP-910/960, see Accessories.

Pressure Tap and Bleed Valve
Standard 1/4" NPT pipe nipple with 1/4" stainless steel bleed valve. Provides connections for mounting optional pressure transmitter (Model PT).

Model PT Pressure Transmitter (Optional)
A pressure transmitter can be mounted using the 1/4" NPT connection on the bleed valve supplied with the meter, eliminating the need for a separate pressure tap. A 4 to 20 mA output, scaled to the desired pressure range, is provided. All pressure transmitters include a siphon tube, bleed valve, plug, nipple, and tee. A pressure transmitter is not available with 110/220 VAC power. See the PT TIS for complete details.

Temperature Sensor (RTD Option)
A 1000 Ω, platinum RTD can be mounted inside the stem of the flow-meter probe, eliminating the need for a separate temperature tap.

Temperature Transmitter (TXX Option)
Includes the RTD option with an additional 4 to 20 mA output, scaled to the desired temperature range. A temperature transmitter is not available with 110/220 VAC power and is not CE approved.

Remote Mount Electronics (RMT Option)
30 ft signal cable and U-bolts are provided with remote mount electronics. Cable must be run in conduit (conduit not supplied). Conduit connection is 3/4" NPT.

Note: Remote mount electronics are only available with EZ-Logic electronics (LOC-TOT Option).

FM Approval (FM Option)
Certified by FM for Class I, Division 2, Groups A, B, C and D; Classes II, III, Division 2, Groups F and G NEMA 4X locations.

Note: FM not available when used with 4 to 20 mA temperature transmitter, a pressure transmitter 0 to 1000 psig, or special scaled pressure transmitter.

Accessories

Gate Valve (Model 2GV) - (for Use with TMP-910/960 Only)
Installation with a 2" double flanged, raised-face, full port gate valve enables the flow sensor to be inserted and removed from the pipe under full flow conditions. Both the valve and pipe tap must have a minimum 2" internal diameter clearance.

Flow Processor (Model FP-93)
A microprocessor-based flow processor may be used to significantly increase the accuracy and functionality of any flow metering application. See the FP-93 TIS for complete details.

Straight Run Piping Requirements

	Upstream	Downstream
One 90° elbow before the meter	10 D	5 D
Two 90° elbows before the meter	15 D	5 D
Two 90° elbows out of plane before the meter	30 D	5 D
Reduction before the meter	10 D	5 D
Regulator or valve partially closed before the meter	30 D	5 D

D is equal to the internal diameter of the pipe.

If there is not sufficient straight run of pipe, a flow rectifier may be used to reduce the above diameter measurements.
Consult your local representative or the factory for your specific application.

Other Installation Considerations

Tap Size
2.0" minimum diameter.

Mounting Position
Turbo-Bar probes may be installed in vertical, horizontal, or angled pipe sections. The meter is attached perpendicular to the axis of the pipe and should not be mounted "upside-down" (with its top section hanging below the pipe mount). For liquid service, the fluid must completely fill the pipe.

Site Selection
The flow measurement location should be selected to minimize turbulence and swirl. The extent of these flow disturbances depends upon the piping configuration. Valves, elbows, pumps, and other piping components may add disturbances to the flow.

Hot Tap Comapatibility
The TMP-600/60S is hot tap compatible, which means that the sensor can be installed and removed under full flow conditions. The TMP-910/960 is hot tap compatible when installed with a 2" double flanged, full port ball or gate valve that adheres to the dimensions shown on page 5.

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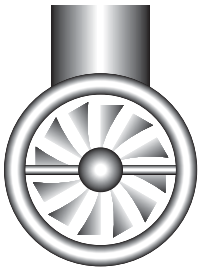
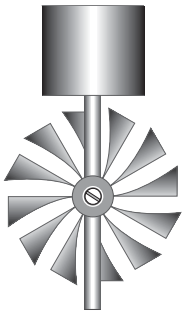
Turbo-Bar Insertion Turbine
Models TMP-600/60S • TMP-700 • TMP-910/960

Rotor Selection Guide

G6 (1" rotor)



G1 through G5, L1 (1.5" rotor)



Selection of the turbine rotor model depends upon the fluid type and operating velocity range of the fluid.

- *For all liquids, the model L1 rotor, with a maximum velocity of 30 ft/sec, must be used.*
- *For gases and steam, six different rotors are available with maximum velocities ranging from 55 to 175 ft/sec. See Table for maximum velocity limits (V_{max}) for all rotors.*

The turbine rotor typically will respond linearly over the velocity range from V_{lin} to V_{max} – within ±1.0% (3.0% for G6 rotor). This is defined as the "linear" range of the rotor. The minimum "measurable" velocity (V_{min}) can be considered the application minimum. Velocities from V_{min} to V_{lin} are measurable and repeatable, but less accurate.

When determining the fluid velocity limits for a given rotor, the following equations can be used to compute fluid velocity.

Average Fluid Velocities	
Fluid	
Liquid	$0.4085 \frac{Q_1}{D^2}$
Gas	$3.056 \frac{Q_2}{D^2}$
Steam	$0.051 \frac{M}{\rho D^2}$
Where:	
V = average fluid velocity	ft/sec
D = pipe inside diameter	in
Q_1 = liquid volumetric flow	gal/min
Q_2 = gas actual volumetric flow	ft^2/min
M = mass flow rate	lb/h
ρ = fluid density	lb/ft^3

Liquid Minimum and Maximum Velocity Rates								
Rotor	Flow Units	All Sizes	3 to 5"		6"		8+"	
		V_{max}	V_{lin}	V_{min}	V_{lin}	V_{min}	V_{lin}	V_{min}
L1	ft/sec	30	1.4	0.5	1.5	0.6	1.6	0.7

Gas or Steam Minimum and Maximum Velocity Rates (ft/sec)							
Rotor	All Sizes	3–5 in.		6 in.		8+ in.	
	V_{max}	V_{lin}	V_{min}	V_{lin}	V_{min}	V_{lin}	V_{min}
G1 40° pitch	55	$3.19/\sqrt{\rho}$	$1.94/\sqrt{\rho}$	$2.00/\sqrt{\rho}$	$1.23/\sqrt{\rho}$	$1.50/\sqrt{\rho}$	$1.00/\sqrt{\rho}$
G2 30° pitch	70	$3.98/\sqrt{\rho}$	$2.26/\sqrt{\rho}$	$2.27/\sqrt{\rho}$	$1.63/\sqrt{\rho}$	$1.90/\sqrt{\rho}$	$1.31/\sqrt{\rho}$
G3 20° pitch	85	$4.52/\sqrt{\rho}$	$2.42/\sqrt{\rho}$	$2.52/\sqrt{\rho}$	$1.95/\sqrt{\rho}$	$2.18/\sqrt{\rho}$	$1.40/\sqrt{\rho}$
G4 15° pitch	115	$5.84/\sqrt{\rho}$	$3.85/\sqrt{\rho}$	$3.78/\sqrt{\rho}$	$2.84/\sqrt{\rho}$	$3.00/\sqrt{\rho}$	$2.19/\sqrt{\rho}$
G5 10° pitch	145	$6.91/\sqrt{\rho}$	$4.57/\sqrt{\rho}$	$4.78/\sqrt{\rho}$	$3.47/\sqrt{\rho}$	$3.54/\sqrt{\rho}$	$2.81/\sqrt{\rho}$
G6 5° pitch	175	$6.10/\sqrt{\rho}$	N/A	$5.53/\sqrt{\rho}$	N/A	$5.00/\sqrt{\rho}$	N/A

Note: Rotors have moving parts that require periodic maintenance.

Note: All values in the above table are approximate and depend on the density of the fluid. Accuracy in both the linear and nonlinear ranges may be improved by using the advanced curve fitting techniques present in the FP-93 flow processors or the EZ-Logic electronics. Consult your local representative if your application falls outside the above limits.

V_{max} = maximum velocity of fluid [ft/sec]
V_{lin} = minimum velocity of fluid at which rotor response is linear [ft/sec]
V_{min} = minimum measurable velocity of fluid [ft/sec]
ρ = density of fluid [lb/ft^3]
N/A = not applicable

Note: Measurable flow rates for your specific application are available using EMCOSIZE (downloadable at www.emcoflow.com).

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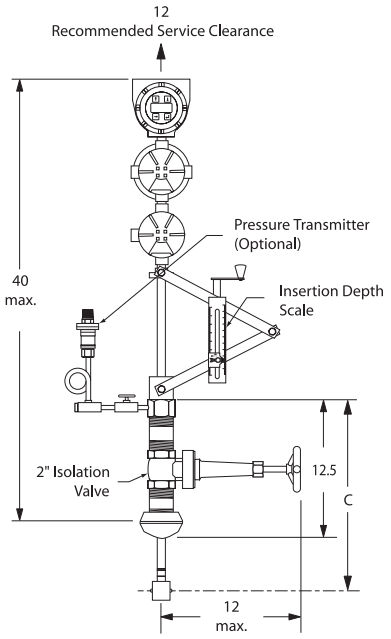
Turbo-Bar Insertion Turbine
Models TMP-600/60S • TMP-700 • TMP-910/960

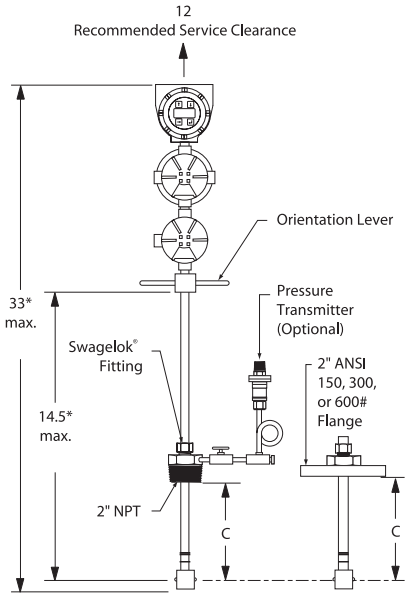
Dimensions and Weights

Dimensions are in inches

TMP-600/60S

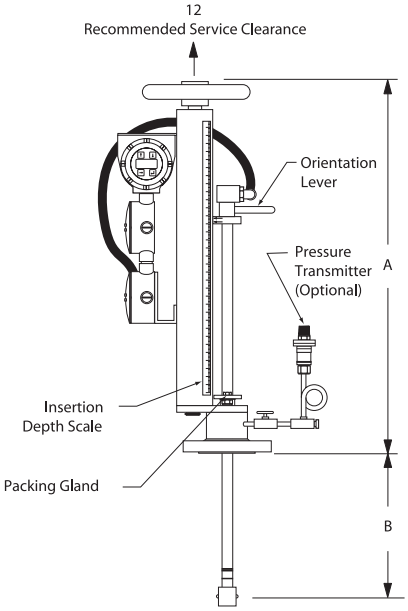


TMP-700



* Add 12" for each additional foot of retractor length.

TMP-910/960



* Add 12" for each additional foot of retractor length.

Dimensions

Model	Connection	C inches
600/60S	2" NPT	4.5 min 18 max
700	2" NPT	3 min 11.25 max
	2" 150#	3 min 12.75 max
	2" 300#	3 min 12.5 max
	2" 600#	3 min 12.25 max
	2" 900#	3 min 12 max

Weight

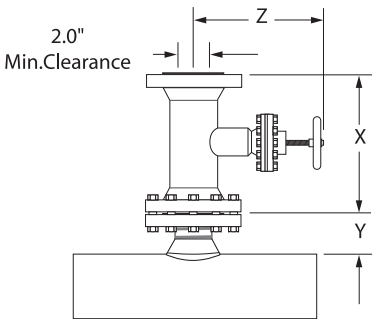
Model	Connection	Weight lb
600/60S	2" NPT	28 max
700[1]	2" NPT	9
	2" 150#	12
	2" 300#	14
	2" 600#	16
	2" 900#	20
910/960[2]	2" 150#	30
	2" 300#	35
	2" 600#	40
	2" 900#	47

1 Add 2.5lb for each additional foot of retractor length.
2 Add 5 lb for each additional foot of retractor length.

Dimensions

Model	Stem Length	B inches	A inches
910/960	Standard	1.5 min 20 max	30

Gate Valve



Type	X inches	Y inches	Z inches
150#	7	3.5	15.325
300#	8.5	3.75	16.325
600#	11.5	3.75	17.875

Type	Weight lb
2" 150#	46
2" 300#	58
2" 600#	84

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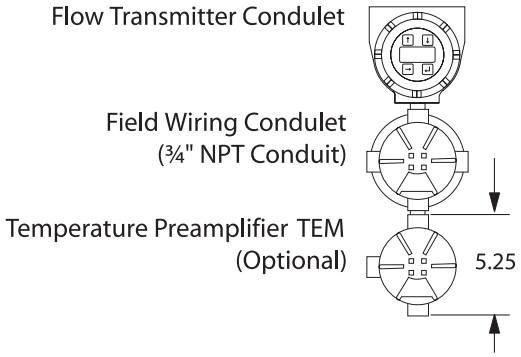
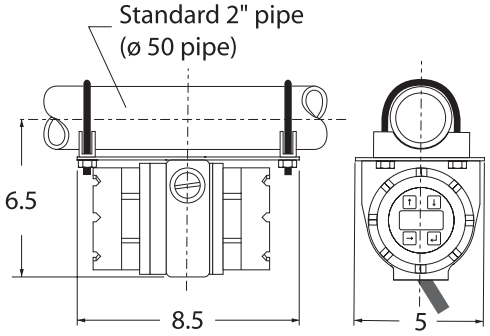
Turbo-Bar Insertion Turbine
Models TMP-600/60S • TMP-700 • TMP-910/960

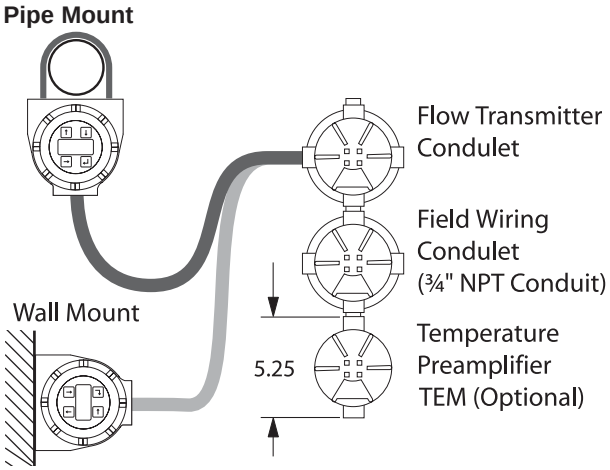
Integral Electronics

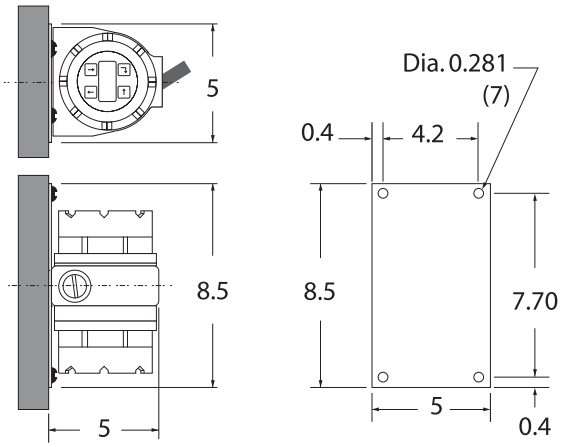


Pipe Mount Remote Electronics



Remote Electronics Configuration

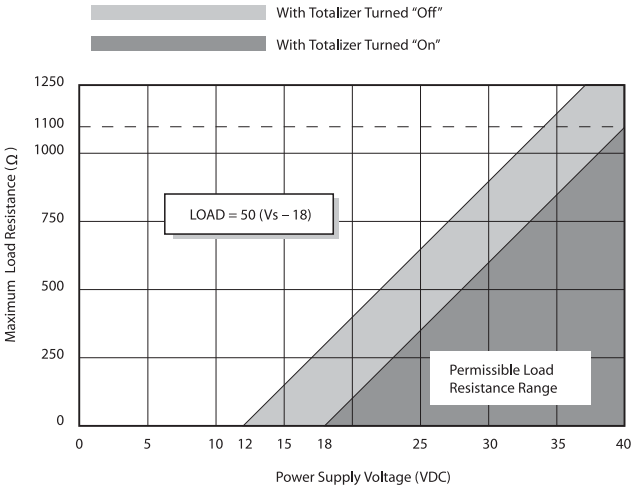


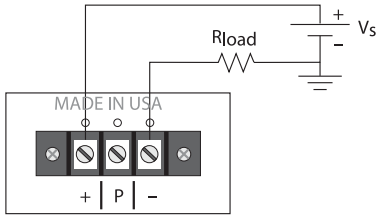


Wiring Diagrams

EZ-Logic Electronics: Analog Output

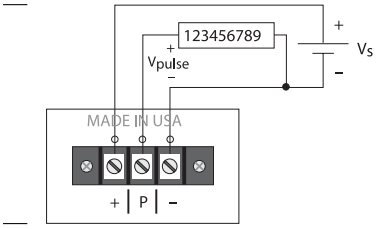
Scalable 4 to 20 mA output, 2-wire principle. Load resistor may be installed on supply or return line. V_s = 18 to 40 VDC. See graph below for permissible R_{load} values.





EZ-Logic Electronics: Pulse Output

3 wire system. Output can be scaled so that 1 pulse indicates a specific quantity of fluid passing through the pipe. V_s = 18 to 40 VDC.



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Turbo-Bar Insertion Turbine
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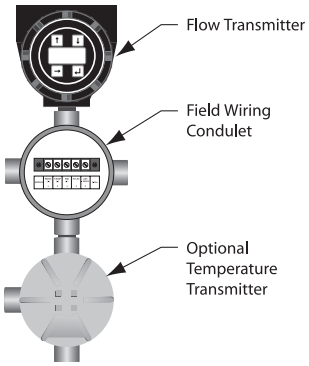
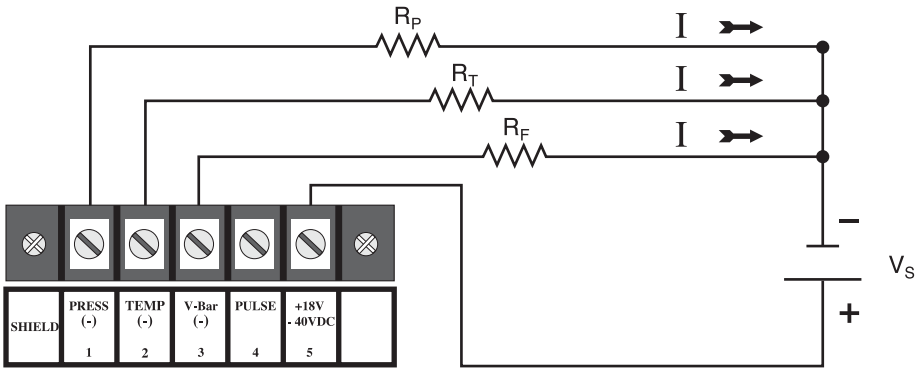
Pressure and Temperature Transmitter Wiring

Remove the field wiring condulet cap to access the field wiring terminal block for power and signal wiring. Flow, pressure, and temperature output wiring connects to the terminal block. Refer to the previous section on 24 VDC power and signal wiring for appropriate load resistance and power supply values. Pressure and temperature transmitters are scaled to the appropriate ranges at the factory.





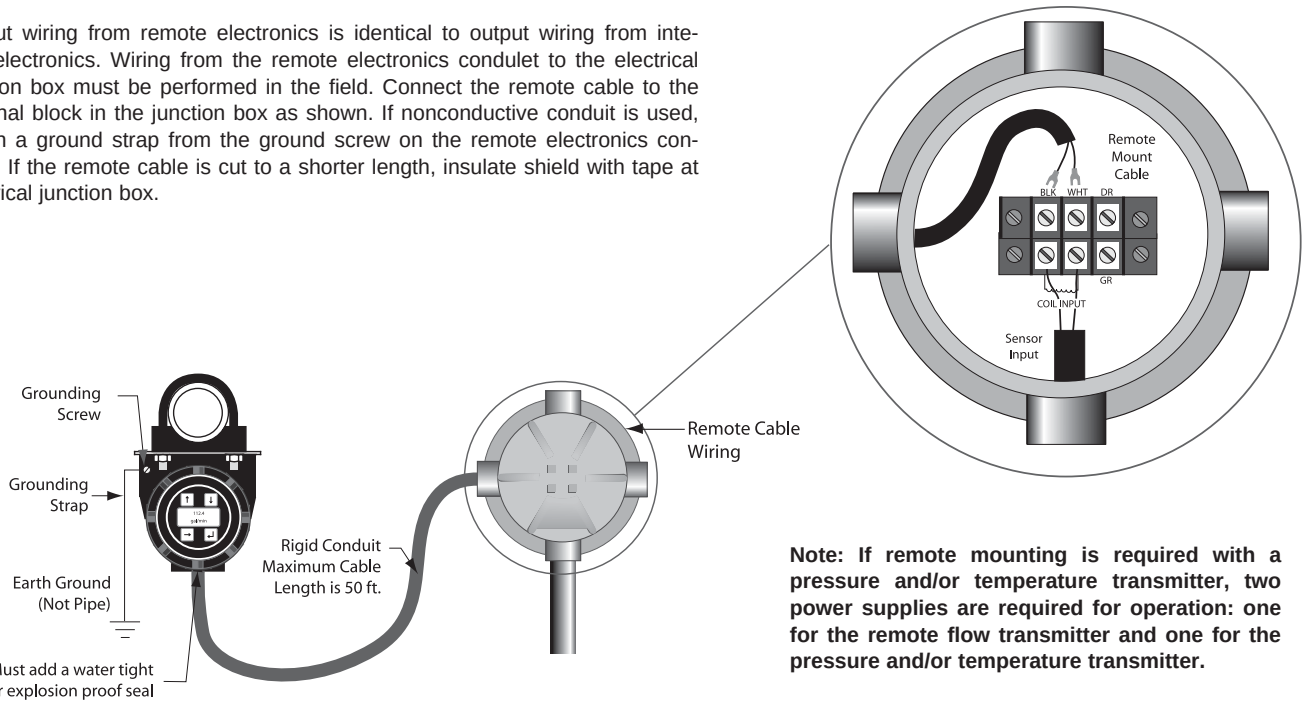
Note: Maximum voltage with optional pressure transmitter is 30 VDC and 110/220 VAC power supply is not available with pressure and/or temperature transmitters.

Wiring with Analog Output

where: V_s = 18 to 30 VDC
R_p = Pressure measuring resistance
R_t = Temperature measuring resistance
R_f = Flow rate measuring resistance

Remote Mount Wiring Diagram (Only Available with EZ-Logic Electronics)

Output wiring from remote electronics is identical to output wiring from integral electronics. Wiring from the remote electronics condulet to the electrical junction box must be performed in the field. Connect the remote cable to the terminal block in the junction box as shown. If nonconductive conduit is used, attach a ground strap from the ground screw on the remote electronics condulet. If the remote cable is cut to a shorter length, insulate shield with tape at electrical junction box.



Note: If remote mounting is required with a pressure and/or temperature transmitter, two power supplies are required for operation: one for the remote flow transmitter and one for the pressure and/or temperature transmitter.

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Turbo-Bar Insertion Turbine
Models TMP-600/60S • TMP-700 • TMP-910/960

Category	Suffix Codes							
Model								
Liquid or gas service, 400°F	TMP-600							
Steam service, 400°F	TMP-60S							
Liquid, gas, or steam service, 600°F	TMP-700							
Liquid, gas, or steam service, 400°F	TMP-910							
Liquid, gas, or steam service, 750°F [7]	TMP-960							
Connection								
2", male NPT (model 700)		2NPT						
2", 150# flange (model 700, 910, 960)		2F150						
2", 300# flange (model 700, 910, 960)		2F300						
2", 600# flange (model 700, 910, 960)		2F600						
2", 900# flange (model 700, 910, 960)		2F900						
3", 150# flange (model 910, 960 extended stem)[8]		3F150						
3", 300# flange (model 910, 960 extended stem)[8]		3F300						
Thread-o-let, xx = 3 to 80 inches (models 600, 60S) includes 2" isolation valve		VXX						
Rotor								
Liquid, 30 ft/sec maximum (9 m/sec) (40° pitch)			L1					
Gas or steam, 55 ft/sec maximum (40° pitch)			G1					
Gas or steam, 70 ft/sec maximum (30° pitch)			G2					
Gas or steam, 85 ft/sec maximum (20° pitch)			G3					
Gas or steam, 115 ft/sec maximum (15° pitch)			G4					
Gas or steam, 145 ft/sec maximum (10° pitch)			G5					
Gas or steam, 175 ft/sec maximum (5° pitch)[1]			G6					
Electronics								
EZ-Logic with local rate and total[3]				LOC-TOT				
Remote, only available with LOC-TOT option[4]				RMT				
FM Approval[5]				FM				
Pressure Transmitter								
No pressure transmitter					XX			
PT for pressure range 0 to 50 psig (0 to 3.44 barg)					50			
0 to 100 psig (0 to 6.89 barg) (models 600/60S, 700, 910/960)					100			
0 to 150 psig (0 to 10.34 barg) (models 600/60S, 700, 910/960)					150			
0 to 200 psig (0 to 13.79 barg) (models 600/60S, 700, 910/960)					200			
0 to 250 psig (0 to 17.24 barg) (models 700, 910/960)					250			
0 to 500 psig (0 to 34.47 barg) (models 700, 910/960)					500			
0 to 1000 psig (0 to 68.95 barg) (models 700, 910/960)					1000			
Special scaling requests[6]					PXX			
Temperature Sensor or Transmitter								
No temperature transmitter						XXX		
RTD only						RTD		
Temperature sensor with preamplifier scaled from 32 to 68°F[2]						T09		
0 to 250°F[2]						T10		
–40 to 150°F[2]						T11		
212 to 400°F[2]						T12		
212 to 800°F (models 700, 960)[2]						T13		
–17.7 to 121.1°C[2]						T20		
–40 to 65°C[2]						T21		
100 to 204°C[2]						T22		
100 to 260°C (models 700, 910/960)[2]						T23		
Special scaling requests[6, 2]						TXX		
Extended Stem								
None (standard length)							XX	
1' extension (not available for models 600/60S)							E1	
2' extension (gas/steam applications only)							E2	
(not available for models 600/60S)								
Pick-up Coil Wires								
TMP-700 Only: Teflon®, - 200 to 400°F								T
TMP-700 Only: Fiberglass, 150 to 600°F [7]								F
	TMP-700-	**3F300-**	**G3-**	**LOC-TOT-**	**200-**	**T12-**	**E1-**	**T**

This example represents a liquid, gas, or steam Turbo-Bar TMP-700 at 600ºF, 3" 300# flange connection, 85 ft/sec gas or steam rotor, EZ-Logic electronics, 0 to 200 psig pressure transmitter, 212 to 400ºF temperature sensor, 1' extended stem, and Teflon® coil wires.

1 The G6 is the only available 1" shrouded rotor. Not available for use with bidirectional meters.
2 Not available with European CE Mark.
3 Unidirectional only. Unit has 4 to 20 mA and frequency output.
4 Remote mount electronics are required for high process temperatures. The standard remote mount option comes with 30 feet (9.1 meters) of cable.
5 Certified by FM for Class I, Div. 2, Groups A, B, C, & D; Class II,III, Div. 2, Groups F & G; NEMA 4X. FM approval with only LOC-TOT and RMT electronics options. If FM is required, use RTD option only for temperature selection. 0 to 1000 psia and special sealing pressure transmitter not available with FM.
6 Special transmitter scaling is available. Please note scaling range below model code with ordering. If no special scaling is indicated, transmitter will be scaled per model code.
7. Not available with FM approval.
8 A 3" flange and 3" hole tap size are recommended for extended stems.

Please specify the following information with your order:
- Fluid type or composition
- Maximum, minimum, & normal operating flow rate
- Maximum, minimum, & normal operating temperatures
- Maximum, minimum, & normal operating pressures
- Specific weight & viscosity at normal operating conditions

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FP-93 Flow Processor

Description

The FP-93 is a microprocessor-based instrument that is designed to monitor a variety of flows within industrial environments. The single-board design enables high reliability in a low cost form factor. Pressure and/or temperature compensation and an 8-point flow calibration curve may be used to further enhance performance. Diagnostic routines constantly monitor the FP-93's performance, automatically displaying any detection of a fault. The FP-93 features a backlit display that is readable in all lighting conditions. An industrial rated NEMA 4 enclosure is available for protection against harsh environments.

Features

- Displayed values with description and user-selectable, engineering units
- Non-volatile memory for programmed data
- Battery-backed memory for statistical values and totalizers
- Self-diagnostics and operational alarm monitoring
- 16-bit resolution A/D converter for superb analog accuracy
- Isolated outputs for digital and analog control
- Backlit display option for viewing in all lighting conditions
- Light weight and low power consumption
- EIA R232C compatible communications interface
- Panel mount unit or optional NEMA 4 enclosure

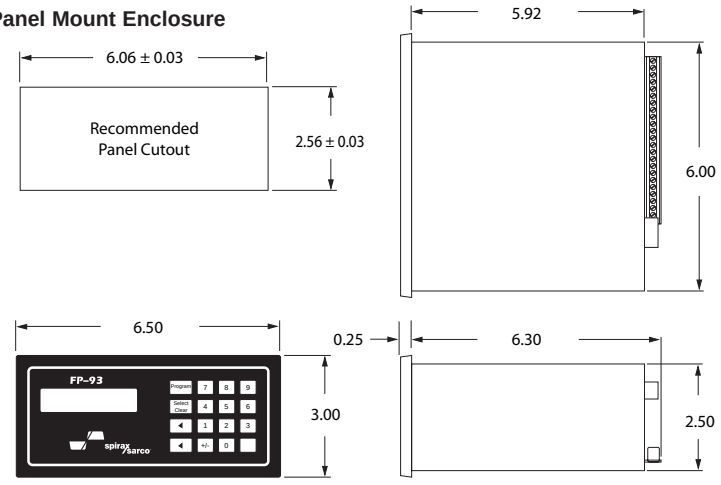
Benefits

- Calculates volume, mass, and heat flow for steam, liquid, and gas
- Single-board design for low cost and high reliability

Dimensions and Weights

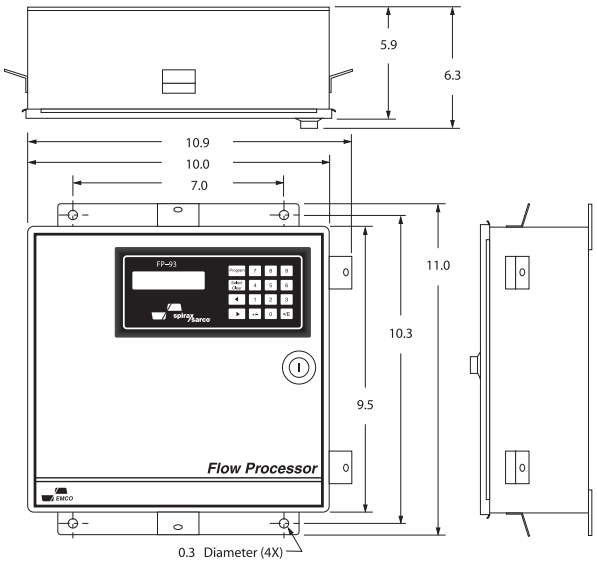
Dimensions are in inches

Panel Mount Enclosure



Weight 1.25 lb

NEMA 4 Enclosure



Weight 15.0 lb

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

FP-93 Flow Processor

Operating Specifications

Fluid Types		Steam condensate, water, water energy, liquid, air, natural gas, ideal gas, steam	
Storage Temperature		–40 to 140°F	
Operating Temperature		32 to 122°F	
Relative Humidity		0 to 95% (non-condensing)	
Power Requirement		The FP-93 power supply, 24 VDC ±5% at 150 mA, is used for powering external transmitters.	
	Standard	10.5 to 36 VDC, 100 mA maximum	
	Option 1	115 VAC ±15% @ 50/60 Hz	
	Option 2	230 VAC ±15% @ 50/60 Hz	
		2 x 3 x 1.75” with 6’ cords	
		VAC Power Weight-—1.25 lb	
Input Signals			
	One Frequency	Range 0 to 10 kHz	
		Accuracy ±(0.01% of reading + 1 count)	
		Impedance 50 kΩ minimum	
		Transition Level +3 volts nominal	
		Hysteresis 0.25 volts	
		Signal Amplitude 4 to 36 VDC	
	One Direction	Impedance 50 kΩ minimum	
		Transition Level +3 volts nominal	
		Hysteresis 0.25 volts	
		Signal Amplitude ±36 volts maximum	
		One 4-Wire RTD Resistance	Range 10 to 4000 Ω
			Resolution—the greater of 0.05% of reading or 0.1 Ω
		Accuracy	10 to 100 Ω ±0.15 Ω
			100 to 2000 Ω ±0.15% of reading
			100 to 4000 Ω ±0.2% of reading (extended range)
	Two Analog (4 to 20 mA) Current	Resolution 0.4 µA	
		Accuracy ±0.15% of full scale (±30 µA)	
		Impedance 100 Ω	
		Alarm Limits	Overrange 21.6 mA
			Underrange 2.4 mA
Output Signals			
	One Isolated 4 to 20 mA Current	Voltage Range 15 to 40 VDC	
		Resolution 6 µA	
		Accuracy ±0.25% of full scale (±50 µA)	
	One Isolated Solid-State Relay	A maximum up to 60 VDC	
Communications			
	Compatibility	EIA R232C	
	Multi-Drop Capability	Up to 10 units on a single R232C port (RS423 compatible)	
	Programmable Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19200, or 38400 baud	
	Data Bits	7 or 8	
	Parity	Even, odd, or none	
	Stop Bits	1 or 2	
	Connector	Chassis mounted 9-pin D-subminiature	

The analog input can be configured for flow input in all applications except BTU measurements with two RTD temperature inputs. For BTU measurements, select frequency input for flow.

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FP-93 Flow Processor

FP-93 Programmed Constants

Column #1	Column #2	Column #3	Column #4 Fluid Parameters	Column #5 Totalizer	Column #6 Analog Output	Column #7 Relay Output	Column #8 Displayed Values	Column #9 Display Units	Column #10 System
Fluid Steam/cond Water Water energy Liquid Air Natural gas Ideal gas Steam	Flow Frequency 4 to 20 mA Substitute Flowmeter Linear Non-linear Insertion Small turbine Large turbine Interpolation Linear Cubic Spline Bidirectional On/Off Substitute freq Pipe diameter Obscuration Profile factor K-factor Full scale vel Full scale freq Diff press cal Frequency #1 Velocity #1 thru Frequency #8 Velocity #8	Temp input None RTD 4 to 20 mA Substitute Sub temp #1 RTD #1 cal A RTD #1 cal B RTD #1 cal R Zero scale Full scale Temp Input #2 None RTD 4 to 20 mA Substitute Sub temp #2 RTD #2 cal A RTD #2 cal B RTD #2 cal R Zero scale Full scale Pressure input None 4 to 20 mA Substitute Sub pressure Zero scale Full scale Atm pressure	Density from Temp. input #1 Temp. input #2 Ref. density Specific gravity Mole frac CO_2 Mole frac N_2 Supercomp Viscosity Temperature #1 Density #1 thru Temperature #8 Density #8	Total #1 None Volume flow Comp flow Mass flow Energy flow Scale factor Total #1 None Volume flow Comp flow Mass flow Energy flow Scale factor #2	Analog out-put None Temperature Temp #2 Diff Temp Pressure Density Velocity Volume flow Comp flow Mass flow Energy flow Zero scale Full scale	Relay output None Temp alarm Temp #2 alarm Diff Temp alarm Pressure alarm Density alarm Velocity alarm Vol flow alarm Comp flow alarm Mass flow alarm Energy alarm Total #1 Total #2 Alarm limit Low High Setpoint Hysteresis	Bar graph Off/On Density Off/On Temperature Off/On Temp Stats Off/On Pressure Off/On Pressure stats Off/On Line velocity Off/On Volume flow Off/On Vol flow stats Off/On Comp vol flow Off/On Comp vol stats Off/On Mass flow Off/On Mass flow stats Off/On Energy flow Off/On Energy stats Off/On Analog output Off/On Relay output Off/On Total #1 Off/On Total #2 Off/On Clock/Calendar Off/On Verification Off/On	Velocity units ft/sec cm/sec m/sec Volume units cubic feet cubic inches gallons barrels cubic cm liters cubic meters quarts Mass units pounds tons grams kilograms metric tons Energy units Btu kJ cal kcal Mcal ton kW MW GW Flow time base /second /minute /hour /day Temp units ˚F/˚R/˚C/K Pressure units psi atm bar kg/cm^2 mm Hg Pressure dis-play absolute gauge Density units lb/ft^3 g/cc kg/m^3	Unit number Baud rate 38400 19200 9600 4800 2400 1200 600 300 Data format 7 Even 7 Odd 8 None Stop bits 1/2 Comm hand-shake None Hardware (CTS) XON/XOFF Both Modem Comm Off/On Password Display scan Sync calc Off/On Temperature TC Pressure TC Flow TC A/D reference A/D int count D/A zero count D/A span count

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FP-93 Flow Processor

Model and Suffix Codes

Category	Suffix Codes					
Model						
Microprocessor-Based Flow Processor	FP-93					
Enclosure						
Panel Mount Unit		P				
NEMA 4 Rated Enclosure		N				
Power Supply						
10.5 to 36 VDC			0			
115 VAC, 50/60 Hz[1]			1			
2305 VAC, 50/60 Hz[1]			2			
Relay Output						
DC Option				D		
Display						
Standard Display					S	
Display with Backlighting					B	
Flow Input						
Frequency						F
Analog 4 to 20 mA						A
Example	**FP-93-**	**P-**	**0-**	**D-**		**F**

FP-93-P-0-D-F represents a panel mount unit, 10.5 to 36 VDC power supply, DC option relay output, standard display, with frequency flow input.

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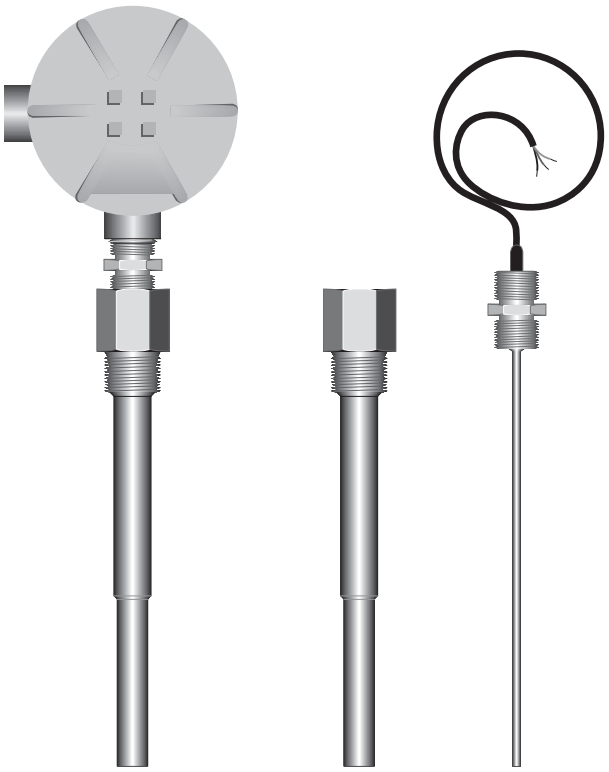
Temperature Sensor/Transmitter Model TEM

Description

TEM platinum resistance temperature sensors measure process fluid temperature for most applications. The TEM uses a resistance temperature device (RTD) to measure process temperature. RTDs operate on the principle that the resistance of the sensing device is proportional to the temperature, producing a highly repeatable and exceptionally stable resistance versus temperature relationship.

The TEM may be selected with either a direct RTD output or with an industry standard 4-20 mA current output. The current output includes a preamplifier that is factory scaled and calibrated to one of several standard temperature ranges in either degrees Fahrenheit or Celsius.

The TEM is thermowell mounted to allow installation and removal without process shutdown. Several immersion lengths are available to accommodate a wide range of pipe sizes.



Features

- RTD or 4–20 mA current output (linear)
- Factory calibrated over selected range
- Rugged design
- Thermowell included

Performance Specifications

RTD Sensor

Accuracy (Ice Point)
± 0.12% (1000 ± 1.2 Ω)

Interchangeability
Accuracy . . . . . ± 0.9 °F or 0.8%
Stability
Better than ± 0.45 °F per year

Sensing Element Coefficient
0.00385 Ω/ Ω/°C

Preamplifier

Accuracy
± 0.1% of span

Ambient Temperature Effect
Zero . . . . . 0.03 + 0.005% of span per °C
Span . . . . . 0.02 + 0.003% of span per °C

Operating Specifications

Temperature Ranges

Output	Preamplifier Model Suffix Code	Temperature Range
RTD Sensor	RTD	–40 to 800 °F (–40 to 426 °C)
Transmitter (4 to 20 mA)	T09	32 to 68 °F
	T10	0 to 250 °F
	T11	–40 to 150 °F
	T12	212 to 400 °F
	T14	212 to 500°F
	T13	212 to 800°F
	T20	–17.7 to 121.1 °C
	T21	–40 to 65 °C
	T22	100 to 204 °C
	T24	100 to 260 °C
	T23	100 to 426 °C

Temperature Sensor/Transmitter
Model TEM

Operating Specifications continued

Temperature Ranges

Ambient Temperature Limit
–30 to 160 °F

Storage Temperature Limit
–60 to 185 °F

Ambient Humidity Limit
0 to 100% relative humidity

Thermowell Pressure Limit
3500 psig at 1140 °F

RTD Sensor

Output
3-wire RTD

Current
1 mA recommended, 2 mA maximum

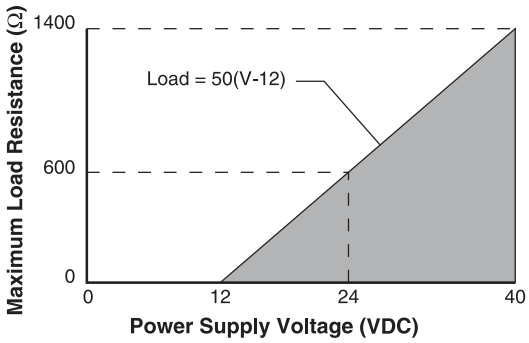
Insulation Resistance
100 mΩ minimum at 300 VDC at 75 °F

Optional Preamplifier

Output
4 to 20 mA, 2-wire

Power Supply
24 VDC nominal, operable from 12 to 40 VDC

Load Resistance
600 at 24 VDC; depends upon power supply voltage



Physical Specifications

Materials

Sensing Element
1000 Ω thin film platinum

RTD Sheath
316 stainless steel

Junction Box
Aluminum

Thermowell
316 stainless steel

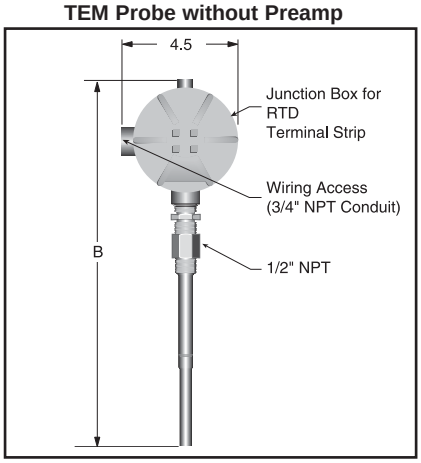
Process Connection (Thermowell)
1/2" NP

Electrical Connection
Junction box with terminal block for external wiring.
3/4" NPT female connection for conduit.

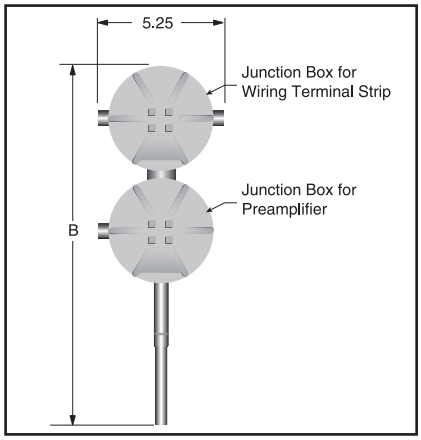
Weight (with 6" Thermowell)
3 lb

Dimensions (in inches)

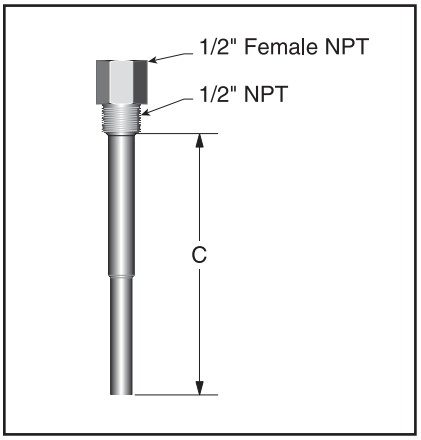
TEM Probe without Preamp



TEM Probe with Preamp



Thermowell



Dimensions Table

Thermowell Length Model Suffix Code	B w/o Preamp in.	B w/ preamp in.	C in.
2"	10.5	15	2
3"	11.5	16	3
4"	12.5	17	4
6"	14.5	19	6

Thermowell Length Model Suffix Code	B w/o Preamp in.	B w/ preamp in.	C in.
8"	16.5	21	8
10"	18.5	23	10
12"	20.5	25	12

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Temperature Sensor/Transmitter
Model TEM

Model and Suffix Codes

Category	Description	Suffix Codes			
Model	Precision RTD with thermowell	TEM-30	. . .	. . .	. . .
Preamplifier (Temperature Range)	None (RTD output only)	. . .	RTD	. . .	. . .
	Preamplifier scaled from: 32 to 68°F (liquid or gas)	. . .	T09	. . .	. . .
	Preamplifier scaled from: 0 to 250°F (liquid or gas)	. . .	T10	. . .	. . .
	Preamplifier scaled from: –40 to 150°F (liquid or gas)	. . .	T11	. . .	. . .
	Preamplifier scaled from: 212 to 400°F (liquid or gas)	. . .	T12	. . .	. . .
	Preamplifier scaled from: 212 to 500°F (steam)	. . .	T14	. . .	. . .
	Preamplifier scaled from: 212 to 800°F (steam)	. . .	T13	. . .	. . .
	Preamplifier scaled from: –17.7 to 121.1°C (liquid or gas)	. . .	T20	. . .	. . .
	Preamplifier scaled from: –40 to 65°C (liquid or gas)	. . .	T21	. . .	. . .
	Preamplifier scaled from: 100 to 204°C (steam)	. . .	T22	. . .	. . .
	Preamplifier scaled from: 100 to 260°C (liquid or gas)	. . .	T24	. . .	. . .
	Preamplifier scaled from: 100 to 426°C	. . .	T23	. . .	. . .
	Transmitters can be scaled to accommodate special requests and bar scaling	. . .	TXX	. . .	. . .
Thermowell Length	2” thermowell length	. . .	. . .	2	. . .
	3” thermowell length	. . .	. . .	3	. . .
	4” thermowell length	. . .	. . .	4	. . .
	6” thermowell length	. . .	. . .	6	. . .
	8” thermowell length	. . .	. . .	8	. . .
	10” thermowell length	. . .	. . .	10	. . .
	12” thermowell length	. . .	. . .	12	. . .
RTD wires (internal)	Teflon, –4 to 400°F	. . .	. . .	. . .	T
	Fiberglass, 150–800°F	. . .	. . .	. . .	F

Example → **TEM-30-T13-6-F**

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Pressure Transmitter Model PT

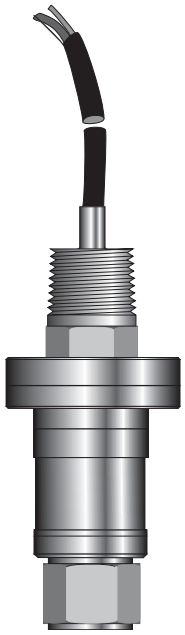
Description

The Model PT combines micro-machined silicon diaphragms with fully welded stainless steel and hastelloy pressure ports to provide a highly accurate, stable pressure transmitter. It is constructed with the materials and environmental protection required for industrial applications.

The silicon sensors incorporate developments derived from aerospace applications. These developments are used to decrease output noise, non-linearity, and hysteresis and to improve long term stability.

A detachable, industrial, electrical connector provides access to the independent zero and span trim controls.

Each transmitter incorporates RFI/EMC and electrical spike protection.



Features

- Process pressure range: 1.5 to 1,000 psig
- Accuracy of ± 0.25% of full scale
- Process temperature range: –40 to 250 °F
- 2-wire, 4 to 20 mA output
- CE Approved
- FM Approved for Class I, Division 2, Groups A, B, C, D; Class II & III, Division 2, Groups F, G

Performance Specifications

Accuracy
± 0.25% of full scale (the best straight line-determined from the combined effects of non-linearity, hysteresis, and repeatability).

Ambient Temperature Effects
For ranges of 5 psi and above, the output will not deviate from room temperature calibration by more than:

2.0% full scale over 15 to 122 °F
3.0% full scale over –5 to 175 °F

Typically:

1.0% full scale over 15 to 122 °F
2.0% full scale over –5 to 175 °F

For ranges below 5 psi these values will increase pro-rata with calibrated span.

Operating Specifications

Service
Liquid, gas, and steam

Proof Pressure
The rated pressure can be exceeded by 2X without degrading performance.

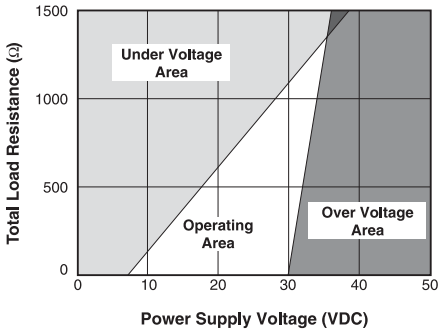
Operating Pressure Range

Part Number	Pressure Range
	psig
S0111151	0 to 50
S0111152	0 to 100
S0111153	0 to 150
S0111154	0 to 200
S0111155	0 to 250
S0111156	0 to 500
S0111172	0 to 1000
S0111171	Customer specified.

Operating Temperature Range

Ambient	Process Media	Storage
–40 to 175 °F	–40 to 250 °F	–40 to 250 °F

Power Supply Requirements
9 to 30 VDC, across red wire (positive) and blue wire (negative). This voltage must appear across the transmitter terminals.



Output
4 to 20 mA (2-wire configuration) proportional for zero to full scale pressure.

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

Pressure Transmitter Model PT

Physical Specifications

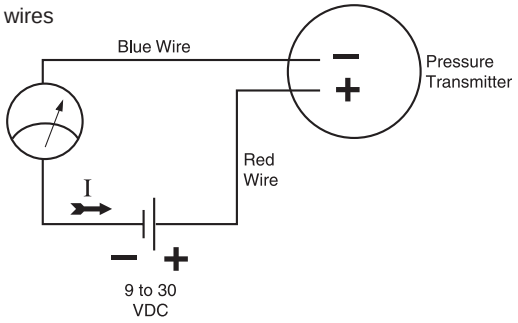
Materials of Construction
Isolating Diaphragm . . . . . Hastelloy C®-276
Transducer Body. . . . . 316 stainless steel

Pressure Connection
1/4" NPT female

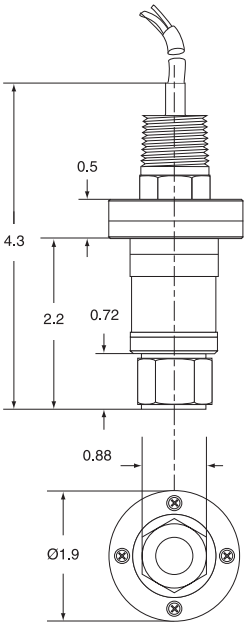
Calibration Standards
Transmitters are calibrated against precision pressure calibration equipment traceable to NIST.

Weight
14 oz nominal

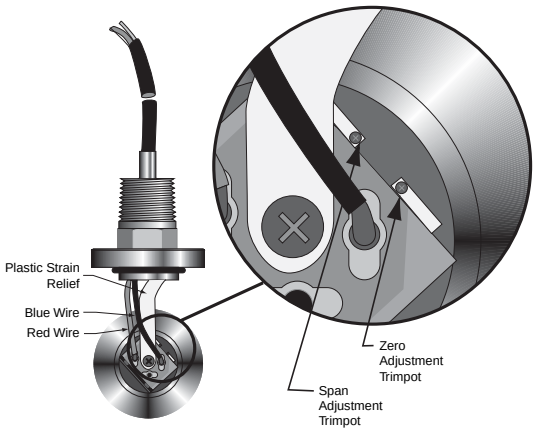
Electrical Connection
Two 22 AWG wires



Dimensions



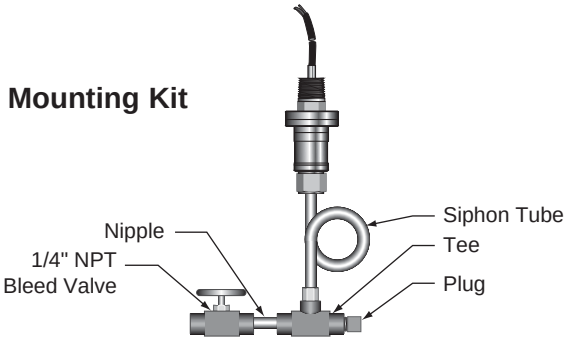
Zero and Span Adjustments



Zero and span adjustments are made using the trimpots. To gain access to trimpots, disassemble the PT as follows:

a. Remove the four screws
b. Gently separate two halves
c. Adjust zero and span as needed
d. Replace the connection plate back on the housing

Mounting Kit



Model and Suffix Codes

Description	Part Number
S-PT for pressure range 0–50 psig	S0111151
S-PT for pressure range 0–100 psig	S0111152
S-PT for pressure range 0–150 psig	S0111153
S-PT for pressure range 0–200 psig	S0111154
S-PT for pressure range 0–250 psig	S0111155
S-PT for pressure range 0–500 psig	S0111156
S-PT for pressure range 0–1000 psig [3]	S0111172
S-PT to accommodate special requests and bar scaling.[1]	S0111171
Mounting Kit: includes bleed valve, siphon tube, plug, nipple, and tee. Must be used with S-PT if process temperature is above 250°F.	S0105894

1. Determine the pressure range that is the most appropriate for your application. Contact your local representative for details.
2. Specify the typical service conditions. A siphon tube on the PT is required for all applications above 250 °F.
3. Not FM Approved.

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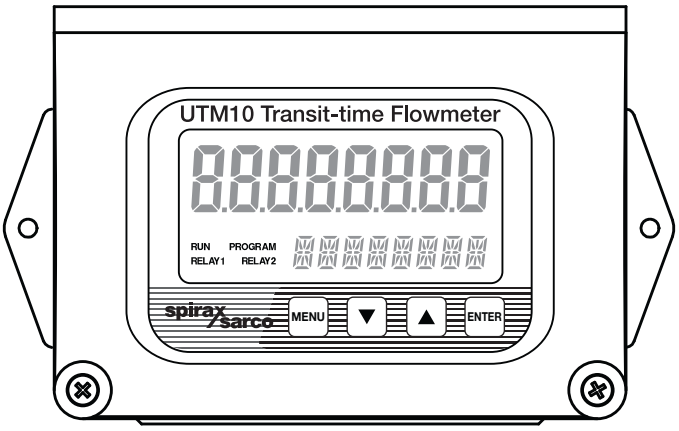
Clamp-On Ultrasonic Flow and Energy Meter for Liquids

Description

UTM10 ultrasonic flow and energy meters clamp onto the outside of pipes and do not contact the internal liquid. The technology has inherent advantages over alternate devices including: low-cost installation, no pressure head loss, no moving parts to maintain or replace, no fluid compatibility issue, and a large, bi-directional measuring range that ensures reliable readings even at very low and high flow rates. UTM10 is available in a variety of configurations that permit the user to select a meter with features suitable to meet particular application requirements.

The UTM10 is available in two versions: a stand-alone flow meter, and an energy flow meter used in conjunction with dual clamp-on RTDs. The energy flow meter measures energy usage in BTU, Tons, kJ and Wh and is ideal for retrofit, chilled water and other HVAC applications.



Features

- May be used to measure clean liquids as well as those with small amounts of suspended solids or aeration (e.g., surface water, sewage).
- Bi-directional flow measurement system. Totalizer options include forward, reverse and net total.
- Modbus RTU over RS485 communications; Ethernet connection includes BACNet®/IP, EtherNet/IPTM and Modbus TCP/IP protocols.
- Large, easy-to-read digital display.
- Rugged, aluminum enclosure ensures a long service life in harsh environments.
- Certified for hazardous area installation in North America and Europe.

Benefits

- Reduced material costs: clamp-on sensor eliminates the need for in-line flanges, pipe fittings, strainers, and filters.
- Reduced installation time: the UTM10 may be installed and fully operational within minutes.
- Reduced maintenance costs: with no moving parts, there is nothing on the UTM10 to wear down – no repair kits or replacement parts are needed.
- No need to shut down the process for installation or maintenance due to clamp-on sensor design.

Clamp-On Ultrasonic Flow and Energy Meter for Liquids

Specifications

System

Liquid Types	Most clean liquids or liquids containing small amounts of suspended solids or gas bubbles
Velocity Range	Bi-directional to 40 FPS (12 MPS)
Flow Accuracy	UTT10-050S/050L/050H: ± 1% of rate at flows > 1 FPS; ± 0.01 FPS (0.003 MPS) at flows < 1 FPS (0.3 MPS) UTT10-025S - UTT10-040S:1" (25 mm) and larger ± 1% of rate from 4 to 40 FPS (1.2 to 12 MPS); ± 0.04 FPS (0.012 MPS) at rates < 4 FPS (1.2 MPS) UTT10-015S - UTT10-020S: ± 1% Full Scale
Temperature Accuracy (Energy Meters Only)	Option 1: 32-122 °F (0-50 °C); Absolute: 0.22 °F (0.12 °C) Difference: 0.09 °F (0.05 °C) Option 2: 32-212 °F (0-100 °C); Absolute: 0.45 °F (0.25 °C) Difference: 0.18 °F (0.1°C) Option 3: -40-350 °F (-40-177 °C); Absolute: 1.1 °F (0.6 °C) Difference: 0.45 °F (0.25 °C)
Sensitivity	**Flow:** 0.001 FPS (0.0003 MPS) **Temperature:** Option 1: 0.03 °F (0.012 °C); Option 2: 0.05 °F (0.025 °C); Option 3: 0.1 °F (0.06 °C)
Repeatability	0.5% of reading
Installation Compliance	General Safety: UL 61010-1, CSA C22.2 No. 61010-1 and EN 61010-1 Hazardous Location: Class I Division 2 Groups C,D; Class II and III, Division 2, Groups C, D, F, and G for US/CAN; ATEX II 2 G Ex nA II T4: UL 1604, CSA 22.2 No. 213, EN 60079-0 and EN 60079-15 CE: EN61326-1:2006 on meter systems with integral flow transducers, transducers constructed with twinaxial cable or remote transducers with conduit

Transmitter

Power Requirements	AC: 95-264 VAC 47-63 Hz @ 17 VA max. DC: 10-28 VDC @ 5 VA max. Protection: auto resettable fuse, reverse polarity and transient suppression
Display	Two line LCD, LED backlit; Top row 0.7 inch (18mm) height, 7-segment; Bottom row 0.35 inch (9 mm) height, 14-segment Icons: RUN, PROGRAM, RELAY1, RELAY2 Flow rate indication: 8-digit positive, 7-digit negative max.; auto decimal, lead zero blanking Flow accumulator (totalizer): 8-digit positive, 7-digit negative max. (reset via keypad press, USP, network command or momentary contact closure)
Enclosure	Type 4 (IP65) Construction: powder-coated aluminum, polycarbonate, stainless steel, polyurethane, nickel-plated steel mounting brackets Size (electronic enclosure only): 6.0" W x 4.4" H x 2.2" D (152 mm W x 112 mm H x 56mm D) Conduit Holes: (2) ½" NPT female; (1) ¾" NPT female; Optional Cable Gland Kit
Temperature	-40 °F to +185 °F (-40 °C to +85 °C)
Configuration	Via optional keypad or PC running USP software (Note: not all configuration parameters are available from the keypad – i.e. flow and temperature calibration and advanced filter settings)
Engineering Units	**Flow Meter:** Feet, gallons, cubic feet, million gallons, barrels (liquor and oil), acre-feet, lbs., meters, cubic meters, liters, million liters, kg **Energy Meter:** BTU, MBTU, MMBTU, Tons, kJ, kWh, MWh and the Flow Meter list from above
Inputs/Outputs	**USB** 2.0: for connection of a PC running USP configuration utility **RS485:** Modbus RTU command set **10/100 Base-T:** RJ45, communication via Modbus TCP/IP, EtherNet/IP™ and BACnet®/IP **4-20mA:** 12-bit, internal power, can span negative to positive flow/energy rates **Flow Meter Model Only:** 0-1,000 Hz:open-collector, 12-bit, can span negative to positive rates; square-wave or turbine meter simulation outputs **Two Alarm Outputs:** open-collector, configure as rate alarm, signal strength alarm or totalizer pulse

Transducers

Type	Compression mode propagation, clamp-on
Construction	UTT10-050S/050L: NEMA 6 (IP 67), CPVC, Ultem®, Nylon cord grip, PVC cable jacket; -40 to 250°F (-40 to 121°C) UTT10-015S - UTT10-040S: NEMA 6 (IP 67), CPVC, Ultem®, Nylon cord grip, PVC cable jacket; -40 to 250°F (-40 to 121°C) UTT10-050S/050L: NEMA 6P (IP 68) option, CPVC, Ultem®, Nylon cord grip, Polyethylene cable jacket; -40 to 250°F (-40 to 121°C) NEMA6: Submersible to a depth of 3ft (1m) for 30 days max. NEMA6P: Submersible to a depth of 100ft (30m) indefinitely
Frequency	UTT10-015S - UTT10-040S: 2 MHz UTT10-050S/050H: 1 MHZ UTT10-050L: 500 KHz
Cables	RG59 Coaxial, 75 ohm or Twinaxial, 78 ohm (optional armored conduit)
Cable Length	990 feet (300 meter) max. in 10 ft. (3 m) increments
RTDs	**Energy Meters Only:** Platinum 385, 1,000 ohm, 3-wire; PVC jacket cable
Installation	**DTT10-050S (S option)/050L/050H:** General and Hazardous Location (see Installation Compliance) **DTT10-050S and IS Barrier (F option):** "Class I Div I, Groups C&D T5 Instrinically Safe Exia;" "CSA C22.2 No.'s 142 & 157, UL 913 & 916"

Software Utilities

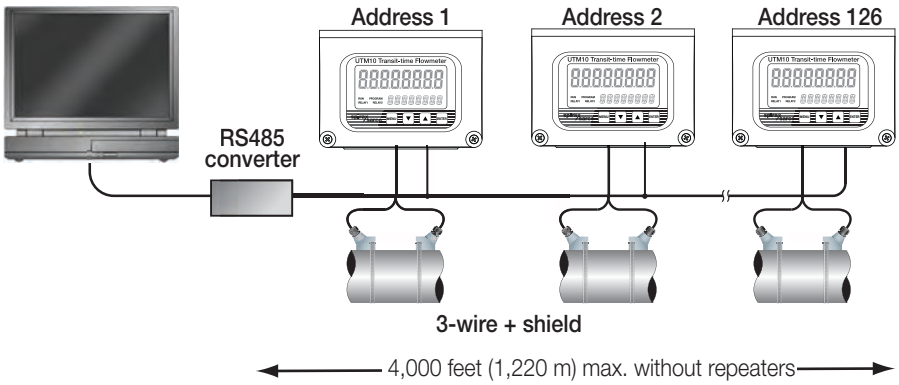
USP	Utilized to configure, calibrate and troubleshoot Flow and Energy meters. Connection via USB A/B cable; software is compatible with Windows 95, Windows 98, Windows 2000, Windows XP, Windows Vista® and Windows® 7
EnergyLink	Utilized to monitor a network of Flow and Energy meters. Connection via RS485. Operates within Microsoft Excel®2003 and Microsoft Excel®2007.

Clamp-On Ultrasonic Flow and Energy Meter for Liquids

UTM10 Network Options

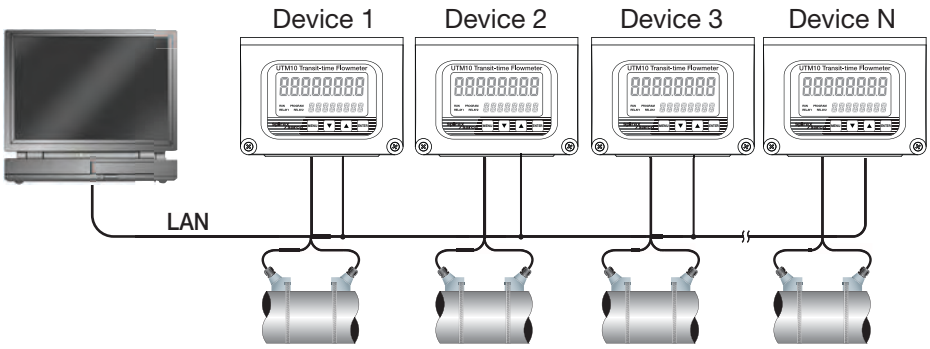
UTM10 Network

All UTM10 meters come equipped with RS485 drivers and utilize a Modbus RTU command set (data can be returned in single-precision, double-precision, integer or floating point values). Up to 126 UTM10 products can be run on a single daisy-chain network and be individually queried for flow rate, positive flow accumulator, negative flow accumula Excel®, application detailed below.



UTM10 Base-T Network

If equipped with the optional Ethernet communications module, the UTM10 can be plugged into a LAN and queried for flow rate, positive flow accumulator, negative flow accumulator, supply temperature, return temperature and signal strength. The module contains Modbus TCP/IP, EtherNet/IP™ and BACnet®/IP network compatibility.

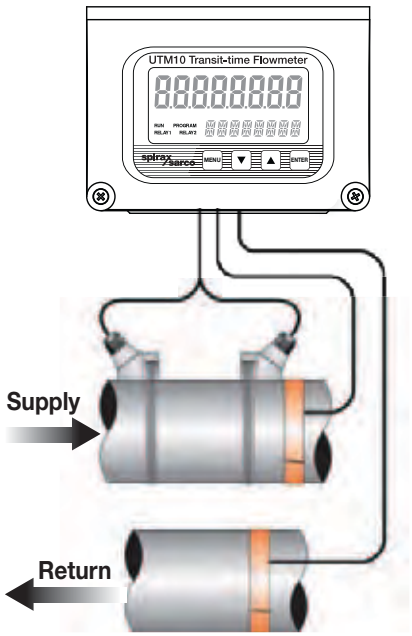


USP Software

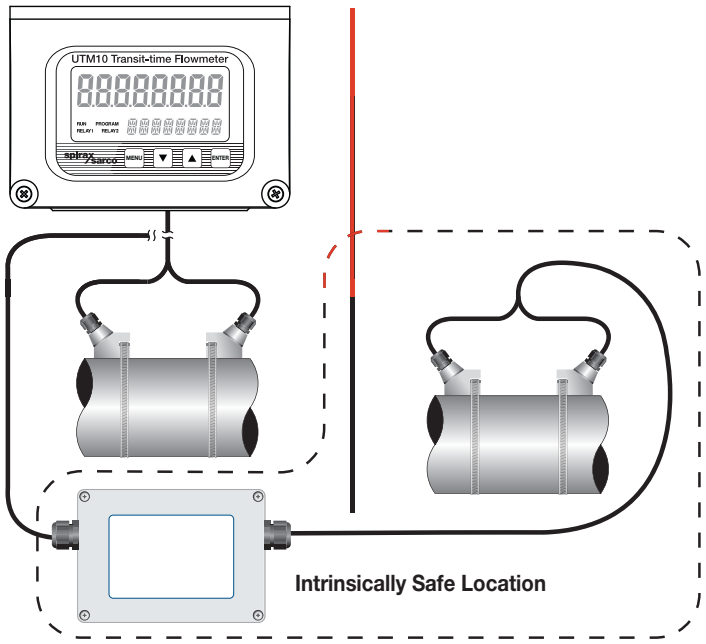
Operating from a standard, low-cost PC, USP software operates within Microsoft® Excel® and provides an efficient method of monitoring and archiving data from a network of UTM10 Energy meters. USP software automatically backs up accumulated energy data every hour, day, month, quarter and year into convenient spreadsheet formats suitable for input into invoicing systems. The Current Readings screen provides real time measurements from all UTM10 meters on the network (up to 126 meters can be connected on a single RS485 network). Data displayed includes: Location name, Room Number, UTM10 address, a good/bad communication indicator, the time and date of the last reading, flow signal level, energy flow rate, energy accumulation, supply temperature and return temperature. The software can be configured to "auto run" should PC power be interrupted or the PC be turned off. The software can also be configured to reset the energy accumulators on all network meters at the beginning of every month or quarter.

Compliance

General Safety



Hazardous Location Installation



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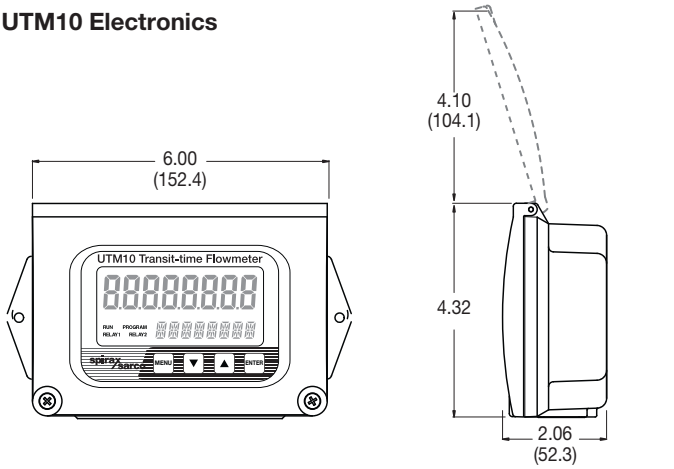
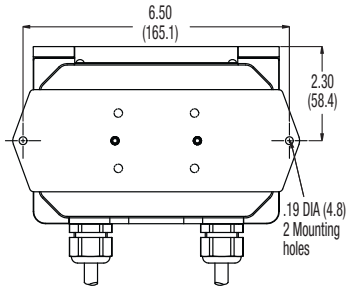
Clamp-On Ultrasonic Flow and Energy Meter for Liquids

Dimensional Specifications
Mechanical Dimensions: Inches (mm)

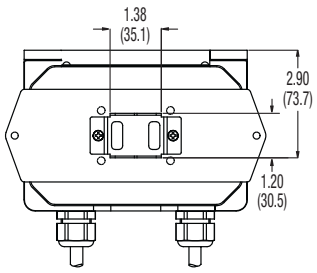
UTM10 Electronics



Wall mount



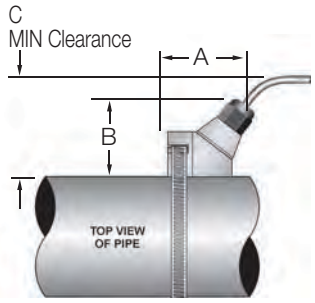
Pipe mount



UTT10 Transducer Dimensions: Inches (mm)

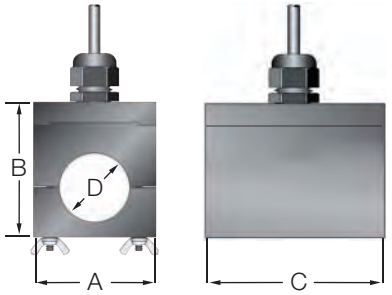
Pipe Size	Pipe Material	A	B	C	D	Measuring Range
½"	ANSI	2.46 (62.5)	2.36 (59.9)	2.66 (67.6)	0.84 (21.3)	2 - 38 GPM 8 - 144 LPM
	Copper	2.46 (62.5)	2.36 (59.9)	3.33 (84.6)	0.63 (15.9)	1.8 - 27 GPM 7 - 102 LPM
	Tubing	2.46 (62.5)	2.28 (57.9)	3.72 (94.5)	0.50 (12.7)	1.5 - 18 GPM 6 - 68 LPM
¾"	ANSI	2.46 (62.5)	2.57 (65.3)	2.66 (67.6)	1.05 (26.7)	2.75 - 66 GPM 10 - 250 LPM
	Copper	2.46 (62.5)	2.50 (63.5)	3.56 (90.4)	0.88 (22.2)	2.5 - 54 GPM 10 - 204 LPM
	Tubing	2.46 (62.5)	2.50 (63.5)	3.56 (90.4)	0.75 (19.0)	2.5 - 45 GPM 10 - 170 LPM
1"	ANSI	2.46 (62.5)	2.92 (74.2)	2.86 (72.6)	1.32 (33.4)	3.5 - 108 GPM 13 - 409 LPM
	Copper	2.46 (62.5)	2.87 (72.9)	3.80 (96.5)	1.13 (28.6)	3.5 - 95 GPM 13 - 360 LPM
	Tubing	2.46 (62.5)	2.75 (69.9)	3.80 (96.5)	1.00 (25.4)	3.5 - 85 GPM 13 - 320 LPM
1-¼"	ANSI	2.80 (71.0)	3.18 (80.8)	3.14 (79.8)	1.66 (42.2)	5 - 186 GPM 19 - 704 LPM
	Copper	2.46 (62.5)	3.00 (76.2)	4.04 (102.6)	1.38 (34.9)	4.5 - 152 GPM 17 - 575 LPM
	Tubing	2.46 (62.5)	3.00 (76.2)	4.04 (102.6)	1.25 (31.8)	4 - 136 GPM 15 - 514 GPM
1-½"	ANSI	3.02 (76.7)	3.42 (86.9)	3.33 (84.6)	1.90 (48.3)	6 - 250 GPM 23 - 946 LPM
	Copper	2.71 (68.8)	2.86 (72.6)	4.28 (108.7)	1.63 (41.3)	5 - 215 GPM 19 - 814 LPM
	Tubing	2.71 (68.8)	3.31 (84.1)	4.28 (108.7)	1.50 (38.1)	5 - 200 GPM 19 - 757 LPM

UTT10-050S/050L/050H
Pipes 2" (50 mm) and larger



	A	B	C
050S	2.95 (74.9)	2.75 (69.8)	3.00 (76.2)
050H	2.95 (74.9)	2.75 (69.8)	3.00 (76.2)
050L	3.40 (86.4)	2.94 (74.7)	3.20 (81.3)

UTT10-015S to UTT10-040S
Pipes ½" to 1.5" (12 mm to 40 mm)



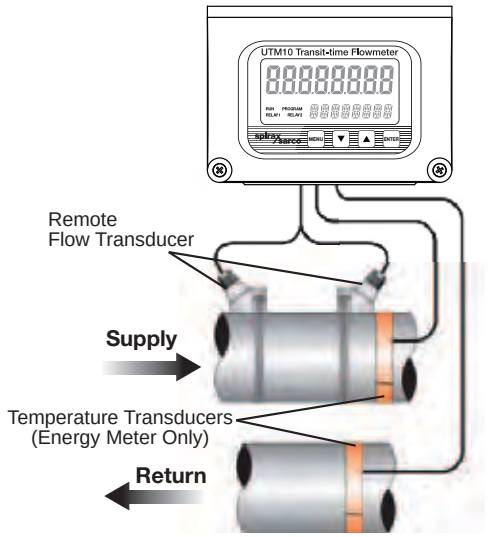
Clamp-On Ultrasonic Flow and Energy Meter for Liquids

Meter with Remote Flow Transducer

UTM10 is available with remote mounted transducers that permit separation of up to 990 feet (300 m) using coaxial or twinaxial cable. This design is utilized when pipes are located in areas that are not convenient for viewing, or on piping systems with severe vibration. PVC constructed transducers are rated to 185 °F (85 °C), CPVC are rated to 250 °F (121 °C) and PTFE are rated to 350 °F (176 °C).

Common Features:

- Rate-Total backlit display
- 4-20mA Output
- 0-1,000 Hz Rate Pulse and Dual Alarm Outputs (Flow Meter Model Only)
- USB Programming Port
- RS485 Modbus Network Connection
- Remote Totalizer Reset



How To Order
Ultrasonic Transit-time Meter

Category	Description	Suffix codes			
Model[1]	Velocity Meter	UTM10-S[2]			
	Energy Meter	UTM10-E[3]			
Electrical Power	DC, 10-28 VDC @ 5 watts maiximum		D		
	AC, 95-264 VAC, 47 to 63 Hz@ 17 VA maximum		A		
Digital Communications	STD (4-20mA, Pulse, Modbus RTU)			00	
	10-100 Base T, (Modbus TCP/IP, BACnet/IP, TCP/IP)			10	
	Totalizing Pulse (Isolated Open Collector)			15	
Energy Temperature Range	None, if selected Electronics Model S				0
	32 to 122 °F (0 to 50°C)				1
	32 to 212 °F (0 to 100°C)				2
	-40 to 350 °F (-40 to 176°C)				3
Example		**UTM10-EA001**			

Notes:

[1]All electronics have a 4 button keypad, remote mounted transducers, Class 1 Division 2 and CE Approvals, 4-20mA ouput, Modbus RTU output, USB connection, and cable gland connections

[2]Velocity meter has two 0-1000 Hz open control outputs

[3]Energy meter has connection for Dual 3 wire 1000 Ohm RTDs

Clamp-On Ultrasonic Flow and Energy Meter for Liquids

How To Order Ultrasonic Transit-time Transducer

Category	Description	Suffix codes						
Model	Transducers, all rated to 121˚C (250˚F) (CPVC, Ultem®)	UTT10-						
Line Size (nominal)	15mm (1/2") 2.0 MHz transducers, maximum temperature 121˚C (250˚F)		015S					
	20mm (3/4") 2.0 MHz transducers, maximum temperature 121˚C (250˚F)		020S					
	25mm (1") 2.0 MHz transducers, maximum temperature 121˚C (250˚F)		025S					
	32mm (1 1/4") 2.0 MHz transducers, maximum temperature 121˚C (250˚F)		032S					
	40mm (1 1/2") 2.0 MHz transducers, maximum temperature 121˚C (250˚F)		040S					
	Standard, 2" and larger, 1.0 MHz transducers, maximum temperature 121˚C (250˚F)		050S					
	Large pipe, 24" and larger, 0.5 MHz transducers, maximum temperature 121˚C (250˚F)		050L					
	High Temperature, 2" and larger, 1.0 MHz transducers, maximum temperature 177˚C (350˚F)		050H					
Pipe Material	050S, 050L, 050H transducers			X				
	ANSI Pipe			M				
	Copper Tube			C				
	Standard Tubing			P				
Cable Length	20 ft (6M)				020			
	50 ft (15m)				050			
	100 ft (30M)				100			
	Custom in 10 ft (3m) increments greater than 100 feet (30m)				C00			
Conduit & Submersible Option	None					N		
	Armored Flex Conduit					A		
	Submersible NEMA 6P (050S without conduit)					S		
	Submersible NEMA 6P (050L without conduit)					T		
	Submersible NEMA 6P (050S and 050L with conduit)					U		
Conduit Length	None						000	
	20 ft (6M)						020	
	50 ft (15m)						050	
	100 ft (30M)						100	
	Custom in 10 ft (3m) increments greater than 100 feet (30m)						C00	
Approvals	Standard, Class 1, Divison 2, CE							S
	Class 1 Division 1 Groups C & D, 050S transducers only							F
Example		UTT10-050SX020N000F						

Note: Armored Flex conduit can be ordered with conduit option A and U only.

Accessories	P/N	Description
RTD Kit	URTD-C-20	Clamp on RTD 20 ft cables
	URTD-C-50	Clamp on RTD 50 ft cables
	URTD-C-100	Clamp on RTD 100 ft cables
Note: RTD Kit includes 2 RTD, heat sink compound, and installation tape. RTDs are 1000 ohm, 400 F.		
Mounting Tracks	UTMT-10	10" Scaled Transducer Mounting Track Assembly
	UTMT-16	16" Scaled Transducer Mounting Track Assembly
Note: For UTT-10-050S transducers only		

Sono-Trak® Doppler Clamp-on Ultrasonic Flow Meter

Description

The Sono-Trak® Doppler ultrasonic flow meter is a non-invasive, ultrasonic flow metering system. Based on the principles of the Doppler effect, it calculates flow velocity by sensing and measuring the frequency shift in motion from reflective materials within a liquid.

Benefits

- Non-invasive design
- Low-cost, simple installation
- Fits pipe sizes from 1 to 100" (25 to 2540 mm) outside diameter
- Rugged and maintenance-free—no moving parts
- No pressure drop and no costly process shutdowns
- Reliable and accurate flow readings—typically provides ±2.0% full scale accuracy and ±0.1% repeatability

Features

- Automatic gain control—as flow profile changes so does the electronics signal
- Noise immunity to variable frequency drive (VFD)
- User-friendly, easy-to-program display with on-screen prompting and keyboard entry
- Digital signal—allows for cable lengths up to 5000' (1524 m)
- AC or DC operation
- Fixed and portable units available

Overview

The Sono-Trak® Doppler flow meter uses advanced signal processing technology that dramatically increases the accuracy of flow rate measurement. Its accuracy ratings are typically ±2.0% of full-scale accuracy, and repeatability is ±0.1% of reading.

This flow metering system uses two transducers mounted side by side, operating as ultrasonic signal transmitters and receivers. The measurement is obstructionless and produces no associated pressure drops. With no moving parts to wear over time, the Sono-Trak® Doppler flow meter is virtually maintenance-free and is available in both fixed and portable units.

Suitable Fluids

The Sono-Trak® Doppler flow meter is suitable for fluids containing suspended particles or bubbles with at least 35 parts per million (ppm) at 40 µ or larger, and a minimum of at least 0.2% density difference from liquid medium.

Applications

- The Sono-Trak® Doppler flow meter easily measures most all liquids containing particles or air bubbles. Some materials well suited for measurement include:

- Agricultural water
- Abrasives
- Asphalts
- Concrete
- Drudge flows
- Drilling mud
- Large contaminates
- Extremely viscous substances
- Grout
- Hazardous wastes
- Municipal sludge and wastes
- Paper pulp
- Rendering products
- Reservoirs and runoffs
- Rivers and streams
- Sludge
- Slurries
- Suspended solids

Sono-Trak® Doppler

Installation Considerations

The Sono-Trak® Doppler flow meter is available in fixed and portable units. The fixed unit consists of:

- Electronics enclosure
- Digitizer
- Two transducers and 25’ cable (7.6 m)
- Tiedown kit
- Sonic coupling gel
- User manual

In addition, portable units include:

- 12 V, 2.2 AH battery
- 110 VAC battery charger
- Tote handle and side latch
- Field transport case

Custom cable lengths of up to 5000’ (1524 m) are available.

Doppler Placement

The ideal placement of the Sono-Trak® Doppler flow meter is within 20 diameters of straight run upstream and 10 diameters of straight run downstream between the meter and any disturbance of the flow; however, the meter has worked with straight runs of as little as 5 diameters upstream and 2 diameters downstream.

Piping Conditions

- The Sono-Trak® Doppler flow meter fits pipe diameters from 1 to 100” (25 to 2540 mm).
- Pipes should be cleaned with all paint and scale removed.
- Horizontal pipe mounting is recommended.

Clamp-on mounting

The Sono-Trak® Doppler flow meter is configured with clamp-on transducers. When installed, the transducers sense fluid flow through a pipe and send this information to the system electronics. The electronics then convert, transmit, and display the received data.

External clamp-on sensors are ideal for smooth, clean pipe surfaces and are installed without shutting down flow. When clamp-mounting the flow meter, attach the sensors side by side in a position approximately 7 to 11 o’clock on the outside of the pipe. Use stainless straps, nylon belts, or bungee straps and a steel chain to secure the clamps in place.

Use only a sonic coupling medium to transmit the energy from the transducer crystals through the pipe wall and into the flow to be measured. Any type of non-fibrous grease or gel will suffice.

Figure 1: Mount the transducers side by side between 7 and 11 o’clock.

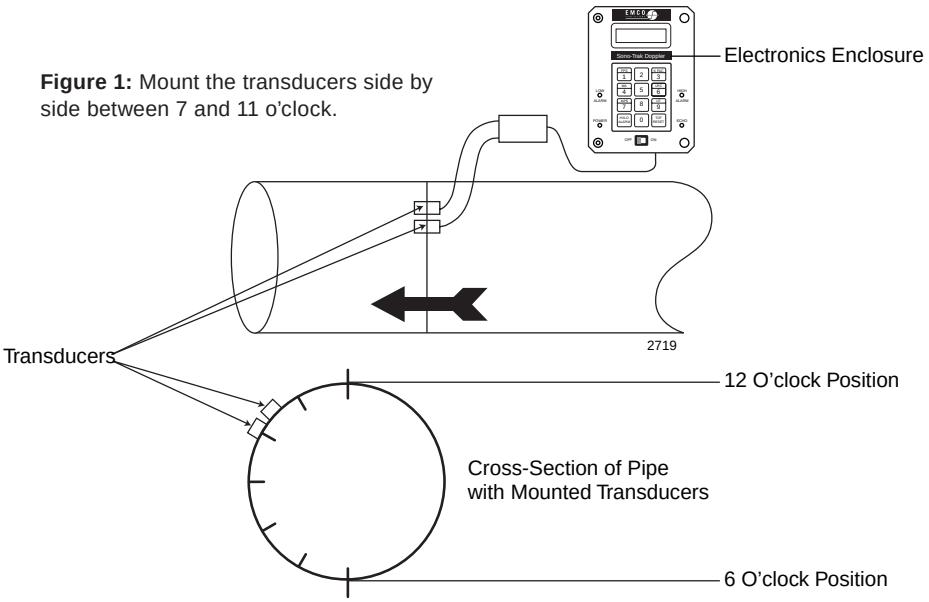


Figure 2: Secure the transducers in place

Cabling

The standard cable length between the electronics enclosure and the transducers is 25’ (7.6 m). Custom cable lengths up to 5000’ (1524 m) are available.

Display Module

A user-friendly, easy-to-read display provides continuous, real-time flow rate, velocity, and totalization measurements in user-selectable engineering units.

On-screen prompting and a full-function, 32-character, dual-line, alphanumeric keypad entry make programming effortless.

The display reads pulse, voltage, and analog rates, and it includes built-in high/low limit alarms, 4 to 20 mA signals, and an echo light to indicate whether the signal is producing accurate readings.

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Sono-Trak® Doppler

Specifications

Fluid Conditions		
Measured Fluid	Homogenous liquids with Newtonian flow profiles (sludges, slurries, sewage, wastewater, and other fluids containing suspended particles)	
State of Flow	Axis-symmetric flow in pipe filled with fluid	
Fluid Type	Liquids containing suspended particles of at least 35 ppm at 40 µ at 0.2% density of undissolved solids or air bubbles	
Measurable Fluid Temperature Range	-40 to 300°F (-40 to 149°C)	
Velocity Range	0.1 to 40 fps (0.04 to 12.19 mps)	
Flow Sensitivity	0.05 fps (0.02 mps)	
Piping Conditions		
Pipe Diameter Range	Volumetric indication	1 to 100" (25 to 2540 mm) diameter
Pipe	Including, but not limited to, carbon steel, stainless steel, ductile iron, cast iron, FRP, PVC, fiberglass, Teflon®, and most concrete-lined or coated pipes	
Pipe Lining	Including, but not limited to, tar, epoxy, mortar, rubber, Teflon®, PVC, and glass	
Measurement Accuracy		
Accuracy **Note: Accuracy is a function of flow profile.**	Typically ±1% to ±3% of full scale, based on straight run of piping of 20 diameters upstream and 10 diameters downstream	
	±3% to ±5% of full scale based on straight run of 10 diameters upstream and 5 diameters downstream	
	±5% to ±10% of full scale based on straight run of 5 diameters upstream and 3 diameters downstream	
Linearity	±0.5% of full scale	
Repeatability	±0.1% of full scale	
Response Time	≤ 1 sec	
Electronics Enclosure		
Dimensions	9.21” (H) x 7.21" (W) x 5.09" (D) (285 mm x 183 mm x 129 mm)	
Weight	12 lb (5.45 kg)	
Materials	Flame-retardant, fiberglass-reinforced polyester with lockable latch, gray in color	
Environmental Rating	NEMA 4X (IP65)	
Ambient Temperature Range	-13 to 132°F (-25 to 55°C)	
Ambient Humidity	< 100% RH	

Sono-Trak® Doppler

Specifications (continued)

Transducers		
Dimensions	Transducer heads	4.85" (L) x 1.33" (W) x 1.35" (D) (123 mm x 33.8 mm x 34.3 mm)
	Digitizer	4.45" (L) x 2.50" (W) x 1.10" (D) (113 mm x 63.5 mm x 28 mm)
Weight	2.3 lb (1 kg)	
Housing Material	Cast aluminum	
Mounting	Mount to the outside of pipe by means of stainless straps, nylon belts, or bungee and steel chain	
Crystal Wedge Material	Epoxy resin (all transducer models)	
Environmental Rating	NEMA 6 (IP67)	
Ambient Temperature Range	-4 to 130°F (-20 to 54°C)	
Ambient Humidity	< 100% RH	
Transducer Cable		
Standard Cable	25' (7.6 m), 2 twisted pairs, 24 AWG, belfoil shield Note: Custom cable lengths are available.	
Maximum cable length	5000' (1524 m)	
Power		
Fixed Units	110 VAC or 220 VAC at 50/60 Hz (AC line voltage selectable via internal selector switch)	
	12 VDC (DC operation enabled by internal selector switch)	
Portable Units	Internal gel-cell, 8-hour continuous operation; built-in battery Recharge time is 12 hours using the external power adapter/charger or DC auto cigarette lighter.	
Power Adapter/Charger	Standard adapter	115 VAC, 50/60 Hz (± 10%) input delivering 12 VDC, 500 mA output
	Optional adapter	230 VAC, 50/60 Hz (± 10%) input delivering 12 VDC, 500 mA output
Power Consumption	10 W typical	
Analog Output Signal	4 to 20 mA DC, 700 maximum load resistance, internally fused, active output	
Alarm Output	When on AC power	15 VDC = Active alarm
		High alarm switched +15 VDC, 500 mA
		Low alarm switched +15 VDC, 500 mA
	When on battery power	12 VDC = Active alarm
		High alarm switched +12.0 VDC, 500 mA
		Low alarm switched +12.0 VDC, 500 mA
Power Failure Backup	An internal super-capacitor allows the electronics assembly to retain all parameter information and current totalizer value for up to ten days.	

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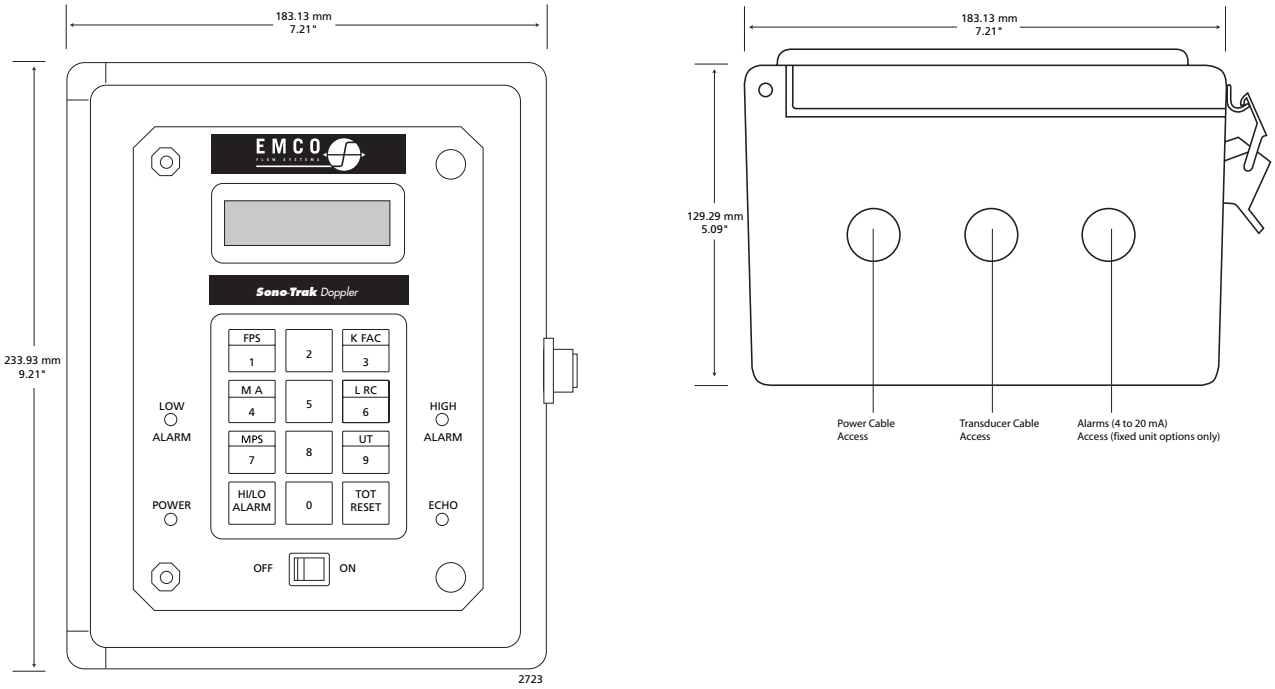
Sono-Trak® Doppler

Specifications (continued)

Standard Interface		
LCD Display	2-line, 16 characters per line, high resolution	
LED Indicators	Yellow	Echo signal received
	Red	High alarm or low alarm activated
	Green	Power available
Keypad	12 keys, tactile feedback *Note: Keypad lockout is available through internal switch.*	
Display Panel	Rate selection	
	Totalizer selection	
	K factor selection	
	Analog output set	
	Low-flow cutoff set	
	Update time (damping) set	
	High/low alarm set	
	Fps or mps selection	
	Totalizer reset	
Output Setting Function	4 to 20 mA output scaling (set in velocity from keypad)	
Alarm Setting Function	High and low alarm set points (entered in velocity from keypad)	
Rate Indication	4-digit LCD, velocity or volume (user selectable)	
	English units	Feet per second (fps), gallons per minute (gpm), cubic feet per second, and million gallons per day *Note: Gallons refers to U.S. gallons.*
	Metric units	Meters per second (mps), liters per second (lps), and cubic meters per second
Totalizer Indication	11-digit LCD	
	English units	Gallons, cubic feet, acre feet, and millions of gallons *Note: Gallons refers to U.S. gallons.*
	Metric units	Liters and cubic meters
Update Time (Damping)	0 to 99 sec, entered from keypad	
Low-Flow Cutoff	0 to 2.5 fps (0 to 0.76 mps), entered from keypad	
K Factor	A value of 1 to 256, entered from the keypad depending upon sensor type; default is 90 Hz (correction factor)	
Totalizer Reset	Totalizer can be manually reset to zero from the keypad.	

Sono-Trak® Doppler

Figure 4-1: Dimensions



Fixed and Portable Models

The Sono-Trak® Doppler flow meter is available in fixed, wall-mounted models or portable models.

Fixed Sono-Trak® Doppler Inclusions	
C5F Model **Part Number 3153140-001**	1 set of electronics in a NEMA 4X case with an LCD display
	2 transducers with 25' (7.6 m) of cable
	Transducer tiedown kit
	Sonic coupling gel
	Operating manual
Portable Sono-Trak® Doppler Inclusions	
C5P Model **Part Number 3153141-001**	1 set of electronics in a NEMA 4X case with an LCD display
	2 transducers with 25' (7.6 m) cable
	Transducer tiedown kit
	Sonic coupling gel
	Operating manual
	12 V, 2.2 AH battery
	120 VAC battery charger
	NEMA enclosure with tote handle and side latch
	Field transport case

UniMag® M Magnetic Flow Tubes
Electromagnetic Flow Meter for Standard Media and Conditions

Description

EMCO UniMag® M flow meters are comprised of the flow tube (spool piece), sensors and junction box. UniMag M flowtubes have no liner, and therefore have no risk of failure due to a defective liner.

Each sensor includes an exciter coil and reference coil. Voltage is generated in the flow tube by the media in accordance with Faraday's Law, from which volumetric flow is calculated.

Features

EMCO's UniMag® M Magnetic Flow Meter System specifically meets the requirements of the Water and Wastewater industry. The complete M system consists of a patented UniMag® flow meter assembly and a remote 4411e transmitter.

- Totally encapsulated sensor components
- No liner; M flow tubes are fusion bonded epoxy coated and approved by NSF61 and AWWA C213 for drinking water
- No liner means no meter failure due to a defective liner
- Low conductivity media > 0.8 µS/cm
- Patented AC coil excitation (high coil current and high pulsation frequency)
- Field replaceable sensors
- Sensor reference coils
- Internal grounding electrodes
- Carbon steel flow tubes for powerful magnetic field retention
- Accuracy unaffected by media coatings such as calcium carbonate, raw sewage, grease, algae and similar
- High signal-to-noise ratio for immunity to media noise

Application Guide

		Temperature Range		Maximum Pressure[1]		Notes
		°F	°C	psi	bar	
Coating	**Fusion Bonded Epoxy**	-40 to 240	-40 to 116	based on sensor		Conforms to USA National Sanitation Foundation Standard NSF61 and AWWA Standard C213 for drinking water.
Sensors	**PVDF (2" - 14" / 50 - 350mm)**	240 max.	116 max.	150	10	Full vacuum capability. Temperature rating is for water and may be lower for other media. PVDF is approved by the US FDA #21 CFR 177.2510
Sensor Notes	Sensor assembly includes a non-wetted carbon steel cover flange, fusion bonded polyethylene protected. Sensor assemblies are supplied with outer cover flanges, 50 feet (15m) cables, re-enterable potting gel, junction box, conduit and stainless steel bolts. Special length cable on request. Standard 2-year warranty against material defects and bad workmanship, not including media compatibility, erosion and abrasion, or for media > 180ºF / 80ºC.					

1 Maximum pressure at maximum temperature with appropriate connection.

UniMag® M Magnetic Flow Tubes
Electromagnetic Flow Meter for Standard Media and Conditions

Media Conductivity

Typical required conductivity: ≥ 5 µS/cm (5 micromhos/cm)
Low conductivity option: for conductivities > 0.80 or < 5 µS/cm use the UniMag® pre-amplifier option
For deionized, distilled or demineralized water, consult EMCO.

Performance Specifications

Accuracy and Traceability	
DTM Accuracy Flow Tubes 2" to 6" (50mm to 150mm)	±0.5% of rate for flows ≥ 2 fps (0.6 m/s) ±0.0075 fps (± 0.00225 m/s) for flows < 2 fps (0.6 m/s)
DTM Accuracy Flow Tubes 8" to 14" (200mm to 350mm)	±0.5% of rate for flows ≥ 2.0 fps (0.45 m/s) ±0.0075 fps (± 0.00225 m/s) for flows < 2.0 fps (0.6 m/s)
Traceability	Accuracy is traceable to the National Institute of Science and Technology. A NIST traceable Calibration Certificate is provided with each flow tube.
Accuracy Notes	Accuracy is unaffected by electrode coatings such as sewage, grease, calcium carbonate, algae or similar.

1 For media such as ferric chloride, ferric sulfate (Odophos) or similar highly conductive media, flow meter performance can be adversely affected. Please consult EMCO for these types of applications, otherwise performance guarantee is null and void.

Operating Specifications: 2-6" (50 to 150 mm)

Flow Range	Minimum	Maximum	Notes
ft/s and m/s	2 ft/s (0.6 m/s)	32 ft/s (9.75 m/s)	
gpm	$4.896D^2$ gpm	$78.34D^2$ gpm	Where D is the I.D. of the pipe in inches.
m^3/h	$.00172D^2$ m^3/hr	$.02757D^2$ m^3/hr	Where D is the I.D. of the pipe in millimeters.

Operating Specifications: 8-14" (200 to 350mm)

Flow Range	Minimum	Maximum	Notes
fps and m/s	2 ft/s (0.6 m/s)	32 ft/s (9.75 m/s)	
gpm	$3.672D^2$ gpm	$78.34D^2$ gpm	Where D is the I.D. of the pipe in inches.
m^3/h	$.00129D^2$ m^3/hr	$.02757D^2$ m^3/hr	Where D is the I.D. of the pipe in millimeters.

Power Requirements for 4411e Flow Transmitter

Power Supply Options	120V, 60Hz	230V, 50Hz	120V, 50Hz
Analog Output	2 x 4-20 mA 2-wire system		
Pulse Output	2-wire potential-free output		

Physical Specifications

Materials of Construction	Flanges and flow tubes: Carbon steel. Flanges have stainless steel retention bolts.
Flange Notes	Maximum pressure and temperature rating of the flow tube may be limited by the flange type selected. Flow tubes can be specially ordered with plain ends or with butt weld ends.
Installation	NEMA 6/IP68 indefinitely submersible to 30 foot water column up to 175°F (80°C)
Process Connections	ANSI 150 RF

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UniMag® M Magnetic Flow Tubes
Electromagnetic Flow Meter for Standard Media and Conditions

Measurable Flow Rates at 0.5% Accuracy

Line Size		Minimum Flow Rate Velocity		Maximum Flow Rate Velocity		Maximum Pressure
inches	mm	fps	gpm	fps	gpm	psi
2	**50**	2	21	32	335	150
3	**80**	2	46	32	737	150
4	**100**	2	79	32	1,270	150
6	**150**	2	180	32	2,882	150
8	**200**	2	312	32	4,990	150
10	**250**	2	492	32	7,865	150
12	**300**	2	705	32	11,280	150
14	**350**	2	860	32	13,753	150

Straight Run Piping Requirements

Piping	Upstream	Downstream	Upstream	Downstream
Minimum requirement	5 D	3 D	5 D	3 D
Single elbow or tee upstream	10 D	5 D	5 D	3 D
Two elbows, coupled in the same plane	10 D	5 D	5 D	3 D
Two elbows, close coupled and out of plane	20 D	5 D	10 D	3 D
Pump, blending point, control valve upstream	30 D	5 D	20 D	3 D
Pump, control valve downstream	10 D	5 D	10 D	5 D

D is equal to the internal diameter of the pipe

Other Installation Considerations

Mounting Recommendations
The UniMag may be mounted into a pipeline in any attitude, taking note of the flow direction arrow on the flow tube. To obtain accurate measurement, the pipe must be completely full and air must not be entrained in the flow.

Straight Run Requirements
For particularly poor velocity profiles caused, for example, by upstream bends in two or more planes or partially open valves, the UniMag M DTM requires a minimum of 10 pipe diameters of straight pipe upstream from the flow tube, and a minimum of 5 diameters downstream.

Non-Homogenous Media
For particularly non-homogenous slurries, pulps or pastes, the flow tube should be mounted in a vertical pipe to obtain the most even distribution of solids and fibers. There must be a minimum of 20 pipe diameters between any media mixing point and the UniMag M flow tube.

Partially Closed Valves
If the piping is horizontal and includes a partially closed valve, the valve should always be installed downstream of the UniMag. This will allow the head pressure in the system to be adjusted, reducing the chance of air entrainment in the flow, and will prevent excessive irregular profiles forming upstream of the flow tube.

Vacuum Conditions
The fusion bonded epoxy coating on UniMag M flow tubes is suitable for vacuum conditions caused, for example, by a pump downstream from the flow tube.

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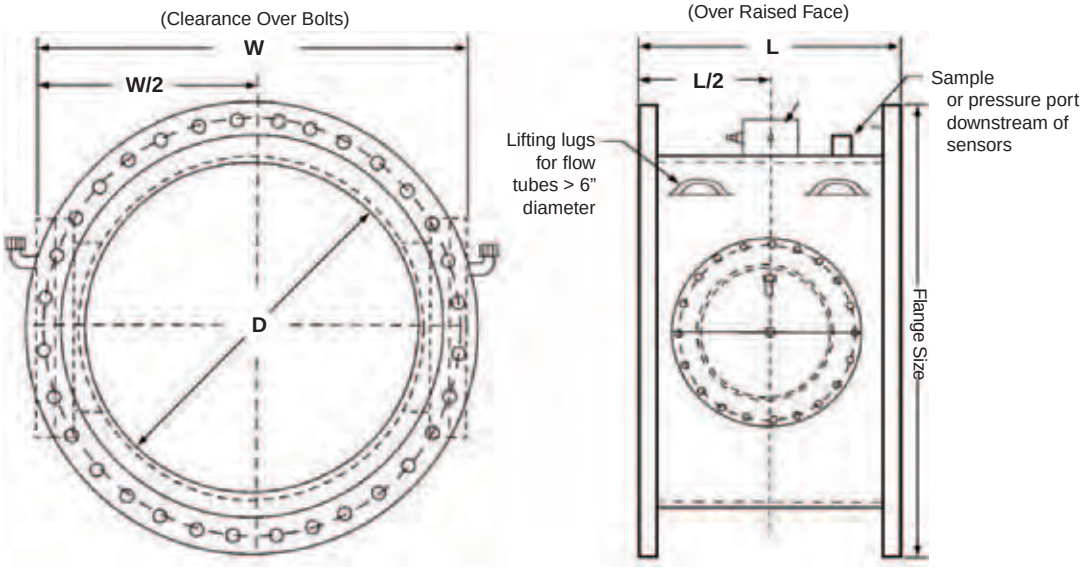
UniMag® M Magnetic Flow Tubes
Electromagnetic Flow Meter for Standard Media and Conditions

Dimensions and Weights



Nominal Size D		Dimension L*		Dimension W		Approximate Weight	
Inches	mm	Inches	mm	Inches	mm	LB	KG
2	50	10	250	9	250	35	16
3	80	10	250	11	250	45	20
4	100	12	300	12	300	65	30
6	150	12	300	15	350	84	38
8	200	18	450	21	550	185	84
10	250	18	450	24	600	225	102
12	300	18	450	26	650	301	137
14	350	18	450	27	700	335	152

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UniMag® M Magnetic Flow Tubes
Electromagnetic Flow Meter for Standard Media and Conditions

Model and Suffix Codes Items in Grey Highlight are normally stocked and have standard lead times.

Category	Description										
UniMag® M	UniMag® M		DTM	. . .		. . .	. . .	. . .	. . .	. . .	. . .
Line Size	2	50	. . .	02	. . .	. . .	. . .	. . .	. . .	. . .	. . .
2-14" (50-350mm)	3	80	. . .	03	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	4	100	. . .	04	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	6	150	. . .	06	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	8	200	. . .	08	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	10	250	. . .	10	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	12	300	. . .	12	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	14	350	. . .	14	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Flowtube/Flange	Carbon Steel Flowtube and Flanges				C	. . .		. . .	. . .	. . .	. . .
Sensors, seals, gaskets	PVDF Sensor, Elastomer Gaskets, Viton Electrode Seals ≤ 16" (400mm)					E	. . .	. . .	. . .	. . .	. . .
Electrodes/Grounding	AISI 316 Stainless Steel Electrodes and Grounding					. . .	T	. . .	. . .	. . .	. . .
Flowtube liner/coating	Fusion Bonded Epoxy inside and outside (note 1)					. . .	. . .	X	. . .	. . .	. . .
Installation	Indefinitely submersible to 30 ft. (10m) water column to NEMA 6/IP68 with 50 ft cables (15m)					. . .	. . .	. . .	R	. . .	. . .
	Extra cable length (up to 150ft max.)					. . .	. . .	. . .	E	. . .	. . .
Process connections	ANSI 150rf Process Flanges						. . .	. . .	. . .	1	. . .
Coil Supply	120V Coils					. . .	. . .	. . .	. . .	. . .	A
	EXAMPLE	**DTM**		**03-**	**C-**	**E-**	**T-**	**X-**	**R-**	**1-**	**A**

NOTES:

1. Approved by NSF61 and AWWA C213 for drinking water.

2. 4411e transmitter must be ordered, as a separate line item, and is included in the price.

3. All flowtubes will be supplied with a 3/4" sample port. The plug is made of brass.

4. Currently, EMCO products are NOT PED approved for sales into European Union countries.

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UniMag® DT Series Electromagnetic Flow Tubes

Description

EMCO's UniMag® DT Magnetic Flow Meter System consists of the patented UniMag Flow Tube and 4411e Transmitter. UniMag sensors are unique because they do not require a liner and can be replaced in the field.

EMCO UniMag® DT flow meters are comprised of the flow tube (spool piece), sensors and junction box. Liner options are available but are not necessary for operation.

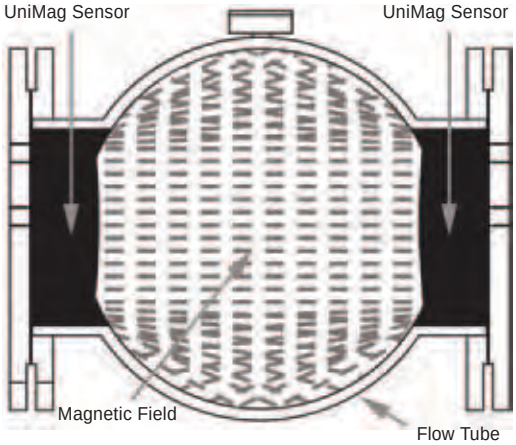
Each sensor includes an exciter coil and reference coil. Voltage is generated in the flow tube by the media in accordance with Faraday's Law, from which volumetric flow is calculated.

UniMag® DT

Features

- Totally encapsulated sensor components
- No liner required for flow tube operation; liners available for abrasive media
- Low conductivity media > 0.08 µS/cm
- Patented AC coil excitation (high coil current and high pulsation frequency)
- Large conical electrodes to project through non-fluidic coatings
- Field replaceable sensors
- Inherent redundancy from multiple sensors
- Sensor reference coils
- Internal grounding electrodes
- Flow tubes can be manufactured to any length
- Various flow tube materials, including carbon steel for powerful magnetic field retention
- Accuracy unaffected by media coatings such as calcium carbonate, raw sewage, grease, algae and similar
- High signal-to-noise ratio for immunity to media noise

UniMag Sensor
UniMag Sensors are completely encapsulated, solid-state, and do not depend on a liner for insulation.



UniMag Magnetic Field
Large UniMag sensors create a magnetic field over the entire flow tube cross section. The flow signal represents the true weighted velocity of the media and is highly insensitive to velocity profile distortion and swirl effects.

UniMag® DT Series Electromagnetic Flow Tubes

Application Guide

	Temperature Range		Maximum Pressure[1]		Notes
	°F	°C	psi	bar	
Liners and Coatings					
Fusion Bonded Epoxy	-40 to 240	-40 to 116	based on sensor		Conforms to USA National Sanitation Foundation Standard NSF61 and AWWA Standard C213 for drinking water.
Polyurethane[2]	175 max.	80 max.	based on sensor		Conforms to NSF61 and AWWA C213 for drinking water. Heavy duty polyurethane is suitable for mining slurries and similar media.
Tefzel™	240 max.	115 max.	based on sensor		Temperatures based on water. Not recommended for high vacuum applications. Other media may reduce this temperature.
Ryton™	250 max.	121 max.	based on sensor		Used for paper mill liquors, lime muds and similar high conductivity media.
Sensors					
Polyurethane	175 max.	80 max.	150	10	Conforms to NSF61 and AWWA C213 for drinking water.
PVDF	240 max.	115 max.	150	10	Full vacuum capability. Temperature rating is for water and may be lower for other media. PVDF is approved by the US FDA #21 CFR 177.2510
UHMWPE	175 max.	80 max.	150	10	
PEEK	250 max.	121 max.	356	25	Full vacuum capability.
Sensor Notes	Sensor assembly includes a non-wetted carbon steel cover flange, fusion bonded polyethylene protected. Sensor assemblies are supplied with outer cover flanges, 30 feet (10m) cables, re-enterable potting gel, junction box, conduit and stainless steel bolts. Special length cable on request. Standard 2-year warranty against material defects and bad workmanship, not including media compatibility, erosion and abrasion, or for media > 180ºF / 80ºC.				

1 Maximum pressure at maximum temperature with appropriate connection.

2 Temperature differential between process and ambient limited to 140ºF / 60ºC for polyurethane sensor, and 212ºF / 100ºC for PVDF sensor.

Media Conductivity

Typical required conductivity: > 1 µS/cm (1 micromho/cm)
Low conductivity option: for conductivities > 0.08 or < 5 µS/cm use the UniMag pre-amplifier option
For deionized, distilled or demineralized water, consult EMCO.

Performance Specifications

Accuracy and Traceability	
Accuracy	±0.5% of rate for flows ≥ 1.5 fps (0.45 m/s) ±0.0075 fps (± 0.00225 m/s) for flows < 1.5 fps (0.45 m/s)
Traceability	Accuracy is traceable to the National Institute of Science and Technology. A NIST traceable Calibration Certificate is provided with each flow tube.
Accuracy Notes	Accuracy is unaffected by electrode coatings such as sewage, grease, calcium carbonate, algae or similar.

1 For media such as ferric chloride, ferric sulfate (Odophos) or similar highly conductive media, flow meter performance can be adversely affected. Please consult EMCO for these types of applications, otherwise performance guarantee is null and void.

UniMag® DT Series Electromagnetic Flow Tubes

Operating Specifications - 2-36" (50 to 900 mm)

Flow Range	Minimum	Maximum	Notes
ft/s and m/s	1.5 ft/s (.4572 m/s)	32 ft/s (9.75 m/s)	
gpm	$3.672D^2$ gpm	78.34D2 gpm	Where D is the I.D. of the pipe in inches
m3/hr	$.00129D^2$ m3/hr	.02757D2 m3/hr	Where D is the I.D. of the pipe in millimeters

Power Requirements for 4411e Flow Transmitter

Power Supply Options	120V, 60Hz 230V, 50Hz 120V, 50Hz
Analog Output	2 x 4-20 mA 2-wire system
Pulse Output	2-wire potential-free output

Physical Specifications

Materials of Construction	Flanges and flow tubes: Carbon steel, 316 stainless steel or HDPE (high density polyethylene)
Flange Notes	Maximum pressure and temperature rating of the flow tube may be limited by the flange type selected. Flow tubes can be specially ordered with plain ends or with butt weld ends. For pressure and temperature ratings of HDPE flow tubes, consult EMCO.
Installation Options	NEMA 6/IP68 indefinitely submersible to 30 foot water column up to 175°F (80°C) NEMA 4X/IP65 for temperatures greater than 175°F (80°C) Entela approved to NEC/CSA Class 1, Division 2, Groups C, D, Temp. T4 Entela approved to ATEX Zone 2 explosive atmospheres
Process Connections	ANSI 150 RF (<28 in.); ANSI/AWWA C207 Class D FF (≥28 in.) ANSI 300 RF AWWA FF (specify class) DIN/BS4504 PN6 DIN/BS4504 PN10 DIN/BS4504 PN16 JIS10krf BS/AS2129 Table D BS/AS2129 Table E

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UniMag® DT Series Electromagnetic Flow Tubes

Measurable Flow Rates at 0.5% Accuracy

Line Size		Minimum Flow Rate Velocity		Maximum Flow Rate Velocity		Maximum Pressure
inches	mm	fps	gpm	fps	gpm	psi
2	**50**	1.5	16	32	335	150
3	**80**	1.5	35	32	737	150
4	**100**	1.5	60	32	1,270	150
6	**150**	1.5	135	32	2,882	150
8	**200**	1.5	234	32	4,990	150
10	**250**	1.5	369	32	7,865	150
12	**300**	1.5	529	32	11,280	150
14	**350**	1.5	645	32	13,753	150
16	**400**	1.5	854	32	18,218	150
18	**450**	1.5	1,093	32	23,310	150
20	**500**	1.5	1,361	32	29,028	150
24	**600**	1.5	1,985	32	42,345	150
28	**700**	1.5	2,727	32	58,169	140
30	**760**	1.5	3,142	32	67,021	
32	**800**	1.5	3,586	32	76,500	
36	**900**	1.5	4,563	32	97,337	90

Straight Run Piping Requirements

Piping	Upstream	Downstream
Minimum requirement	5 D	3 D
Single elbow or tee upstream	5 D	3 D
Two elbows, coupled in the same plane	5 D	3 D
Two elbows, close coupled and out of plane	10 D	3 D
Pump, blending point, control valve upstream	20 D	3 D
Pump, control valve downstream	--	5 D

D is equal to the internal diameter of the pipe

UniMag® DT Series Electromagnetic Flow Tubes

Other Installation Considerations

Mounting Recommendations
The UniMag may be mounted into a pipeline in any attitude, taking note of the flow direction arrow on the flow tube. To obtain accurate measurement, the pipe must be completely full and air must not be entrained in the flow.

Straight Run Requirements
For particularly poor velocity profiles caused, for example, by upstream bends in two or more planes or partially open valves, the UniMag DT requires a minimum of 10 pipe diameters of straight pipe upstream from the flow tube, and a minimum of 5 diameters downstream.

Non-Homogenous Media
For particularly non-homogenous slurries, pulps or pastes, the flow tube should be mounted in a vertical pipe to obtain the most even distribution of solids and fibers. There must be a minimum of 20 pipe diameters between any media mixing point and the UniMag DT flow tube.

Partially Closed Valves
If the piping is horizontal and includes a partially closed valve, the valve should always be installed downstream of the UniMag. This will allow the head pressure in the system to be adjusted, reducing the chance of air entrainment in the flow, and will prevent excessive irregular profiles forming upstream of the flow tube.

Vacuum Conditions
For vacuum conditions caused, for example, by a pump downstream from the UniMag flow tube, use internally coated fusion bonded epoxy, or no liner at all. For full vacuum, use PEEK sensors only.

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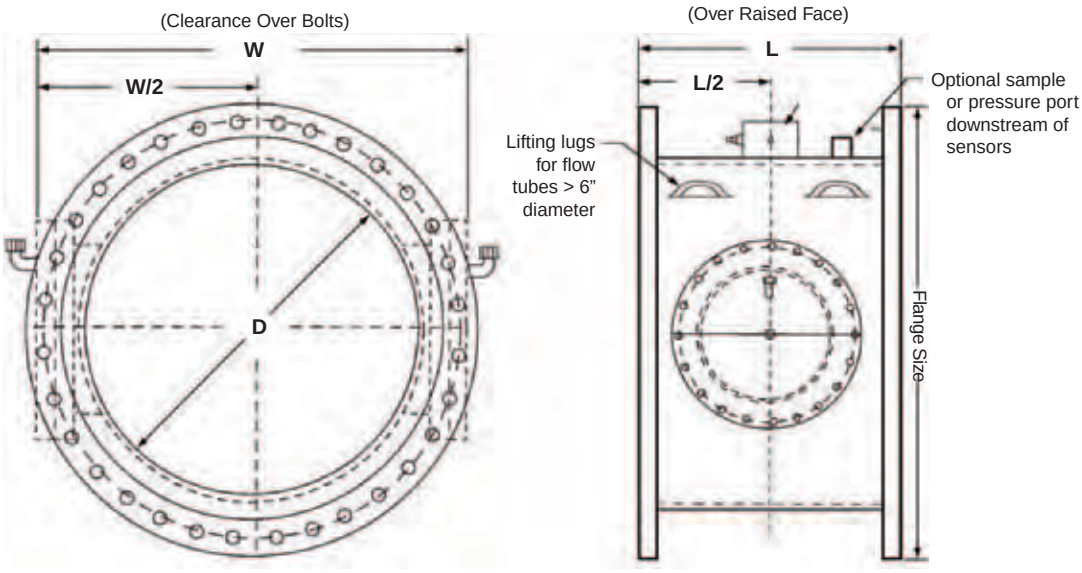
UniMag® DT Series Electromagnetic Flow Tubes

Dimensions and Weights



Nominal Size D		Dimension L*		Dimension W		Approximate Weight	
Inches	mm	Inches	mm	Inches	mm	LB	KG
2	50	10	250	13	250	35	16
3	80	10	250	14	250	45	20
4	100	12	300	16	300	65	30
6	150	12	300	19	350	84	38
8	200	18	450	21	550	185	84
10	250	18	450	24	600	225	102
12	300	18	450	26	650	301	137
14	350	18	450	27	700	335	152
16	400	20	500	30	750	490	223
18	450	20	500	32	800	515	234
20	500	20	500	35	900	615	280
24	600	24	600	39	1000	840	382
28	700	30	800	42	1000	980	445
30	750	30	800	44	1100	1280	582
32	800	30	800	46	1150	1310	595
36	900	30	800	50	1300	1625	739

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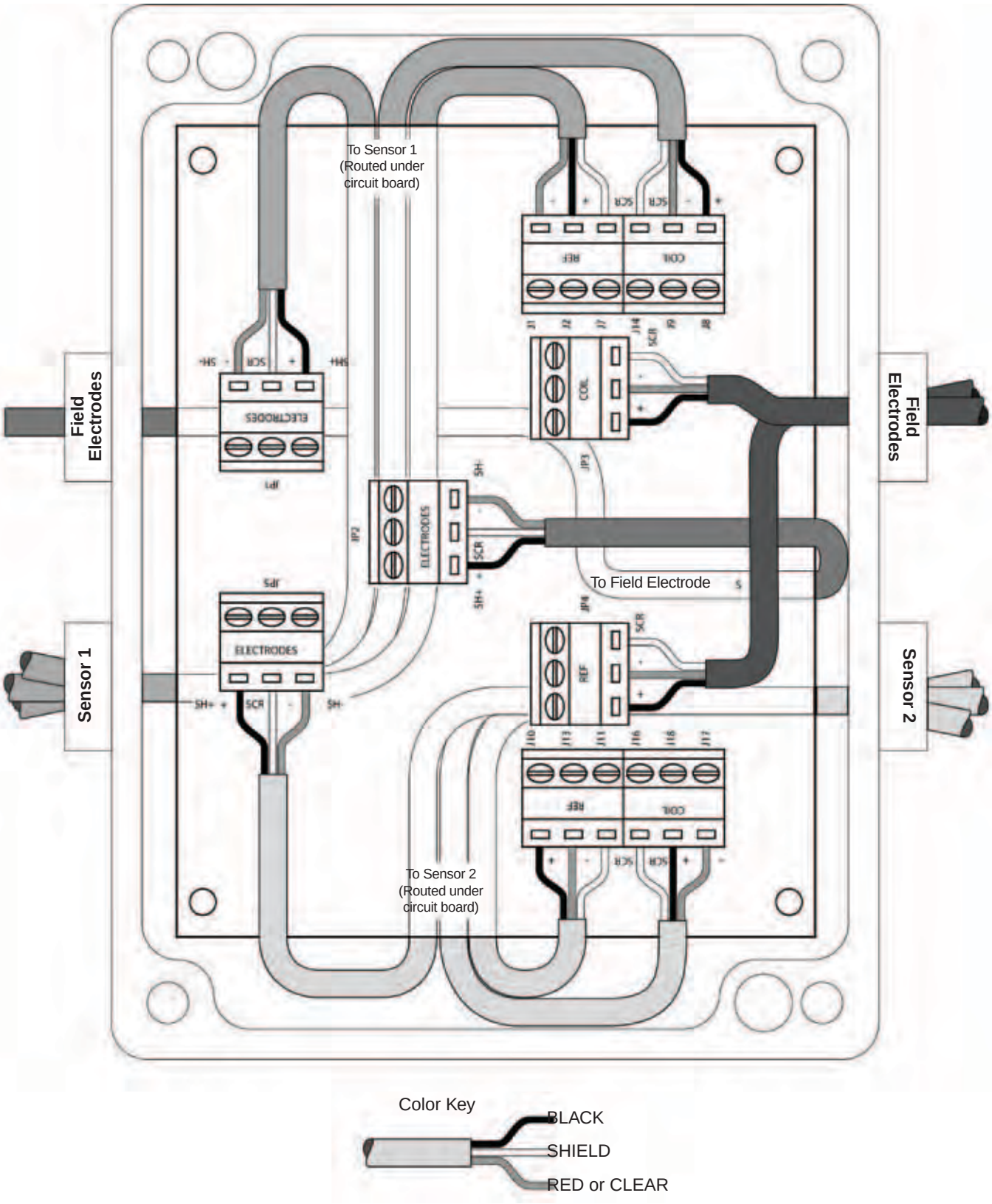
UniMag® DT Series Electromagnetic Flow Tubes

Wiring Diagrams - Junction Box Wiring (1 or 2 Sensors)



UniMag® DT Series Electromagnetic Flow Tubes

Model and Suffix Codes (Items in Grey Highlight are normally stocked and have standard lead times.)

Category	Description													
Type	DT Type Flowtube: Multiple Sensors				DT	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Line Size	2	50				02	. . .	. . .	. . .	. . .	. . .	. . .		
	3	80				03	. . .	. . .	. . .	. . .	. . .	. . .		
	4	100				04	. . .	. . .	. . .	. . .	. . .	. . .		
	6	150				06	. . .	. . .	. . .	. . .	. . .	. . .		
	8	200				08	. . .	. . .	. . .	. . .	. . .	. . .		
	10	250				10	. . .	. . .	. . .	. . .	. . .	. . .		
	12	300				12	. . .	. . .	. . .	. . .	. . .	. . .		
	14	350				14	. . .	. . .	. . .	. . .	. . .	. . .		
	16	400				16	. . .	. . .	. . .	. . .	. . .	. . .		
	18	450				18	. . .	. . .	. . .	. . .	. . .	. . .		
	20	500				20	. . .	. . .	. . .	. . .	. . .	. . .		
	24	600				24	. . .	. . .	. . .	. . .	. . .	. . .		
	28	700				28	. . .	. . .	. . .	. . .	. . .	. . .		
	30	760				30	. . .	. . .	. . .	. . .	. . .	. . .		
	32	800				32	. . .	. . .	. . .	. . .	. . .	. . .		
	36	900				36	. . .	. . .	. . .	. . .	. . .	. . .		
Flowtube/Flange	Carbon Steel (Water & Waste)					. . .	C	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Materials	316 Stainless Steel Flowtube, Carbon Steel Flanges					. . .	A	. . .	. . .	. . .	. . .	. . .	. . .	. . .

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UniMag® DT Series Electromagnetic Flow Tubes

Model and Suffix Codes (Items in Grey Highlight are normally stocked and have standard lead times.)

Category	Description													
Materials (cont.)	All AISI 316 Stainless Steel					. . .	T	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	Non-Standard Pipewall Thickness					. . .	W	. . .	. . .	. . .	. . .	. . .	. . .	. . .
	Sensor	Gasket	Seal	Line Size										
Sensor, Gasket, and Seal Materials by line size (note 1,5)	PVDF	Elastomer	Viton	2-14" (50-350mm)				E	. . .	. . .	. . .	. . .	. . .	. . .
	PVDF	Teflon	Viton	2-14" (50-350mm)				D	. . .	. . .	. . .	. . .	. . .	. . .
	Polyurethane	Elastomer	Viton	> 16" (400mm)				P	. . .	. . .	. . .	. . .	. . .	. . .
	PVDF	Teflon	Kalrez	2-14" (50-350mm)				F	. . .	. . .	. . .	. . .	. . .	. . .
	Peek	Klinger	Chemraz	2-14" (50-350mm)				K	. . .	. . .	. . .	. . .	. . .	. . .
	PVDH	Elastomer	Viton	2-14"(50-350mm) (note 5)CONCAVE				U	. . .	. . .	. . .	. . .	. . .	. . .
	Peek	Klinger	Fused	2-14" (50-350mm) (note 2)				H	. . .	. . .	. . .	. . .	. . .	. . .
	Polyurethane	Elastomer	Viton	> 16" (400mm) CONCAVE				C	. . .	. . .	. . .	. . .	. . .	. . .
	Special							S	. . .	. . .	. . .	. . .	. . .	. . .
Electrodes (note 3)	AISI 316 Stainless Steel (Water & Waste)					. . .	. . .	. . .	T	. . .	. . .	. . .	. . .	. . .
	Hastelloy B					. . .	. . .	. . .	B	. . .	. . .	. . .	. . .	. . .
	Hastelloy C					. . .	. . .	. . .	C	. . .	. . .	. . .	. . .	. . .
	Titanium					. . .	. . .	. . .	I	. . .	. . .	. . .	. . .	. . .
	Tantalum					. . .	. . .	. . .	A	. . .	. . .	. . .	. . .	. . .
Flowtube liners and Coatings	Fusion Bonded Epoxy Coating Inside and outside					. . .	. . .	. . .	. . .	X	. . .	. . .	. . .	. . .
	Heavy Duty Polyurethane inside, Epoxy Enamel outside (note 7)					. . .	. . .	. . .	. . .	M	. . .	. . .	. . .	. . .
	Heavy Duty Tefzel (ETFE) (note 8)					. . .	. . .	. . .	. . .	Z	. . .	. . .	. . .	. . .
	No Coating inside, Fusion Bonded Epoxy outside (note 9)					. . .	. . .	. . .	. . .	N	. . .	. . .	. . .	. . .
	Ryton Coated inside, Epoxy Enamel outside (note 18)					. . .	. . .	. . .	. . .	R	. . .	. . .	. . .	. . .
Installation	50 feet (15m) cables NEMA 6/IP68 (note 14)					. . .	. . .	. . .	. . .	. . .	R	. . .	. . .	. . .
	Extra length cables (>150ft add pre-amp)					. . .	. . .	. . .	. . .	. . .	E	. . .	. . .	. . .

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UniMag® DT Series Electromagnetic Flow Tubes

Model and Suffix Codes (Items in Grey Highlight are normally stocked and have standard lead times.)

Category	Description													
Process	ANSI 150 RF (<28",700mm) ANSI/AWWA C207 Class D FF (> 28", 700mm)											1	. . .	. . .
Connections	ANSI 300 RF					. . .	. . .	. . .	. . .	. . .	. . .	2	. . .	. . .
and Flanges	DIN/BS4054 PN 6					. . .	. . .	. . .	. . .	. . .	. . .	4	. . .	. . .
	DIN/BS4504 PN 10 (note 12)					. . .	. . .	. . .	. . .	. . .	. . .	5	. . .	. . .
	DIN/BS4504 PN 16 (note 12)					. . .	. . .	. . .	. . .	. . .	. . .	6	. . .	. . .
	Special					. . .	. . .	. . .	. . .	. . .	. . .	S	. . .	. . .
Options	Pre-Amplifier (note 10)					. . .	. . .	. . .	. . .	. . .	. . .	. . .	A	. . .
	Extra-Long 316 Stainless Steel Electrodes (note 11)					. . .	. . .	. . .	. . .	. . .	. . .	. . .	B	. . .
(note 22)	Special Lay Length (note 20)					. . .	. . .	. . .	. . .	. . .	. . .	. . .	L	. . .
	No Options					. . .	. . .	. . .	. . .	. . .	. . .	. . .	O	. . .
	Special (note 21)					. . .	. . .	. . .	. . .	. . .	. . .	. . .	S	. . .
Coil Supply	120V supply					. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	A
	230V supply					. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	B
				Example	DT-	03-	C-	E-	T-	X-	R-	1-	A-	A

NOTES:

1 For PVDF, PEEK, UHMWPE and Teflon sensors greater than 14 inch (350 mm) diameter, consult EMCO.

3 Extra-Long electrodes are provided for thick, non-fluidic coating applications. Advise Thickness. For other materials, consult EMCO.

5 For highly abrasive materials used with NON COATED internal flowtubes as a lower cost alternative to M (Heavy Duty Polyurethane) liners.

6 Option P (Polyurethane) is intended as an alternative in the Water & Waste industry only to meet inferior engineering specifications. It is not as effective as an X (Fusion Bonded Epoxy) coating and is not intended for abrasive material.

7 Recommended for mining slurries and similar fluids. Please include internal piping diameter of mating pipe so the UniMag® can be manufactured to match.

8 Tefzel is a fusion bonded ETFE, similar to Teflon. It is intended for use with acids or similar non-abrasive, but corrosive media.

9 Non-internally coated flowtubes are intended for use with concave sensors, normally up to 8 inches flowtube diameter, for highly abrasive media. The wear rate of the sensor equals the wear rate of the flowtube. This is a lower cost alternative to M liner flowtubes, but service life is typically 25% less than with an M liner. Their internal diameter must match the i.d. of the mating pipework.

10 A Pre-amplifier is required in the junction box for media conductivity <5 µS/cm or for cables 150 feet (50m) or greater.

11 Extra-long electrodes are provided for thick, non-fluidic coating applications. Advise thickness. For other materials, consult EMCO.

12 Options 5 and 6 have the same dimensions up to 6 inches (150mm).

13 Round all % increases up to the nearest dollar.

14 Indefinitely submersible to 30 foot water column.

15 Water & Waste notifies the recommended standard option for water, raw sewage and similar applications.

16 For media such as ferric chloride, ferric sulphate and similar, consult EMCO.

17 Stainless steel tags (tag number only) available upon request, additional charge.

18 Ryton coating is used for media normally found in the paper industry. We recommend Ryton coating as follows:

_ Maximum 220° F (104°C): Use K sensors with W or X electrodes and grounding

_ Maximum 250° F (176°C): Use H sensors with H electrodes and grounding

19 For acids, always specify % in solution with water and operational temperature range with inquiries.

20 Consult EMCO for non-standard flowtube lengths up to double length.

21 All special orders must include a complete description along with the ordering code. Use 'special' option for combinations.

22 All flowtubes will be supplied with a sample port. For line sizes < 24" (600mm) the sample port will be 3/4", for line sizes >28" (700mm) the sample port will be 1_".

23 Currently, EMCO products are NOT PED approved for sales into European Union countries.

23 4411e is NOT included in the price & must be a separate line item on your order

UniMag DP Series Electromagnetic Flow Tubes

Description

EMCO UniMag DP flow meters are comprised of a PVC flow tube (spool piece), sensors and junction box. DP Series UniMags have no liner, so they will never fail due to liner damage.

Each sensor includes an exciter coil and reference coil. Voltage is generated in the flow tube by the media in accordance with Faraday's Law, from which volumetric flow is calculated.

Features

- Totally encapsulated sensor components
- No liner; no meter failure due to a defective liner
- Low conductivity media > 0.08 mS / cm
- Patented AC coil excitation (high coil current and high pulsation frequency)
- Large conical electrodes to project through non-fluidic coatings
- Field replaceable sensors
- Sensor reference coils
- Internal grounding electrodes
- Polyvinylchloride (PVC) flow tubes for use in plastic piping systems
- Accuracy unaffected by media coatings such as calcium carbonate, raw sewage, grease, algae and similar
- High signal-to-noise ratio for immunity to media noise

UniMag Technology

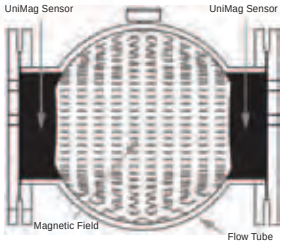
Innovative Sensor Technology

- UniMag sensors include an exciter coil and a reference coil, and are available in various electrically insulative materials.
- A unique electrode design distributes the magnetic field over the flow tube's entire cross section.
- These combined effects, along with a uniquely powerful field strength, provide a truly weighted velocity signal.
- Each sensor includes a reference coil, separate from the exciter coil.

No Liners

- Each UniMag sensor is a complete solid-state insulated magmeter; a liner is not necessary for insulation.
- DP Series UniMags have no liner, therefore will never fail due to a defective liner.

UniMag Sensor
UniMag Sensors are completely encapsulated, solid-state, and do not depend on a liner for insulation.



UniMag Magnetic Field
Large UniMag sensors create a magnetic field over the entire flow tube cross section. The flow signal represents the true weighted velocity of the media and is highly insensitive to velocity profile distortion and swirl effects.

Modular Construction / True Field Repairability

- Sensors can be replaced in the field, meaning minimal downtime and no need to ship the flow tube back to the manufacturer.
- Spare sensors can be kept in stock for easy replacement if needed.
- Output continues if one sensor fails (in a dual-sensor system), with 1% to 3% of rate typical accuracy.
- Costly bypass pumping is unnecessary since sensors can be removed and immediately replaced.

Available With One or Two Sensors

DP Series UniMags are available with one or two sensors. The number of sensors used is based on the following:

- A single sensor is the most cost-effective option. Single sensor flow tubes have virtually the same accuracy as dual sensor tubes; however, single sensor flow tubes have longer straight run piping requirements.
- Dual sensor flow tubes have shorter straight run piping requirements and are less sensitive to velocity profile distortion and swirl effects. Tubes with two sensors also have inherent signal redundancy; the output signal will continue in the rare case of coil failure, with a typical accuracy of 1% to 3% of rate.

UniMag DP Series Electromagnetic Flow Tubes

Application Guide

	Maximum Temperature		Maximum Pressure[1]		Notes
	°F	°C	psi	bar	
Polyvinylchloride (PVC) Flow Tube (No Liner) PVDF Sensors	85	30	80	5.5	Temperature and pressure ratings are based on water. Other media may affect these ratings.
	105	40	60	4	
	140	60	15	1	
Sensor Notes	Sensor assembly includes a non-wetted carbon steel cover flange, fusion bonded polyethylene protected. Sensor assemblies are supplied with outer cover flanges, 50 feet (15m) cables, re-enterable potting gel, junction box, conduit and stainless steel bolts. Special length cable on request. Standard 2-year warranty against material defects and bad workmanship, not including media compatibility, erosion and abrasion, or for media > 180ºF / 80ºC.				

1 Maximum pressure at maximum temperature with appropriate connection.

Media Conductivity

Typical required conductivity: > 1 µS/cm (1 micromho/cm)
Low conductivity option: for conductivities > 0.08 or < 5 µS/cm use the UniMag pre-amplifier option
For deionized, distilled or demineralized water, consult EMCO.

Performance Specifications

Accuracy and Traceability	
Accuracy	±0.5% of rate for flows ≥ 1.5 fps (0.45 m/s) ±0.0075 fps (± 0.00225 m/s) for flows < 1.5 fps (0.45 m/s)
Traceability	Accuracy is traceable to the National Institute of Science and Technology. A NIST traceable Calibration Certificate is provided with each flow tube.
Accuracy Notes	Accuracy is unaffected by electrode coatings such as sewage, grease, calcium carbonate, algae or similar.

1 For media such as ferric chloride, ferric sulfate (Odophos) or similar highly conductive media, flow meter performance can be adversely affected. Please consult EMCO for these types of applications, otherwise performance guarantee is null and void.

Operating Specifications

Flow Range	Minimum	Maximum	Notes
fps and m/s	0 to 2 fps (0 to 6 m/s)	50 fps (15 m/s)	
gpm	0 to $50D^2$ gpm	$120D^2$ gpm	Where D is in inches
m^3/h	0 to $0.0017D^2$ m^3/h	$0.043D^2$ m^3/h	Where D is in millimeters

Power Requirements for 4411e Flow Transmitter

Power Supply Options	120V, 60Hz 230V, 50Hz 120V, 50Hz
Analog Output	2 x 4-20 mA 2-wire system
Pulse Output	2-wire potential-free output

Physical Specifications

Materials of Construction	Flow tubes and flanges: Schedule 80 Polyvinylchloride (PVC) with raised face PVC flanges.
Flange Notes	Maximum pressure and temperature rating of the flow tube may be limited by the flange type selected. Flow tubes can be specially ordered with plain ends or with butt weld ends.
Installation Options	NEMA 6/IP68 indefinitely submersible to 30 foot water column up to 175°F (80°C) NEMA 4X/IP65 for temperatures greater than 175°F (80°C)
Process Connections	ANSI 150 RF DIN/BS4504 PN10 Plain Pipe Ends (Schedule 80)

Measurable Flow Rates at 0.5% Accuracy

Line Size		Minimum Flow Rate Velocity		Maximum Flow Rate Velocity	
inches	mm	fps	gpm	fps	gpm
1.5	40	1.5	15	50	490
2	50	1.5	15	50	490
3	80	1.5	33	50	1,103
4	100	1.5	59	50	1,960
6	125	1.5	132	50	4,410
8	150	1.5	235	50	7,840
10	200	1.5	368	50	12,250
12	250	1.5	529	50	17,640

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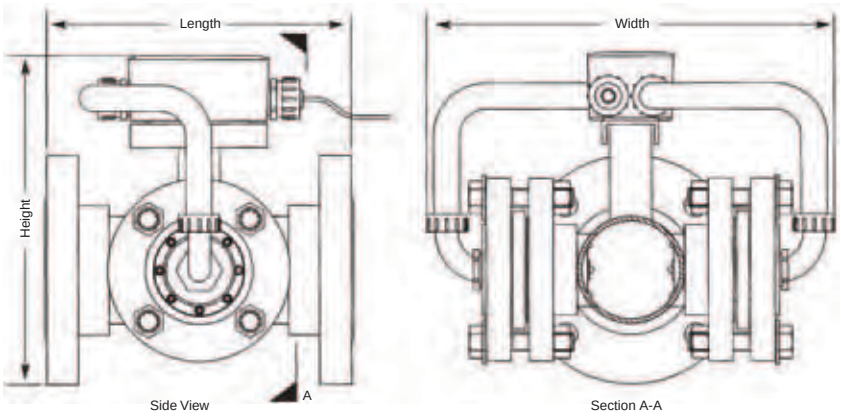
UniMag DP Series Electromagnetic Flow Tubes

Straight Run Piping Requirements

Piping	Upstream / Downstream Piping Requirement	
	1 Sensor	2 Sensors
Minimum requirement	10 D up / 5 D down	5 D up / 3 D down
Single elbow or tee upstream	10 D up / 5 D down	5 D up / 3 D down
Two elbows, coupled in the same plane	10 D up / 5 D down	5 D up / 3 D down
Two elbows, close coupled and out of plane	20 D up / 5 D down	10 D up / 3 D down
Pump, blending point, control valve upstream	30 D up / 5 D down	20 D up / 3 D down
Pump, control valve downstream	5 D down	5 D down

D is equal to the internal diameter of the pipe

Dimensions and Weights



NOTE: For single sensor flowtubes and L dimension remains the same as shown in the table below, and the W dimension in the table value less 2.50 in. (65 mm)

Nominal Size		Dimensions						Weight (Flanged) Double Sensors		Weight (Flanged) Single Sensors	
		Length		Height		Width					
Inches	mm	Inches	mm	Inches	mm	Inches	mm	lb	kg	lb	kg
1½	40	12.00	305	10.00	254	12.00	310	13	6.0	9	4
2	50	10.00	254	10.00	254	12.00	310	14	6.4	10	4.5
2½	65	10.00	254	11.00	280	13.00	330	16	7.3	11	5.0
3	80	10.00	254	11.00	280	13.50	345	18	8.2	12	5.5
4	100	12.00	305	12.00	305	16.00	410	25	11.4	17	8.0
6	150	12.00	305	14.00	360	17.00	435	32	15.0	22	10.0
8	200	20.00	508	16.00	410	18.00	460	58	26.0	40	18.0
10	250	20.00	508	19.00	485	25.00	635	72	33.0	48	22.0
12	300	20.00	508	22.00	560	26.00	660	95	43.0	65	30.0

Notes 1. For flowtubes 6" Ø (150mm) and less having ¾" NPT or 1½" NPT female sampling / pressure ports, the length dimension is increased to 16.00" (406mm).

2. 2½" (40mm) size is only available with 2 sensors.

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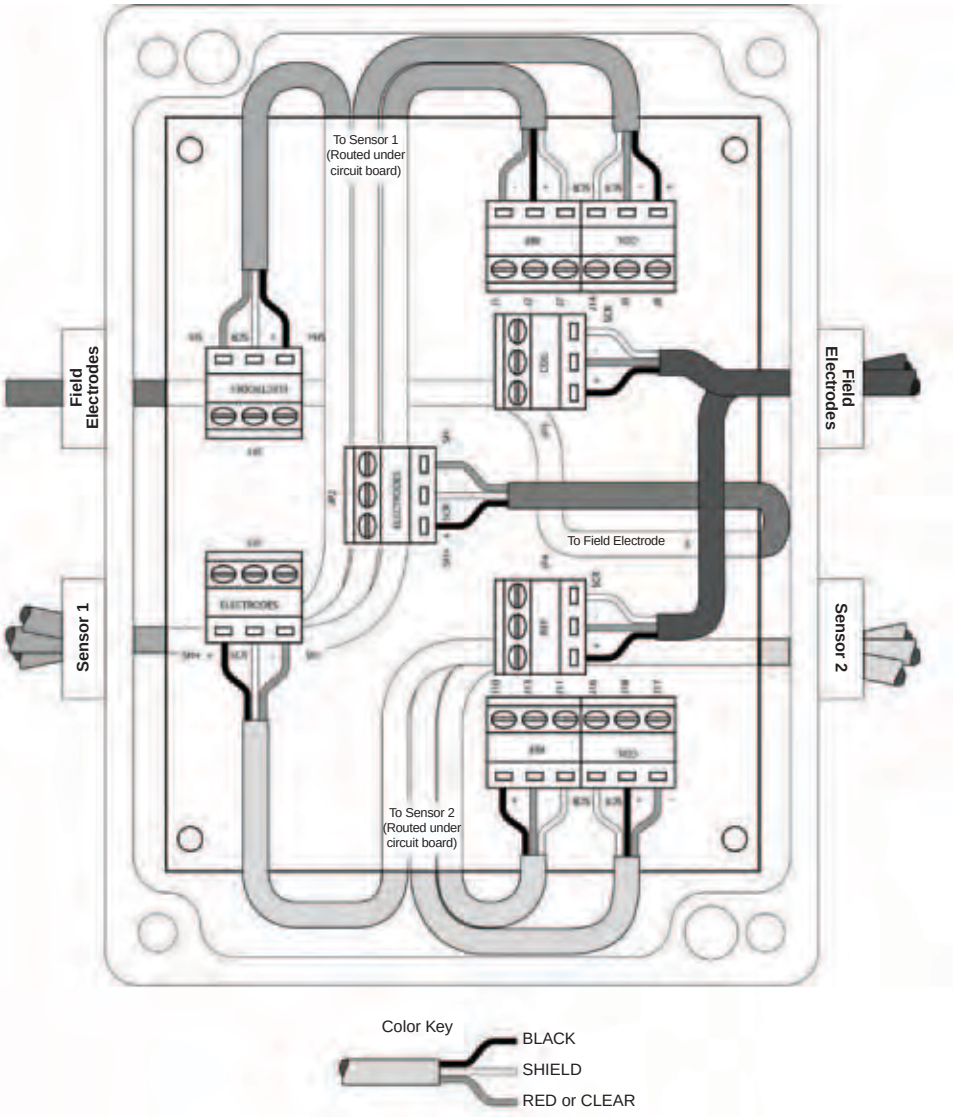
UniMag DP Series Electromagnetic Flow Tubes

Wiring Diagrams
Junction Box Wiring (1 or 2 Sensors)



Other Installation Considerations

Mounting Recommendations
The UniMag may be mounted into a pipeline in any attitude, taking note of the flow direction arrow on the flow tube. To obtain accurate measurement, the pipe must be completely full and air must not be entrained in the flow.

Straight Run Requirements
For particularly poor velocity profiles caused, for example, by upstream bends in two or more planes or partially open valves, the UniMag DP requires a minimum of 10 pipe diameters of straight pipe upstream from the flow tube, and a minimum of 5 diameters downstream.

Non-Homogenous Media
For particularly non-homogenous slurries, pulps or pastes, the flow tube should be mounted in a vertical pipe to obtain the most even distribution of solids and fibers. There must be a minimum of 20 pipe diameters between any media mixing point and the UniMag DP flow tube.

Partially Closed Valves
If the piping is horizontal and includes a partially closed valve, the valve should always be installed downstream of the UniMag. This will allow the head pressure in the system to be adjusted, reducing the chance of air entrainment in the flow, and will prevent excessive irregular profiles forming upstream of the flow tube.

UniMag DP Series Electromagnetic Flow Tubes

Model and Suffix Codes

Category	Suffix Codes									
Model										
UniMag DP Series Flow Tube	DP									
Nominal Size										
1½ inches (40mm)		1H								
2 inches (50mm)		02								
3 inches (80mm)		03								
4 inches (100mm)		04								
6 inches (150mm)		06								
8 inches (200mm)		08								
10 inches (250mm)		10								
12 inches (300mm)		12								
Sensor and Seal Material										
PVDF Sensors, Elastomer Gaskets, Viton Electrode Seals			E							
PVDF Sensors, Teflon Gaskets, Viton Electrode Seals			D							
Flow Tube Material										
Schedule 80 PVC				C						
Electrodes										
AISI 316 Stainless Steel					T					
Hastelloy B					B					
Hastelloy C					C					
Titanium					I					
Tantalum					A					
Sensor Option										
Single Sensor						S				
Dual Sensors						D				
Installation (all options include 50 feet / 15m cables)										
NEMA 6/IP68 Indefinitely Submersible to 30 foot water column							R			
Extra Cable Length > 50 feet							E			
Process Connections										
ANSI 150 RF								1		
DIN/BS 4504 PN10								3		
Pipe Plain Ends (Schedule 80)								P		
Conductivity Option										
Conductivity ≥ 5 µS/cm									A	
Conductivity ≥ 0.08 µS/cm									B	
Options Sample Part ¾" FNPT									P	
No options									O	
Coil Supply										
120V Supply										A
230V Supply										B
	DP	08	E	C	T	S	R	1	A	A

1 All special orders must include a complete description along with the ordering code. Always use the “Special” option for combinations.

2 The 4411e transmitter must be located in the non-explosive atmosphere.

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DemiMag DM Series Electromagnetic Flow Tubes

Description

EMCO DemiMag DM flow tubes are sized from 1/16" to ½" (1.5mm to 12mm), all with ½" connectors. DemiMag flow tubes do not have a liner and therefore will never fail due to a defective liner.

Each sensor includes an exciter coil and reference coil. Voltage is generated in the flow tube by the media in accordance with Faraday's Law, from which volumetric flow is calculated.

Features

- Totally encapsulated sensor components
- No liner; no meter failure due to a defective liner
- Low conductivity media > 0.08 mS / cm
- Patented AC coil excitation (high coil current and high pulsation frequency)
- Low flow range capability, down to 0.01 gpm (5 lph)
- Option for quick disconnect process connections
- Fast time constant of 0.03 seconds
- Internal grounding electrodes
- For use in explosive atmospheres
- High signal-to-noise ratio for immunity to media noise

Application Guide

Materials of Construction	Diameter		Maximum Temperature		Maximum Pressure	
	inches	mm	°F	°C	psi	bar
Kynar (polyvinylidene fluoride PVDF, PVDF2) flow tube with fused conductive Kynar electrodes	1/8"	4mm	250 70	120 20	40 150	3 10
	1/4"	8mm				
Aluminum trioxide ceramic flow tube with fused-in platinum electrodes and type 316 stainless steel grounding	1/16"	1.5mm	285	140	150	10
	1/2"	12mm				

Media Conductivity

—Typical required conductivity: ≥ 5 µS/cm (5 micromhos/cm)
—Low conductivity option: for conductivities > 0.08 or < 5 µS/cm use the UniMag pre-amplifier option

All DemiMag DM Series flow tubes are equipped with a pre-amp; however, for media < 5 µS/cm a booster pre-amp is embodied. For deionized, distilled or demineralized water, consult EMCO.

Performance Specifications

Accuracy and Traceability	
Accuracy	±0.5% of rate for flows ≥ 1.5 fps (0.45 m/s) ±0.0075 fps (± 0.00225 m/s) for flows < 1.5 fps (0.45 m/s)
Accuracy Notes	Accuracy is unaffected by electrode coatings such as sewage, grease, calcium carbonate, algae or similar.

1 For media such as ferric chloride, ferric sulfate (Odophos) or similar highly conductive media, flow meter performance can be adversely affected.
Please consult EMCO for these types of applications, otherwise performance guarantee is null and void.

DemiMag DM Series Electromagnetic Flow Tubes

DemiMag DM Flow Rates at 0.5% Accuracy

Line Size		Minimum Flow Velocity		Maximum Flow Velocity	
inches	mm	gpm	lph	gpm	lph
1/16	2	0.01	5	0.3	100
1/8	4	0.06	20	1.2	410
1/4	8	0.25	90	4.6	1650
1/2	12	1.00	190	19	3700

Power Requirements for 4411e Flow Transmitter

Power Supply Options	120V, 60Hz 230V, 50Hz 120V, 50Hz
Analog Output	2 x 4-20 mA 2-wire system
Pulse Output	2-wire potential-free output

Physical Specifications

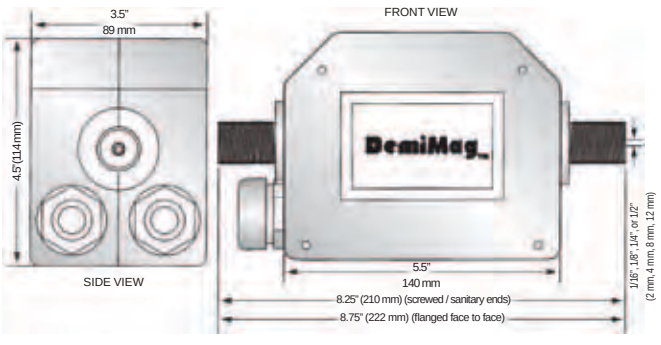
Materials of Construction	PVDF or Ceramic flow tubes, Viton or Kalrez seals, 316 Stainless Steel or PVDF connections
Process Connections	Flanged ANSI 150 RF Flanged ANSI 300 RF Flanged DIN/BS4504 PN10-40 Threaded G½" to ISO 228 Threaded ½" NPT Tri-Clamp Sanitary Ends DIN 11851 Sanitary Ends

Straight Run Piping Requirements

Piping	Upstream	Downstream
All piping configurations	10 D	5 D
Pump Upstream	5 D	0 D
Pump Downstream	10 D	3 D

D is equal to the internal diameter of the pipe

Dimensions and Weights



Weight: 7 lb (3 kg) with plastic enclosure
11 lb (5 kg) with stainless steel enclosure

Other Installation Considerations

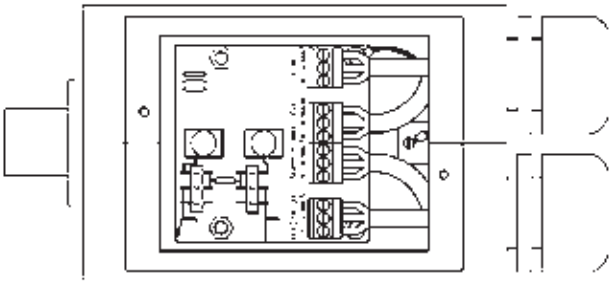
Mounting Recommendations
The DemiMag may be mounted into a pipeline in any attitude, taking note of the flow direction arrow on the flow tube. To obtain accurate measurement, the pipe must be completely full and air must not be entrained in the flow.

Straight Run Requirements
For particularly poor velocity profiles caused, for example, by upstream bends in two or more planes or partially open valves, the DemiMag requires a minimum of 10 pipe diameters of straight pipe upstream from the flow tube, and a minimum of 5 diameters downstream.

Non-Homogenous Media
For particularly non-homogenous slurries, pulps or pastes, the flow tube should be mounted in a vertical pipe to obtain the most even distribution of solids and fibers. There must be a minimum of 20 pipe diameters between any media mixing point and the DemiMag flow tube.

Partially Closed Valves
If the piping is horizontal and includes a partially closed valve, the valve should always be installed downstream of the DemiMag. This will allow the head pressure in the system to be adjusted, reducing the chance of air entrainment in the flow, and will prevent excessive irregular profiles forming upstream of the flow tube.

Wiring Diagram



DemiMag Cable Connections			
Exciter Coils	Electrodes	Pre-Amp	Reference
Black to 4	Black to 24	Shield to 19	Black to 31
White to 5	White to 25	Black to 20	White to 32
Shield to 6	Shield to 26	White to 21	Shield to 19

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DemiMag DM Series Electromagnetic Flow Tubes

Model and Suffix Codes

Category	Suffix Codes										
Model											
DemiMag DM Series Flow Tube	DM										
Nominal Size											
1/16 inch (2mm) Ceramic Only		02									
1/8 inch (4mm) PVDF Only		04									
1/4 inch (8mm) PVDF Only		08									
1/2 inch (12mm) Ceramic Only		12									
Flowtube Materials											
PVDF (Size Codes 04 and 08 Only)			F								
Ceramic (Size Codes 02 and 12 Only)			T								
Electrode Materials											
Conductive PVDF				F							
Fused Platinum (Ceramic Flow Tubes Only)				L							
Seal Materials											
Viton					V						
Kalrez					K						
Connection Materials											
316 Stainless Steel						T					
PVDF						F					
Process Connections[1]											
Flanged ANSI 150 RF							A				
Flanged ANSI 300 RF							B				
Flanged DIN/BS4504 PN10-40							C				
Threaded G ½" to ISO 228							G				
Threaded NPT ½"							H				
Tri-Clamp Sanitary Ends[2]							I				
DIN 11851 Sanitary Ends[2]							J				
Conductivity Rating											
Conductivity ≥ 5 µS/cm								N			
Conductivity ≥ 0.08 µS/cm, < 5 µS/cm, or Cables Longer than 15 feet (5m)[3]								A			
Enclosure											
Nylon									P		
Cable Lengths											
15 Feet (5m) Cables										N	
Special Cable Length										E	
Coil Supply											
120V Coil Supply											A
230V Coil Supply											B
	DM	02	F	F	V	T	H	N	P	N	A

1 316 stainless steel process connections have sanitary, threaded or rotary stainless steel flanges. Kynar (PVDF) process connections have threaded or rotary PVC flanges.

2 All DM Series DemiMags have a pre-amplifier; however, for cables > 15 feet (5m) or media conductivity < 5 µS/cm, a booster pre-amp is incorporated. For deionized or demineralized water applications, consult EMCO.

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DemiMag DL Series Electromagnetic Flow Tubes

Description

EMCO DemiMag DL flow tubes are sized from 3/4" to 1½" (20mm to 40mm), all with ½" connectors. DemiMag flow tubes do not have a liner and therefore will never fail due to a defective liner.

Each sensor includes an exciter coil and reference coil. Voltage is generated in the flow tube by the media in accordance with Faraday's Law, from which volumetric flow is calculated.

Features

- Totally encapsulated sensor components
- No liner; no meter failure due to a defective liner
- Low conductivity media > 0.08 mS / cm
- Patented AC coil excitation (high coil current and high pulsation frequency)
- Low flow range capability, down to 1.5 gpm (350 lph)
- Option for quick disconnect process connections
- Fast time constant of 0.03 seconds
- Internal grounding electrodes
- For use in explosive atmospheres
- High signal-to-noise ratio for immunity to media noise

Application Guide

Materials of Construction	Diameter		Maximum Temperature		Maximum Pressure	
	inches	mm	°F	°C	psi	bar
Kynar Flow Tubes	3/4 1 1½	20 25 40	250 70	120 20	40 150	3 10

Media Conductivity

Typical required conductivity: ≥ 5 µS/cm (5 micromhos/cm)
Low conductivity option: for conductivities > 0.08 or < 5 µS/cm use the UniMag pre-amplifier option
For deionized, distilled or demineralized water, consult EMCO.

Performance Specifications

Accuracy and Traceability	
Accuracy	±0.5% of rate for flows ≥ 1.0 fps (0.3 m/s) ±0.005 fps (± 0.0015 m/s) for flows < 1.0 fps (0.3 m/s)
Accuracy Notes	Accuracy is unaffected by electrode coatings such as sewage, grease, calcium carbonate, algae or similar.

[1] For media such as ferric chloride, ferric sulfate (Odophos) or similar highly conductive media, flow meter performance can be adversely affected.
Please consult EMCO for these types of applications.

DemiMag DL Series Electromagnetic Flow Tubes

DemiMag DL Flow Rates at 0.5% Accuracy

Line Size		Minimum Flow Velocity		Maximum Flow Velocity	
inches	mm	gpm	lph	gpm	lph
¾	20	1.50	350	42	10,300
1	25	2.50	540	74	16,000
1½	40	5.50	1380	280	41,000

Power Requirements for 4411e Flow Transmitter

Power Supply Options	120V, 60Hz 230V, 50Hz 120V, 50Hz
Analog Output	2 x 4-20 mA 2-wire system
Pulse Output	2-wire potential-free output

Physical Specifications

Materials of Construction	PVDF flow tubes; 316 Stainless Steel, Hastelloy B, Hastelloy C, Titanium or Tantalum Electrodes; Viton or Kalrez Seals
Process Connections	Flanged ANSI 150 RF Flanged ANSI 300 RF Flanged DIN/BS4504 PN10-40 Tri-Clamp Sanitary Ends DIN 11851 Sanitary Ends

Straight Run Piping Requirements

Piping	Upstream	Downstream
All piping configurations	5 D	2 D
Pump Upstream	20 D	5 D
Pump Downstream	10 D	5 D

D is equal to the internal diameter of the pipe

Other Installation Considerations

Mounting Recommendations

The DemiMag may be mounted into a pipeline in any attitude, taking note of the flow direction arrow on the flow tube. To obtain accurate measurement, the pipe must be completely full and air must not be entrained in the flow.

Straight Run Requirements

For particularly poor velocity profiles caused, for example, by upstream bends in two or more planes or partially open valves, the DemiMag requires a minimum of 10 pipe diameters of straight pipe upstream from the flow tube, and a minimum of 5 diameters downstream.

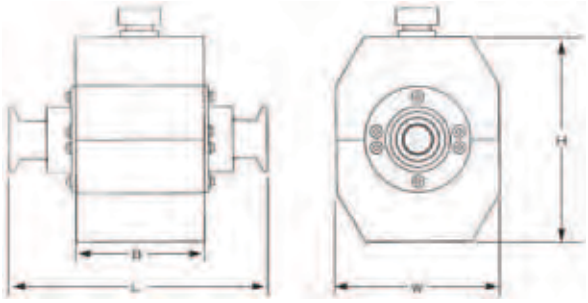
Non-Homogenous Media

For particularly non-homogenous slurries, pulps or pastes, the flow tube should be mounted in a vertical pipe to obtain the most even distribution of solids and fibers. There must be a minimum of 20 pipe diameters between any media mixing point and the DemiMag flow tube.

Partially Closed Valves

If the piping is horizontal and includes a partially closed valve, the valve should always be installed downstream of the DemiMag. This will allow the head pressure in the system to be adjusted, reducing the chance of air entrainment in the flow, and will prevent excessive irregular profiles forming upstream of the flow tube.

Dimensions and Weights



Part No.	Nominal Size	L	B	W	H	Weights (Flanged)	
						LB	KG
DL20	0.75” (20 mm)	7.87” (200 mm)	3.92” (100 mm)	5.00” (125 mm)	6.30” (160 mm)	13	6
DL25	1” (25 mm)	7.87” (200 mm)	3.92” (100 mm)	5.00” (125 mm)	6.30” (160 mm)	18	8
DL40	1.5” (40 mm)	7.87” (200 mm)	3.92” (100 mm)	5.50” (138 mm)	7.00” (175 mm)	26	12

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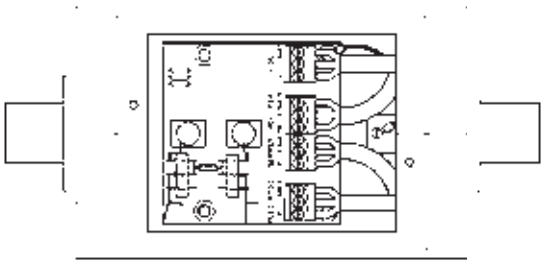
DemiMag DL Series Electromagnetic Flow Tubes

Wiring Diagram



DemiMag Cable Connections			
Exciter Coils	Electrodes	Pre-Amp	Reference
Black to 4	Black to 24	Shield to 19	Black to 31
White to 5	White to 25	Black to 20	White to 32
Shield to 6	Shield to 26	White to 21	Shield to 19

Model and Suffix Codes

Category	Suffix Codes										
Model											
DemiMag DL Series Flow Tube	DL										
Nominal Size											
3/4 inch (20mm)		20									
1 inch (25mm)		25									
1½ inch (40mm)		40									
Flowtube Materials (Wetted)											
PVDF[1]			F								
Electrode and Grounding Materials (Wetted)											
316 Stainless Steel				T							
Hastelloy B				B							
Hastelloy C				C							
Titanium				I							
Tantalum				A							
Seal Materials (Wetted)											
Viton					V						
Kalrez					K						
Connection Materials (Wetted)											
316 Stainless Steel; Fixed Flanges						T					
PVDF[2]						F					
Process Connections											
Flanged ANSI 150 RF							A				
Flanged ANSI 300 RF							B				
Flanged DIN/BS4504 PN10-40							C				
Tri-Clamp Sanitary Ends[3]							I				
DIN 11851 Sanitary Ends[3]							J				
Conductivity Rating											
Conductivity ≥ 5 µS/cm								N			
Conductivity ≥ 0.08 µS/cm, < 5 µS/cm, or Cables Longer than 15 feet (5m)[4]								A			
Enclosure											
Powder Coated Polyester Carbon Steel									W		
Polished Stainless Steel									L		
Cable Lengths											
15 Feet (5m) Cables										N	
Special Cable Length										E	
Coil Supply											
120V Coil Supply											A
230V Coil Supply											B
	DL	20	F	T	V	T	A	N	W	N	A

1 Mating connectors, seals and clamps not included.

2 Includes non-wetted rotary PVC or fixed PVDF flanges, depending on availability.

3 For deionized or demineralized water, consult EMCO.

DeltaKit Series Magnetic Flow Sensor Assemblies

Description

EMCO DeltaKit flow sensor assemblies are used as spare sensor assemblies for existing flow tubes, or as economic flow meters using existing weldable piping for 2" to 36" (50mm to 900mm) diameters.

Each sensor includes an exciter coil and reference coil. Voltage is generated in the flow tube by the media in accordance with Faraday's Law, from which volumetric flow is calculated.

Features

- Sensors mount flush with internal pipe diameter and do not obstruct flow
- Uses existing weldable pipe work (no liners)
- Low conductivity media > 0.08 mS / cm
- Patented AC coil excitation (high coil current and high pulsation frequency)
- Optional extended electrodes to project through non-fluidic coatings
- Field replaceable sensors
- Inherent redundancy from multiple sensors
- Sensor reference coils
- Internal grounding electrodes
- Accuracy unaffected by media coatings such as calcium carbonate, raw sewage, grease, algae and similar
- High signal-to-noise ratio for immunity to media noise
- Compatible with pulps, slurries, raw sewage and similar

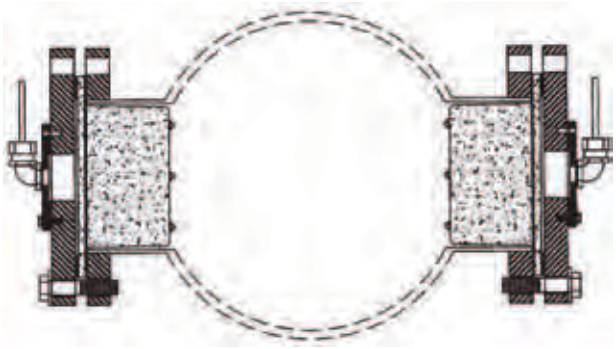
UniMag Technology

Innovative Sensor Technology

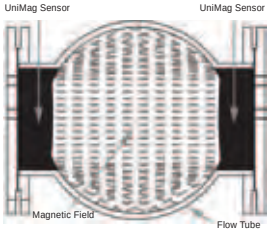
- DeltaKit sensors include an exciter coil and a reference coil, and are available in various electrically insulative materials.
- A unique electrode design distributes the magnetic field over the flow tube's entire cross section.
- These combined effects, along with a uniquely powerful field strength, provide a truly weighted velocity signal.
- Each sensor includes a reference coil, separate from the exciter coil.

No Liner Necessary

- Each DeltaKit sensor is a complete solid-state insulated magneter; a liner is not necessary for insulation.



UniMag Sensors
Sensor with standard conical electrodes (top) and extended conical electrodes (bottom). Cones wear off with abrasive media. This has no effect on accuracy.



UniMag Magnetic Field
Large UniMag sensors create a magnetic field over the entire flow tube cross section. The flow signal represents the true weighted velocity of the media and is highly insensitive to velocity profile distortion and swirl effects.

Modular Construction / True Field Repairability

- Sensors can be replaced in the field, meaning minimal downtime and no need to ship the flow tube back to the manufacturer.
- Spare sensors can be kept in stock for easy replacement if needed.
- Output continues if one sensor fails, with 1% to 3% of rate typical accuracy.
- Costly bypass pumping is unnecessary since sensors can be removed and immediately replaced.

Configurations for a Variety of Applications

There are four basic UniMag configurations:

- Sensors with non-obtrusive conical electrodes: used for water, sewage and similar applications
- As above, except with extended conical electrodes: used when media coats the flow tube thick enough to cover standard electrodes
- Concave sensors with flat electrodes; used for dredging slurries and similar moderately abrasive media

DeltaKit Series Magnetic Flow Sensor Assemblies

Application Guide

	Temperature Range		Maximum Pressure[1]		Notes
	°F	°C	psi	bar	
Sensors					
Polyurethane	175 max.	80 max.	150	10	Conforms to NSF61 and AWWA C213 for drinking water.
PVDF	240 max.	115 max.	150	10	Full vacuum capability. Temperature rating is for water and may be lower for other media. PVDF is approved by the US FDA #21 CFR 177.2510
UHMWPE	175 max.	80 max.	150	10	
Sensor Notes	Sensor assembly includes a non-wetted carbon steel cover flange, fusion bonded polyethylene protected. Sensor assemblies are supplied with outer cover flanges, 30 feet (10m) cables, re-enterable potting gel, junction box, conduit and stainless steel bolts. Multiple sensors are pre-wired to the junction box, conduited and potted with re-enterable gel. Temperature differential between process and ambient limited to 140ºF (60ºC) for polyurethane sensor and 212ºF (100ºC) for PVDF sensor. Sensors must be removed from standpipe before welding.				

Media Conductivity

Typical required conductivity: > 0.5 µS/cm standard
Low conductivity option: > 0.08 µS/cm on request.
Low conductivity option does not include deionized, distilled or demineralized water; consult EMCO.

Performance Specifications

Accuracy and Traceability[1]	
Accuracy (Single Sensor)	±1.0% of rate for flows ≥ 2.0 fps (0.6 m/s) ±0.02 fps (± 0.06 m/s) for flows < 2.0 fps (0.6 m/s)
Accuracy (Multiple Sensors)	±1.0% of rate for flows ≥ 1.5 fps (0.45 m/s) ±0.015 fps (± 0.0045 m/s) for flows < 1.5 fps (0.45 m/s)
Traceability	Accuracy is traceable to the National Institute of Science and Technology. A NIST traceable Calibration Certificate is provided with each flow tube.
Accuracy Notes	Accuracy is unaffected by electrode coatings such as sewage, grease, calcium carbonate, algae or similar.

1 For media such as ferric chloride, ferric sulfate (Odophos) or similar highly conductive media, flow meter performance can be adversely affected.
Please consult EMCO for these types of applications, otherwise performance guarantee is null and void

Operating Specifications

Flow Range	Minimum	Maximum	Notes
Single Sensor			
fps and m/s	0 to 2 fps (0 to 0.6 m/s)	50 fps (15 m/s)	
gpm	0 to $5D^2$ gpm	$120D^2$ gpm	Where D is in inches
m^3/h	0 to $0.002D^2$ m^3/h	$0.04D^2$ m^3/h	Where D is in millimeters
Multiple Sensors			
fps and m/s	0 to 1.5 fps (0 to 0.4 m/s)	50 fps (15 m/s)	
gpm	0 to $5D^2$ gpm	$120D^2$ gpm	Where D is in inches
m^3/h	0 to $0.002D^2$ m^3/h	$0.04D^2$ m^3/h	Where D is in millimeters

Power Requirements for 4411e Flow Transmitter

Power Supply Options	120V, 60Hz 230V, 50Hz 120V, 50Hz
Analog Output	2 x 4-20 mA 2-wire system
Pulse Output	2-wire potential-free output

Physical Specifications

Materials of Construction	Sensors: Polyurethane, PVDF, UHMWPE Standpipe & flanges: Carbon steel, 316 stainless steel
Installation Options	NEMA 6/IP68 indefinitely submersible to 30 foot water column up to 175°F (80°C) NEMA 4X/IP65 for temperatures greater than 175°F (80°C)

DeltaKit Series Magnetic Flow Sensor Assemblies

Straight Run Piping Requirements

Piping	Upstream Piping Requirement		Downstream Piping Requirement	
	Single Sensor	Multiple Sensors	Single Sensor	Multiple Sensors
Minimum requirement	10 D	5 D	5 D	3 D
Single elbow or tee upstream	10 D	5 D	5 D	3 D
Two elbows, coupled in the same plane	10 D	5 D	5 D	3 D
Two elbows, close coupled and out of plane	20 D	10 D	5 D	3 D
Pump, blending point, control valve upstream	20 D	10 D	5 D	3 D
Pump, control valve downstream	10 D	10 D	5 D	3 D

D is equal to the internal diameter of the pipe

Measurable Flow Rates at 1.0% Accuracy (Multiple Sensors)

Line Size		Minimum Flow Rate Velocity		Maximum Flow Rate Velocity	
inches	mm	fps	gpm	fps	gpm
2	50	1.5	15	50	490
2.5	65	1.5	23	50	766
3	80	1.5	33	50	1,103
4	100	1.5	59	50	1,960
6	125	1.5	132	50	4,410
8	150	1.5	235	50	7,840
10	200	1.5	368	50	12,250
12	250	1.5	529	50	17,640
14	300	1.5	720	50	24,010
16	350	1.5	941	50	31,360
18	400	1.5	1,191	50	39,690
20	450	1.5	1,470	50	49,000
22	500	1.5	1,779	50	59,290
24	600	1.5	2,117	50	70,560
28	700	1.5	2,881	50	96,040
32	800	1.5	3,763	50	125,440
36	900	1.5	4,763	50	158,760

Other Installation Considerations

Mounting Recommendations
DeltaKit sensors may be mounted into a pipeline in any attitude, taking note of the flow direction arrow on the sensors. To obtain accurate measurement, the pipe must be completely full and air must not be entrained in the flow.

Straight Run Requirements
For particularly poor velocity profiles caused, for example, by upstream bends in two or more planes or partially open valves, the DeltaKit requires a minimum of 10 pipe diameters of straight pipe upstream from the flow tube, and a minimum of 5 diameters downstream.

Non-Homogenous Media
For particularly non-homogenous slurries, pulps or pastes, the DeltaKit should be installed in a vertical pipe to obtain the most even distribution of solids and fibers. There must be a minimum of 20 pipe diameters between any media mixing point and the DeltaKit sensors.

Partially Closed Valves
If the piping is horizontal and includes a partially closed valve, the valve should always be installed downstream of the DeltaKit. This will allow the head pressure in the system to be adjusted, reducing the chance of air entrainment in the flow, and will prevent excessive irregular profiles forming upstream of the flow sensors.

Vacuum Conditions
For full vacuum, use PEEK sensors only.

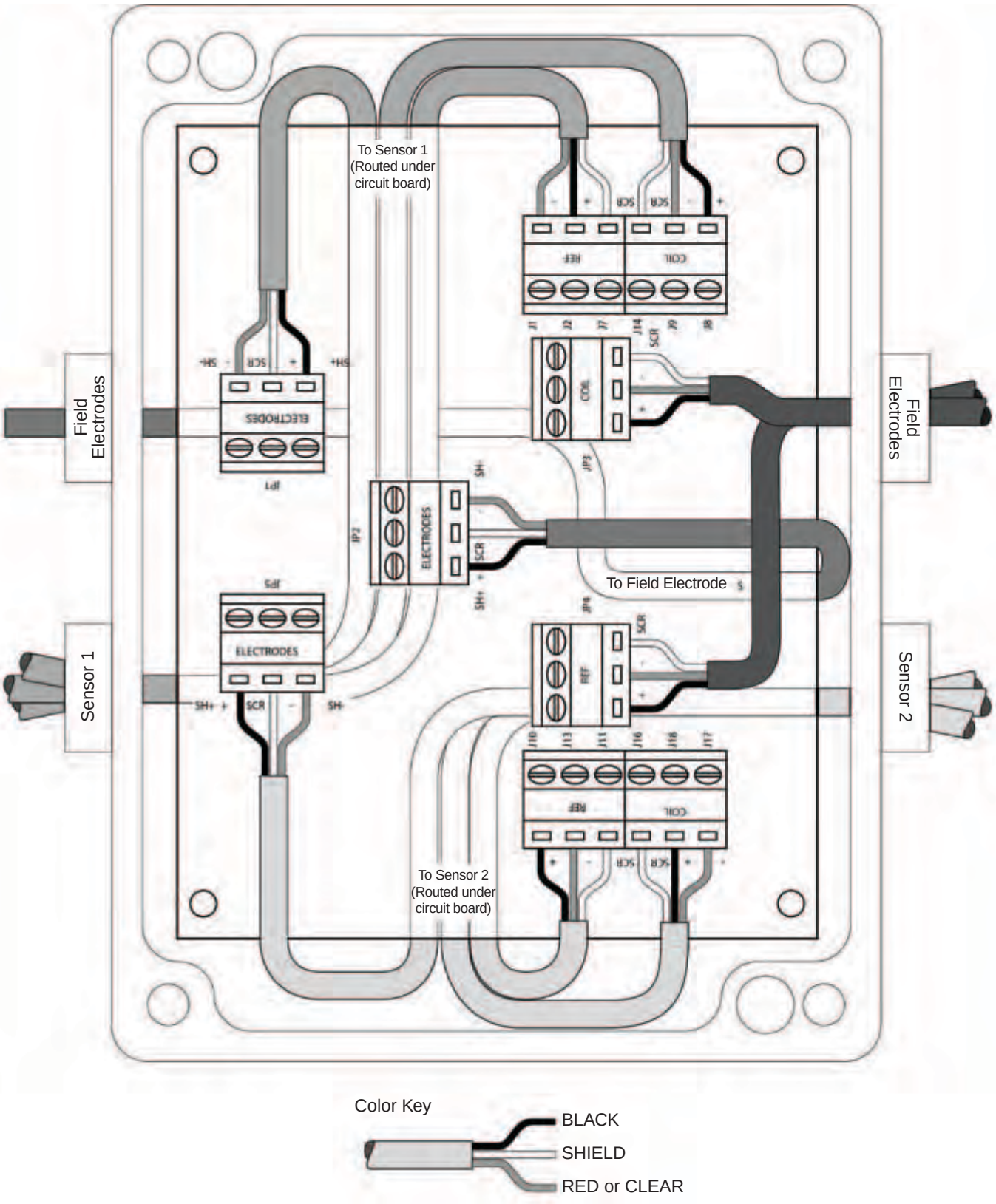
Dimensions and Weights
Consult EMCO representative for dimensional information

Pipe Size	1 Sensor	2 Sensors	4 Sensors	Single Standpipe and Flange	Sensor Assembly Size
2” - 3” (50mm - 80mm)	9 lb (4 kg)	16 lb (8 kg)	N/A	19 lb (9 kg)	2” (50mm)
4” - 6” (100mm - 150mm)	15 lb (7 kg)	27 lb (12 kg)	N/A	24 lb (11 kg)	3” (80mm)
8” - 14” (200mm - 350mm)	38 lb (17 kg)	71 lb (32 kg)	N/A	40 lb (18 kg)	6” (150mm)
16” - 24” (400mm - 600mm)	63 lb (29 kg)	118 lb (54 kg)	N/A	74 lb (34 kg)	8” (200mm)
28” - 36” (700mm - 900mm)	118 lb (54 kg)	225 lb (102 kg)	440 lb (200 kg)	120 lb (55 kg)	12” (300mm)

1 Includes weight of sensors and mounting assemblies
2 Add the weight of the standpipe and flange assemblies to the sensor assembly weights to arrive at the total

DeltaKit Series Magnetic Flow Sensor Assemblies

Wiring Diagrams
Junction Box Wiring (1 or 2 sensors)



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DeltaKit Series Magnetic Flow Sensor Assemblies

Model and Suffix Codes

Category	Suffix Codes									
Model										
DeltaKit Series Sensor Assembly	DK									
Nominal Size										
2 Inches to 80 Inches (50mm to 2000mm)		02 - 36								
Sensor and Gasket Material[2]										
PVDF With Elastomer Gaskets, Viton Seals (Water & Waste, 14" Max. Diameter)			E							
PVDF With Teflon Gaskets, Viton Seals			D							
PVDF With Teflon Gaskets, Kalrez Seals			F							
PEEK With Klinger Gaskets, Chemraz Seals			K							
PEEK With Klinger Gaskets, Teflon Seals[3]			H							
Polyurethane Concave With Elastomer Gaskets, Viton Seals (Water & Waste, 16" to 34" Diameters)			C							
Concave Teflon With Teflon Gaskets, Kalrez Seals			T							
UHMWPE Concave WIth Elastomer Gaskets, Viton Seals			U							
Polyurethane With Elastomer Gaskets, Viton Seals (Water & Waste, 36" Diameter)			P							
Special			S							
Sensor Standpipe Assembly Quantity and Size										
2 - 6 inches (50-150 mm) 1 sensor				1						
2 - 36 inches (50-900 mm) 2 sensor				2						
Standpipe / Flange Materials										
Carbon Steel Standpipe					C					
316 Stainless Steel Standpipe					T					
316 Stainless Steel Standpipe					A					
No Standpipes, For Use In Internally Uncoated Carbon Steel Pipes					O					
No Standpipes, For Use In Internally Uncoated Stainless Steel Pipes					N					
For Use With PVC UniMag®					P					
Pipe Coating										
Uncoated Pipe						U				
Fusion Bonded Epoxy Coating						X				
Lined						M				
Other						O				

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DeltaKit Series Magnetic Flow Sensor Assemblies

Category	Suffix Codes									
Electrodes										
AISI 316 Stainless Steel							T			
Hastelloy B (Small)							B			
Hastelloy C (Small)							C			
Titanium							I			
Hastelloy C (Large)[6]							W			
Hastelloy B (Large)[6]							X			
Tantalum							A			
Installation										
Junction Box Potted to NEMA 6 and IP68 Submersible to 50' (15m) (Standard Supply)								R		
Extra Cable Length								E		
As Option R Above, Except With Weldable Junction Box Support Table								A		
Extra-Long 316 Stainless Steel Electrodes								B		
Special, Including Special Cable Length[1]								S		
Pressure Rating										
ANSI 150 PSI (10 Bar G)									1	
ANSI 300 PSI (16 Bar G)									2	
Coil Supply										
120 V Supply										A
230 V Supply										B
	DK	24	E	C1	D	T	A	R	1	A

1 All special orders must include a complete description along with the ordering code. Always use the "Special" option for combinations. Contact factory for pricing.

2 Sensor assembly includes a non-wetted carbon steel cover, fusion bonded polyethylene.

3 Use H electrodes on paper mill liquors and lime mud > 200ºF (93ºC). Use with H sensors only. Use with Ryton internally coated UniMag flow tubes only.

4 Standpipes have temporary epoxy enamel finish. The junction box assembly includes conduit and non-wetted outer cover carbon steel flange. Single sensors have the junction box attached directly to the outer cover flange. Standard supply is 50 feet (15m) cables.

5 Stainless steel standpipes have carbon steel flanges welded on, unless otherwise specified.

6 Use with W or X electrodes with K (PEEK) sensors only, for paper mill liquors and lime mud > 200ºF (93ºC). Use with Ryton internally coated UniMag flow tubes only.

4411e Magnetic Flow Transmitter

Description

EMCO's 4411e flow transmitter produces a clean and powerful bi-directional flow signal with unsurpassed fast response and a uniquely high signal strength.

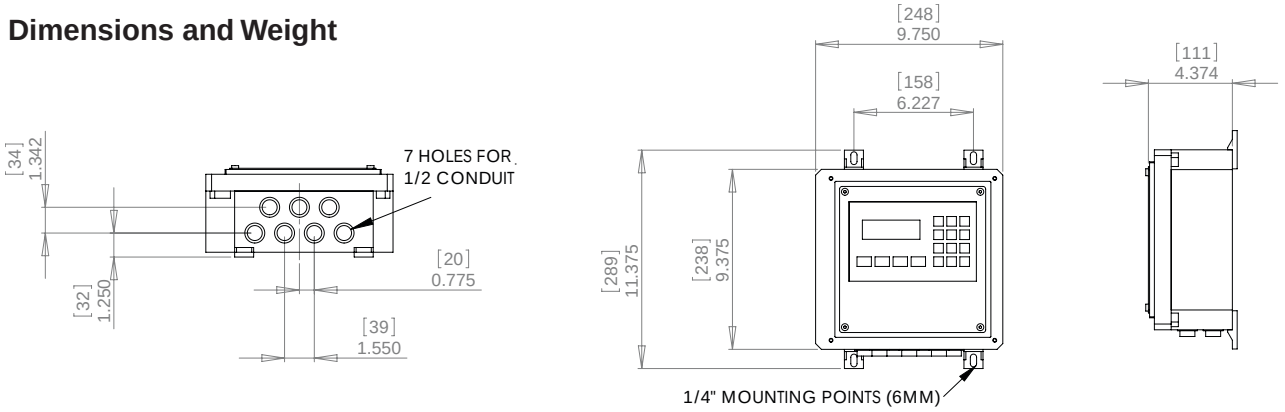
The 4411e flow transmitter uses an innovative and patented Pulsed Hybrid method of coil excitation to create an ultra stable flow signal to media noise ratio up to 50 times higher than other magmeter technologies.

The 4411e is a versatile and advanced magmeter transmitter with a user-friendly keypad for programming, a 10-year memory, batch control, RS232 interface, two 4 x 20mA outputs and a scaleable pulse frequency output.

Features

- High excitation current (to 5.5 base to peak) and high exciter frequency (40 Hz or 33 Hz) for all size UniMag Sensors
- Suitable for problem media (mining, slurries, pulps, liquors and low conductivity media)
- 4 lines of 20 character alphanumeric, backlit LCD display with sealed, tactile feedback and vandal-resistant keyboard
- Noise countervailence and auto-zero circuits with RF and VFD filtration
- Virtually immune to common noise effects, including eddy current drift, radio frequency, variable frequency drives and similar
- Bi-directional flow measurement; accurately eliminates back flow from net totals
- Reference coils to compensate for media temperature
- Fast time constant of 0.30 seconds
- Comprehensive alarm relays and setpoints

Dimensions and Weight



Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.
In the interests of development and improvement of the product, we reserve the right to change the specification.

4411e Magnetic Flow Transmitter

4411e Specifications

Enclosure	Wall mounted, UV resistant fiberglass.
Display	Four lines of 20 characters; waterproof, back-lit LCD display.
Front Panel Keypad	Tactile feedback, waterproof sealed.
Environmental Protection	NEMA 4X and IP65
Ambient Temperature[1]	-4ºF to 140ºF (-20ºC to 60ºC)
Supply Voltage	120V, 60Hz; 120V, 50Hz; 230V, 50Hz
Power Consumption	20 watts typical, including sensors.
Diagnostics	All necessary diagnostics, readings and system status are available via the front panel keypad without opening the door. A user security password is programmable, allowing revalidation of the magmeter's NIST traceable Calibration Certificates. A separate calibration box is not necessary.
Windows Interface Program	Computer interface via serial connection, enabling programming of setup, the ability to upload new firmware and download diagnostics and status.
Magnetizing Current	Up to 5.5A, depending on sensor size.
Exciter Frequency	40Hz (with 60Hz) or 33Hz (with 50 Hz)
Time Constant (T)	Minimum 30 milliseconds
Signal Averaging (5T)	Infinitely adjustable 150ms to 300 seconds.
Optional Batch Control	For batch control, the total set amount is entered via the keypad and displayed. Keypad actuation of batch flow via a 4411e relay initiates flow, counting from zero to the total set amount.
Frequency Mode	0 to 1000Hz, up to 10,000Hz square wave. The external isolated outputs are rated 30V DC maximum, current of 250mA.
Analog Outputs[2]	Two 4-20mA outputs from separate terminals are available for bi-directional flow. Either may be configured as an internally powered 2-wire output or an externally powered 2-wire output.
Pulsed Outputs	An externally powered, 2-wire scaled output (for totalizing flow) or frequency output (for rate of flow) is available as follows: • Slow speed: 100 ms pulse width, 5Hz maximum frequency • Medium speed: 50 ms pulse width, 10Hz maximum frequency • Fast speed: 5 ms pulse width, 100Hz maximum frequency
Communication Outputs	RS-232 and RS-485 are available as standard.
Relay Outputs	Two user configurable form C (changeover) relays with contact rating 125V AC, 1A, 30VA.
Contact Inputs	Two user configurable inputs, rated 12V DC, 10mA. These inputs require a contact closure or transistor switch between the terminals.
Input Impedance	10^{12} Ohms
Pre-Amp Supply	A pre-amp is internally supplied on all DM Series DemiMags as standard. On other magmeters, an internal booster pre-amp is recommended for media condictivity < 5 uS/cm.
Analog Inputs (Including Level)[3]	Two 4 - 20mA inputs with 2 wire, 18V DC supply.
Maximum Cable Length	50 feet (15m) for conductivities < 3 µS/cm (micromhos/cm) or 300 feet or 10 x C (90m or 3 x C) for conductivities > 3 µS/cm, whichever is less, where C is the conductivity in µS/cm (preamplifier required over 150 feet).

See footnotes on next page.

4411e Magnetic Flow Transmitter

Model and Suffix Codes- Items Grey Highlight are normally stocked and have standard lead times

Category	Description				
Type	4411e transmitter with RS232 communication	DSM	. . .	. . .	. . .
Approvals[1]	Pending UL and CSA	. . .	1	. . .	. . .
Power Supply[2]	120V AC, 60Hz	. . .	. . .	1	. . .
	120V AC, 50 Hz	. . .	. . .	2	. . .
	230V AC, 50Hz	. . .	. . .	3	. . .
Options	No Further Options	. . .	. . .	. . .	O
	2-Wire Level,12-30V DC Supply / 4-20mA Input (note 3)		. . .	. . .	C
	CE transmitter for use with ChannelMag and NFP ONLY (note 3)			. . .	E
	Special for use with combinations (note 4)				S
	Example	DSM-	1-	1-	O

Notes:

1 The 4411e Transmitter must be in the safe area.

2 For dredging applications with 120V / 230V AC, always recommend using EGS Sola HeviDuty Power Conditioner 63 series on quotations.

3 For use with UniMag® NFP, ChannelMag PM2, and ChannelMag CM2

4 All special orders must include a complete description along with the ordering code. Use 'special' option for combinations.

5 Currently, EMCO products are NOT PED approved for sales into European Union countries.

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

Description

MAGFLO® electromagnetic flowmeters employ Faraday's law to measure the volumetric flow rate of conductive liquids. EMCO offers a wide variety of electromagnetic flowmeters. In addition to standard meters for typical applications, we have specialized meters, like our sanitary MAG 1100 FOOD–for application-specific flow measurement.

Features

6000 signal converter (electronics)
- 0.25% accuracy
- Compact and practical design
- User-friendly design
- SENSORPROM™ Technology
- Bidirectional measurement
- Self-diagnostic
- Backlit display
- HART protocol available
- Empty Pipe Cut-Off
- Batch Control Function
- Electrode Cleaning available

5000 same features as 6000 except
- 0.5% accuracy
- Less Batch Control Function

1100 sensor
- Universal sensor
- High liquid temperature
- Withstands rigorous cleaning
- Food version
  - *3A and FDA approved*
  - *Steam CIP cleanable*
  - *Withstands rigorous cleaning*
  - *Sanitary Design*
  - *Tri-clamp connections*
- Line sizes
  - *Standard: 1/4" to 4"*
  - *High temperature: 1/2" to 4"*
  - *Food: 3/8" to 4"*
  - *Wafer connection*

3100 sensor
- Line Sizes: 1/2" to 80"
- Several Liner and Electrode Materials Available
- NEMA 6 (Accidental Submersible)
- Flange Connection

5100 W
- DN 25 to DN 1200 (1" to 48")
- Connection flanges EN 1092-1 (DIN 2501), ANSI, AWWA and AS.
- Ebonite Hard Rubber liner for all water applications
- Drinking water EPDM liner with approvals
- Hastelloy integrated grounding and measuring electrodes
- Increased low flow accuracy for water leak detection, due to coned liner design.
- Drinking water approvals
- Suitable for direct burial and constant flooding
- Build-in length according to ISO 13359
- Easy commissioning, SENSORPROM unit automatically uploads calibration values and settings.
- Designed that patented in-situ verification can be conducted. Using SENSORPROM fingerprint.

Applications

MAGFLO® electromagnetic flowmeters offer important advantages such as no pressure drop, no moving parts, high accuracy, and a wide variety of materials of construction. They have been successfully used in many industries including food, beverage, pharmaceutical, chemical, power, heat, pulp & paper, steel and water treatment. No maintenance, low cost of ownership, and high reliability make MAGFLO® the flowmeter of choice for many flow measurement applications.

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

Performance Specifications

Mag 6000 signal converter

Accuracy

- *Better than ± 0.25% of rate*

Compact and practical design

The NEMA 6 signal converter can be installed either integrally on the sensor or remote on a wall or pipe. Front and back panel NEMA 4x converters are also available as an option.

User-friendly design

Alphanumeric display

Electronic unit and display can be rotated for easy viewing.

Sensorprom™ technology

Easy to start up–sensor data is downloaded from the SENSORPROM™ located in the terminal box to the signal converter. After power failure or converter replacement, all settings are automatically downloaded from the SENSORPROM™ to the MAG 5000 –no need for reprogramming.

Self-diagnostic

Operating malfunctions are indicated in the display and error relays are activated. The last 10 errors are stored in Error Pending and Error Log.

Backlit display

Hart protocol available

Electrode cleaning

Converter can control an optional external electrode cleaning unit–output and display values are maintained during cleaning.

Bidirectional

Flow can be measured in both forward and reverse directions using a relay output to indicate direction changes.

Empty-pipe cut-off

If the sensor is drained, the converter automatically suppresses the input and indicates zero flow.

Batch function

Mag 5000 signal converter

Accuracy

± 0.5% of rate

Compact and practical design

The NEMA 6 signal converter can be installed either integrally on the sensor or remote on a wall or pipe. Front and back panel NEMA 4x converters are also available as an option.

User-friendly design

Alphanumeric display

Electronic unit and display can be rotated for easy viewing.

Sensorprom™ technology

Easy to start up–sensor data is downloaded from the SENSORPROM™ located in the terminal box to the signal converter. After power failure or converter replacement, all settings are automatically downloaded from the SENSORPROM™ to the MAG 5000–no need for reprogramming.

Bidirectional

Flow can be measured in both directions with two internal totalizers.

Self-diagnostic

Operating malfunctions are indicated in the display and error relays are activated. The last 10 errors are stored in Error Pending and Error Log.

Backlit display

Hart protocol available

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

Mag 1100 sensor
(standard, high temp and food)
Universal sensor
Ceramic Liner with platinum electrodes

High liquid temperature
Standard 302° F, optional 390° F

Withstands rigorous cleaning
External construction in stainless steel, and enclosure meets NEMA 6 (accidental submersible), and can be steam cleaned.

Food version
- *3A and FDA approved*
- *Steam CIP cleanable*
- *Withstands Rigorous Cleaning:*
  - *External construction in stainless steel.*
  - *Enclosure meets NEMA 6 (accidental submersible).*
- *Sanitary Design:*
  The electrodes are fused into the ceramic liner
  –no crevices where bacteria can grow
- *Tri-clamp connections*

Line sizes
- *Standard: 1/4" to 4"*
  - *High temperature: 1/2" to 4"*
  - *Food: 3/8" to 4"*

Mag 3100 sensor
Line sizes:
1/2" to 80"

Several liner and electrode materials available
See following pages for selection

Nema 6 (accidental submersible)
Can easily be upgraded to NEMA 6P (continuously submersible to 30 ft of water)

Fully welded sensor construction

Flange version
ANSI Class 150, 300 or AWWA class D

Mag 5100W
- DN 25 to DN 1200 (1" to 48")
- Connection flanges EN 1092-1 (DIN 2501), ANSI, AWWA and AS.
- Ebonite Hard Rubber liner for all water applications
- Drinking water EPDM liner with approvals
- Hastelloy integrated grounding and measuring electrodes
- Increased low flow accuracy for water leak detection, due to coned liner design.
- Drinking water approvals
- Suitable for direct burial and constant flooding
- Build-in length according to ISO 13359
- Easy commissioning, SENSORPROM unit automatically uploads calibration values and settings.
- Designed that patented in-situ verification can be conducted. Using SENSORPROM fingerprint.

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

Specifications - Sensor Mag 1100

	MAG 1100 Ceramic 	MAG 1100 PFA 
Type	Flangeless sensor (Wafer)	
Nominal size	1/4", 3/8", 1/2", 1", 1 1/2", 2", 3", 4"	3/8", 1/2", 1", 1 1/2", 2", 3", 4"
Operating pressure	1/4"-2 1/2": 600 psi, 3": 560 psi, 4": 450 psi	300 psi
Vacuum	1.5×10^{-5} psi	0.3 psi
Temperature of medium *PFA*		–20°F to +265°F
Ceramic	0°F to +300°F	
High temperature version	0°F to +400°F	Suitable for steam sterilization at 300°F
Temperature shock (Ceramic liner)	(Duration > 1 min.):	Max. ±210°F momentarily
	1/4", 3/8", 1/2", 1": Max. ΔT ≤ 60°F/min.	
	1 1/2", 2", 2 1/2": Max. ΔT ≤ 50°F/min.	
	3", 4" : Max. ΔT ≤ 40°F/min.	
	(Duration ≤ 1 min., followed by 10 min. rest):	
	1/4", 3/8", 1/2", 1": Max. ΔT ≤ 175°F	
	1 1/2", 2", 2 1/2": Max. ΔT ≤ 160°F	
	3", 4": Max. ΔT ≤ 140°F	
Ambient temperature	Remote mount signal converter: –40°F to +210°F	
	Integral mount signal converter: –5°F to +120°F	
Liner	Aluminum oxide Al_2O_3 (ceramics)	Reinforced PFA (Teflon)
Electrodes	Platinum with gold/titanium brazing alloy	Hastelloy C-276
Enclosure	Stainless steel AISI 316L (1.4404)	Stainless steel AISI 316 (1.4436)
Terminal box *Standard*	Fiberglass-reinforced polyamide	Fiberglass-reinforced polyamide
(Remote installation only) *High temp.*	Stainless steel AISI 316 (1.4436)	Stainless steel AISI 316L (1.4404)
Studs & nuts	Stainless steel AISI 304 (1.4301)	
	Number and size to DIN 2501	
Mating flanges	DIN 2501 (150-600 psi), ANSI B16.5, class 150 and 300 or equivalent	
Option	1/4" & 3/8": 1/2" NPT threaded adaptor	
Gaskets *Standard*	EPDM (max. 300°F, 600 psi)	
Option	Graphite (max. 390°F, 600 psi)	
Option	PTFE (max. 210°F, 300 psi)	
Cable entries	4 pcs. PG 13.5	
Enclosure rating *Standard*	NEMA 4X / 6 (3 ft. submersion for 30 min)	
Option	NEMA 6P (30 ft. continuous submersion)	
Mechanical load (vibration)	18-1000 Hz random, 3.17 G rms in all directions to EN 60068-2-36	
Test pressure	1200 psi (2 × nominal)	600 psi (2 × nominal)
Ex approvals		
Excitation frequency programmable	1/4" - 2 1/2": 15 Hz	3/8" - 2 1/2": 15 Hz
	3", 4": 7.5 Hz	3", 4": 7.5 Hz

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

Specifications - Sensor Mag 1100 FOOD

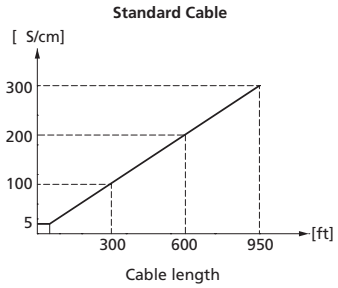
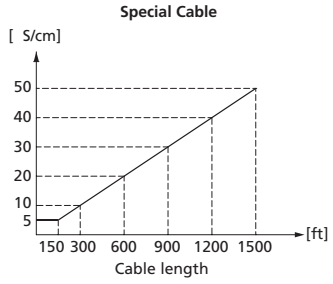
	MAG 1100 FOOD 	MAG 1100 FOOD PFA 
Type	Hygienic sensor	
Nominal size	$^3/_8$", $^1/_2$", 1", 1$^1/_2$", 2", 3", 4"	
Process connection	Hygienic adapters available for: ♦ Direct welding in ♦ Clamp fitting ♦ Threaded fitting	
Operating pressure	$^3/_8$"-2$^1/_2$": 600 psi, 3": 560 psi, 4": 450 psi	300 psi
Vacuum	1.5×10^{-5} psi	0.3 psi
Temperature of medium	0°F to +300°F	–20°F to +270°F
	Suitable for steam sterilization	Suitable for steam sterilization at 300°F
Temperature shock	(Duration > 1 min.):	Max. ±212°F momentarily
	$^3/_8$", $^1/_2$", 1" Max. ΔT ≤ 60°F/min.	
	1$^1/_2$", 2", 2$^1/_2$" Max. ΔT ≤ 50°F/min.	
	3", 4" Max. ΔT ≤ 40°F/min.	
	(Duration ≤ 1 min., followed by 10 min. rest):	
	$^3/_8$", $^1/_2$", 1" Max. ΔT ≤ 175°F	
	1$^1/_2$", 2", 2$^1/_2$" Max. ΔT ≤ 160°F	
	3", 4" Max. ΔT ≤ 140°F	
Ambient temperature	Remote mount signal converter: –40°F to +210°F	Remote mount signal converter: –40°F to +210°F
	Integral mount signal converter: –5°F to +120°F	Integral mount signal converter: –5°F to +120°F
Liner	Aluminum oxide Al_2O_3 (ceramic)	Reinforced PFA (Teflon)
Electrodes	Platinum with gold/titanium brazing alloy	Hastelloy C-276
Enclosure	Stainless steel AISI 316L (1.4404)	Stainless steel AISI 316L (1.4404)
Terminal box *Standard*	Fiberglass-reinforced polyamide	Fiberglass-reinforced polyamide
(Remote installation only) *Option*	Stainless steel AISI 316 (1.4436)	Stainless steel AISI 316 (1.4436)
Cable entries	4 pcs. PG 13.5	4 pcs. PG 13.5
Enclosure rating *Standard*	NEMA 4X / 6 (3 ft. submersion for 30 min)	NEMA 4X / 6 (3 ft. submersion for 30 min)
Option	NEMA 6P (30 ft. continuous submersion)	NEMA 6P (30 ft. continuous submersion)
Mechanical load (vibration)	18-1000 Hz random, 3.17 G rms in all directions, to EN 60068-2-36	18-1000 Hz random, 3.17 G rms in all directions, to EN 60068-2-36
Test pressure	1200 psi (2 × nominal)	600 psi (2 × nominal)
Approvals	3A, EHEDG	3A
Excitation frequency programmable	$^3/_8$" - 2$^1/_2$": 15 Hz	$^3/_8$" - 2$^1/_2$": 15 Hz
	3", 4": 7.5 Hz	3", 4": 7.5 Hz

Accessories
MAG 1100 FOOD

Adapters	**Stainless steel AISI 316**		**Pressure**
Pipe connection/ Operating pressure	**Adapter for direct welding into pipe:** ***Tri-Clover*** ISO 2037, DIN 11850, SMS 3008, BS 4825-1		
		$^3/_8$", $^1/_2$", 1", 1$^1/_2$", 2", 3"	600 psi
		4"	350 psi
	Clamp adapter: ***Tri-Clamp*** ISO 2852, DIN 32676, SMS 3016, BS 4825-3		
		$^3/_8$", $^1/_2$", 1", 1$^1/_2$", 2"	200 psi
		2$^1/_2$", 3", 4"	150 psi
	Thread adapter:		
	DIN 11851:	$^3/_8$", $^1/_2$", 1", 1$^1/_2$"	600 psi
		2", 2$^1/_2$", 3", 4"	350 psi
	ISO 2853, SS 3351, BS 4825-4:	$^3/_8$", $^1/_2$", 1", 1$^1/_2$", 2", 3", 4"	200 psi
	SMS 1145:	1", 1$^1/_2$", 2", 2$^1/_2$", 3"	80 psi
Gasket *Standard*	EPDM (ethylene, propylene rubber) (–5 °F to 300 °F)		
Option	NBR (nitrile butadiene rubber) (–5 °F to 210 °F)		
Material	Stainless steel AISI 304, ISO 2852		

Note
It is always a system so please state system max. pressure and **not** MAG 1100 or adapter.

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

		
	MAG 3100	
Type	Sensor with flanges	
Nominal Size	1/2" to 80"	
Measuring Range	Adjustable from 0-0.8 ft/s to 0-33 ft/s	
Coil Current	Pulsating DC with one of the following frequencies: 6 1/4 Hz or 12 1/2 Hz depending on sensor size	
Process Temperature (Pressure ≤ 580 psi)	Neoprene: 32° to 158° F	Linatex Rubber: -40° to 160° F
	PTFE®: -5° to 266° F **	Ebonite: 32° to 200° F
	High Temp PTFE 0 to 355° F	EPDM: -15 to 158° F
Ambient Temperature	Remote Signal Converter	-40° F to 210° F
	Integral Signal Converter	-40° F to 120° F
Pipe Connection		
Standard	1/2" to 24" ANSI B 16.5 Class 150 28" to 80" AWWA C-207 Class D (150 psi)	
Option	1/2" to 24" ANSI B 16.5 Class 300 Others on request	
Process Vacuum	Maximum process vacuum depends on liner material:	
	Neoprene, Ebonite, EPDM, Natural rubber: 7.25 psia	
Liner		
Standard	Neoprene	
Option	Teflon®, Natural rubber, EPDM, Ebonite	
Electrodes		
Standard	Stainless steel 316 Ti	
Option	Hastelloy C276, Platinum, Titanium, Monel, Tantalum, AISI 316Ti coated	
Enclosure		
Standard	Carbon steel, corrosion-resistant two-component coating	
Option	Stainless steel AISI 316	
Measuring Pipe	Stainless steel AISI 304	
Enclosure Rating		
Standard	NEMA 6 accidental submersible (tested to 10 ft of water 72h)	
Option	NEMA 6 submersible, tested to 30 ft of water (no time limit if	
	NEMA 6P submersible kit is being used)	
Cable Entries	2 Pg 13.5–2 others available	
Mechanical Load Design	3 G, 1-800 Hz sinusoidal in all directions	
Pressure	1.5 x flange rating	
Conductivity		
Compact installation	Liquids with an electric conductivity ≥ 5 µs/cm	
	For a conductivity between 1 and 5 µs/cm, the accuracy may degrade to ±0.5% of actual flow.	
Remote installation	 	
	Note: For detection of empty sensor the min. conductivity must always be ≥ 20 µs/cm and the max. length of electrode cable when remote mounted is 150 ft. Special cable must be used.	

* -5 to 120° F with signal converter mounted on sensor

** Each temperature class assumes a maximum ambient temperature of 105° F.

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

MAG 3100 Liner Selection Guide	
Liner	**Applications**
Neoprene	General purpose, sewage, drinking water and district heating
EPDM	Drinking water, sea water
PTFE	Agressive chemicals, paper and pulp, high temperature applications
Linatex®	Abrasive media and mining slurries
Ebonite	Drinking water, high pressure applications and district heating

Electrode Selection Guide	
Electrodes	**Applications**
AISI 316 Ti	General purpose, water, sewage and district heating
AISI 316 Ti Ceramic coated	High content of fibres, paper pulp
Hastelloy C-276	Good chemical proporties, sea water
Monel	Salt, brine and alkaline solutions
Titanium	Chlorine, chlorite, nitric and chromic acids.
	Textile bleaching industry
Tantalum	Almost any acid solution
Platinum and platinum/irridium	The ultimate electrode material.
	Unaffected by most liquids

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

Specifications - MAG 5100 W

Technical specifications			
Design	**Full bore sensor**	**Coned bore sensor**	**Full bore sensor**
Nominal size	DN 25 ... 40 (1" ... 1½")	DN 50 ... 300 (2" ... 12")	DN 350 ... 1200 (14" ... 48")
Measuring principle	Electromagnetic induction		
Excitation frequency	12.5 Hz	• 50 ... 65 mm (2" ... 2½"): 12.5 Hz • 80 ... 150 mm (3" ... 6"): 6.25 Hz • 200 ... 300 mm (8" ... 12"): 3.125 Hz	DN 350 ... 450 (14" ... 18"): 3.125 Hz DN 500 ... 1200 (20" ... 48"): 1.5625 Hz
Process connection			
Flanges		Flat face flanges	
• EN 1092-1	PN 40 (580 psi)	• 50 ... 300 mm: PN 16 (2" ... 12": 230 psi) • 200 ... 300 mm: PN 10 (8" ... 12": 145 psi)	• PN 10 (145 psi) • PN 16 (230 psi)
• ANSI B16.5	Class 150 lb	Class 150 lb ~20 bar (290 psi)	--
• AWWA C-207	--	--	28" ... 48": Class D
• AS4087	PN 16 (230 psi) DN 50 ... 1200 (2" ... 48"), 14 bar (232 psi)		
Rated Operation conditions			
Ambient temperature • Sensor • With compact transmitter MAG 5000/6000 • With compact transmitter MAG 6000 I	 -40 ... +70 °C (-40 ... +158 °F) -20 ... +50 °C (-4 ... +122 °F) -20 ... +60 °C (-4 ... +140 °F)		
Operating pressure	0.01 ... 40 bar (0.15 ... 580 psi)	0.03 ... 20 bar (0.44 ... 290 psi)	0.01 ... 16 bar (0.15 ... 232 psi)
Enclosure rating • Standard • Option	 IP67 to EN 60529 / NEMA 4X/6 (1 mH2O for 30 minutes) IP68 to EN 60529 / NEMA 6P (10 mH2O continuously)		
Pressure drop at 3 m/s (10 ft/s)	As straight pipe	Max. 25 mbar (0.36 psi)	As straight pipe
Medium conditions			
Temperature of medium			
• NBR	-10 ... +70 °C (14 ... +158 °F)		
• EPDM	-10 ... +70 °C (14 ... +158 °F)		
EMC	89/336 EEC		
Design			
Weight	See dimensional drawings		
Material • Housing and flanges • Terminal box • Measuring pipe • Liner • Electrodes • Grounding electrodes standard	 Carbon steel, St 37.2 Standard Fibre glass reinforced polyamide AISI 304 (1.4301) Ebonite Hard Rubber (hydro carbon resistent) Hastelloy C276 Hastelloy C276		
Certificates and approvals			
Custody Transfer (only together with MAG 5000/6000 CT), order as special Approvals	OIML R 49 pattern approval cold water (Denmark and Germany): DN 50 ... 300 (2" ... 12") MI 001 cold water (EU): DN 50 ... 300 (2" ... 12") FM Class 1, Div 2		
Approvals	PED – 97/23 EC1), CRN		

1) For sizes larger than 600 mm (24") in PN 16 PED conformity is available as a cost added option. The basic unit will carry the LVD (Low Voltage Directive) and EMC approval.

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

	 			 
	MAG 6000 Signal Converter: 0.25%			**MAG 5000 Signal Converter: 0.5% accuracy**
Functions	Display flowrate, 2 totalizers, low flow cuf-off, empty pipe cut-off, flow direction, error system, operating time uni/bidi-rectional flow, limit switches, pulse output, control for clean-ing unit and batch			Display flowrate, 2 totalizers, low flow cuf-off, empty pipe cut-off, flow direction, error system, operating time, uni/ bidirectional flow, limit switches, pulse output, control for cleaning unit
Current Output				
Current	0-20 mA or 4-20 mA			0-20 mA or 4-20 mA
Load	< 800 ohm			< 800 ohm
Time Constant	0.1-30 s adjustable			0.1-30 s adjustable
Frequency/Pulse Output	Short-circuit-protected			Short-circuit-protected
Frequency	0-10 kHz, 50% duty cycle			0-10 kHz, 50% duty cycle
Pulse Width	50 ms, 500 ms, 5 ms, 50 ms, 100 ms, 500 ms, 1 s, 5 s			50 ms, 500 ms, 5 ms, 50 ms, 100 ms, 500 ms, 1 s, 5 s
Time Constant	0.1-30 s adjustable			0.1-30 s adjustable
Active	24 V DC			24 V DC supplied by the signal converter
		≤ 1 Hz	≤ 10 kHz	0-2 Hz: load: 125 ohm to 100 kohm
	Min. R_{load}	150 Ω	1 KΩ	0-10 kHz: load: 125 ohm to 100 kohm
Passive	Max. R_{load}	≤ 10 KΩ	≤ 10 KΩ	
	3-30 V DC			External supply of 5-50 V DC (max. current: 200 mA)
		U = 3 V	U = 30 V	0-10 kHz: load: 125 ohm to 10 kohm
	Min. R_{load}	10 Ω	225 Ω	
	Max. R_{load}	≤ 10 KΩ	≤ 10 KΩ	
Relay	Switch relay to indicate flow direction or fault			Switch relay to indicate fault
Load	Max.: 42 V/ 2 A, 24 Vd.c./1 A			Max.: 42 V/2A, 24 Vd.c./1A
Time Constant	Flow direction: 5 s; Fault : 1 s			1 s
Digital input	11-30 V d.c., R_i = 4.4 KΩ (reset Totalizer, Force Output and Batch Control)			11-30 V d.c., R_i = 4.4 KΩ (reset Totalizer, Force Output)
Activation time	50 msec.			50 msec
Current	$I_{11\ V\ d.c.}$ = 2.5 mA, $I_{30\ V\ d.c.}$ = 7 mA			$I_{11\ V\ d.c.}$ = 2.5 mA, $I_{30\ V\ d.c.}$ = 7 mA
Galvanic Isolation	All inputs and outputs are galvanically isolated			All inputs and outputs are galvanically isolated
Cut-off				
Low-flow	0–9.9% of maximum flow			0–9.9% of maximum flow
Empty Pipe	Detection of empty pipe. (special cable required)			detection of empty pipe. (special cable required)
Counter	Two internal eight-digit counters for forward, net or reverse flow source			

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

		 	 
		MAG 6000 Signal Converter: 0.25%	**MAG 5000 Signal Converter: 0.5% accuracy**
Electrode Cleaning		For process liquids which can leave insulating deposits on the sensor's electrodes, or leave conductive deposits on the inside of the sensor.	N/A
		Electrode cleaning requires a special 19" rack cleaning unit.	
Display		Backlit alphanumeric text, 3 x 20 characters to indicate flow, volume, settings and faults. Reverse flow indicated by negative sign.	Backlit alphanumeric text, 3 x 20 characters to indicate flow, volume, settings and faults. Reverse flow indicated by negative sign.
Zero Point Adjustment		Automatic	Automatic
Input Impedance		> 1 x 10^{14} Ω	> 1 x 10^{14} Ω
Exitation Frequency		Pulsating DC current with one of the following frequencies: 1 9/16 Hz, 3 1/8 Hz, 6 1/4 Hz or 12 1/2 Hz, 25 Hz	Pulsating DC current at a frequency of 3 1/8 Hz
Ambient Temperature		During operation -5° to 120° F	During operation -5° to 120° F
		During storage -40° to 160° F (RH max. 95%)	During storage -40° to 160° F (RH max. 95%)
Supply Voltage			
AC		115/230 V AC. +10% to -15%, 50-60 Hz, 9 VA	115/230 V AC +10% to -15%, 50-60 Hz, 9 VA
DC		11-30 V DC/11-24 V AC, 9 W	11-30 V DC/11-24 V AC 9 W
Integral/Remote		Can be mounted integrally on sensor, or remote on pipe or wall	Can be mounted integrally on sensor, or remote on pipe or wall
	Material	Fiberglass-reinforced polyamide or optional stainless steel	Fiberglass-reinforced polyamide or optional stainless steel
	Rating	NEMA 6, accidental submersible (3ft of water for 30 min.)	NEMA 6, accidental submersible (3 ft of water for 30 min.)
	Mechanical Load	3.17 G, 18-1000 Hz random in all directions	3.17 G, 18–1000 Hz random in all directions
19" insert		Insert fits in a 19" rack or wall, front, back panel unit	Insert can be fitted in a 19" rack or wall, front, back panel unit
	Material	Standard 19" insert of Aluminum/steel	Standard 19" insert of Aluminum/steel
	Rating	19" Insert and back panel mount: NEMA 1	19" Insert and back panel mount: NEMA 1
		Front panel and wall mount unit: NEMA 4X	Front panel and wall mount unit: NEMA 4X
	Mechanical Load	115/230 V AC version: 1 G, 1-800 Hz sinusoidal in all directions	115/230 V AC version: 1 G, 1-800 Hz sinusoidal in all directions
		24 V DC version: 1 G, 1-800 Hz sinusoidal in all directions	
Communication			
Standard		Prepared for client mounted add-on modules	Without serial communication
Optional		HART® as add on module	HART®

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
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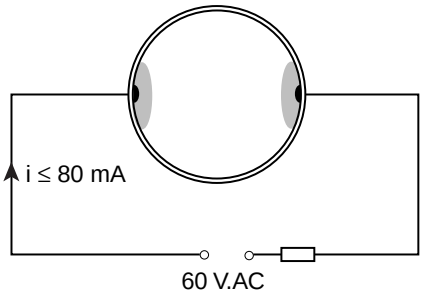
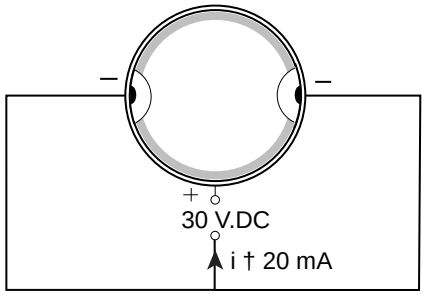
	MAGFLO® Cleaning Unit
Application	For use with MAG 6000 and MAG 5000 19" insert to clean the electrodes on MAG 1100 and MAG 3100.
Cleaning Voltage	
AC	cleaning: 60 V a.c.
DC	cleaning: 30 V d.c.
Cleaning Period	60 sec + 60 sec. pause period
Relay	Switch relay indicating cleaning in progress
Load:	42 V/2A
Indicator Lamps	LEDs: “ON” and “CLEANING”
Supply Voltage	
AC	115/230 V AC +10% to -15%, 50-60 Hz, 7 VA cleaning, 5 VA stand by
DC	18-30 V DC, 17 W cleaning, 3 W stand by
Ambient Temperature	During operation: -5 to 120° F
	During storage: -5 to 160° F
19" insert	19" insert for MAG 6000 and MAG 5000 in either a front, back or wall mount unit
	Enclosure material: Standard 19" insert in Aluminum/steel
	Enclosure rating: NEMA 1; if front or wall mount kit is used: NEMA 4X
	Mechanical load: 1 G, 1-800 Hz sinusoidal in all directions

MAG 6000 can be MAG 5000 can be mounted with the Cleaning Unit. The electronic package can be mounted in either a wall, front, or back panel unit.



AC Cleaning

AC Cleaning is used to remove greasy deposits on the electrodes caused from measurement of waste water flows from abattoirs or water containing oil residues. During cleaning, heat is generated on the electrode surface, softening the greasy particles. This causes gas bubbles which remove the deposits from the electrode surface.



DC Cleaning

DC cleaning is used to remove conductive deposits from the meter pipe. When measuring district heating water flows, conductive magnetite deposits can accumulate. If the water’s conductivity is below approx. 250µS/cm, these deposits can short the electrode signal and cause measuring error. This cleaning method involves electrolysis in which the electron flow leads the deposited particles away from the area around the electrodes.

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
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Sensor size selection guide

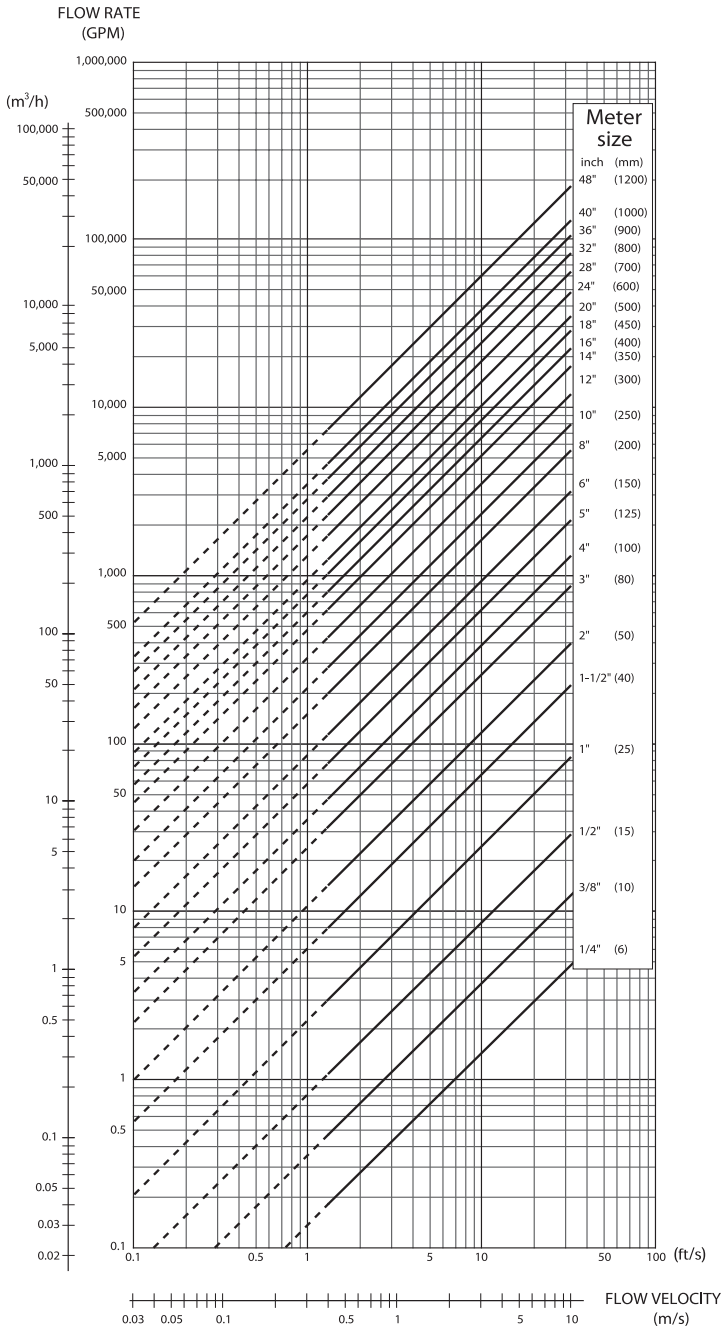
The table shows the relationship between flow velocity V, flow quantity Q, and sensor size.

Guidelines for selection of sensor

Min. measuring range: 0-0.8 ft/s

Max. measuring range: 0-33 ft/s

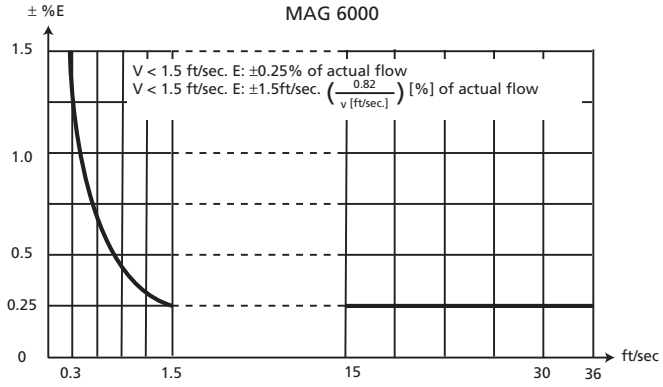
Normally the sensor is selected with a nominal flow in the measuring range of 3-5 ft/s.



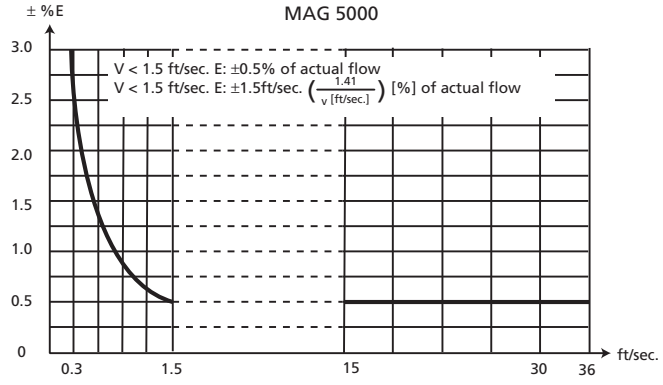
Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

Accuracy

Meter uncertainty under reference conditions (display/frequency/ pulse output)



V: Actual flow velocity [ft/sec]
E: Meter uncertainty as a percentage of actual flow



V: Actual flow velocity [ft/sec]
E: Meter uncertainty as a percentage of actual flow

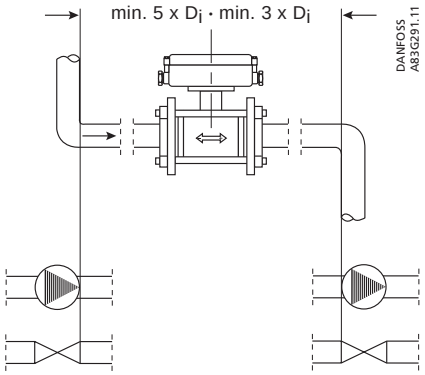
Reference Conditions (ISO/DP9104)	
Temperature of medium	68° F ±4 °F
Ambient temperature	68° F ±4 °F
Supply voltage	Un ±1%
Warm-up time	30 min
Incorporation in pipe section in accordance with reference conditions (ISO)	Inlet section 10 x DN
	Outlet section 5 x DN
	Sensor optimally grounded and centered
	For further information contact EMCO
Flow conditions	Fully developed flow profile

Other Accuracy Statements	
Current output	Pulse output: ±(0.1% of actual flow +0.05% FSO)
Effect of ambient temperature	Display/frequency/pulse output: < ±0.003% / Kelvin
	Current output: < ±0.005% / Kelvin
Effect of supply voltage	< 0.005% of measuring value on 1% change
Repeatability	±0.1% of actual flow for V ≥ 1.5 ft/s

Inlet and outlet conditions

For accurate flow measurement, it is essential to have sufficient straight run of inlet and outlet pipes, and a certain distance between pumps and valves.

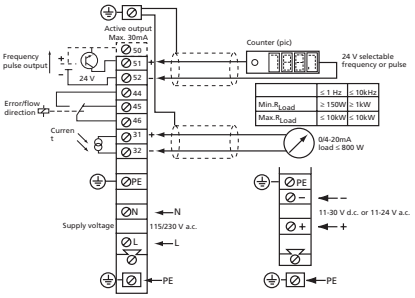
It is also important to center the flowmeter in relation to the pipe flanges and gaskets.



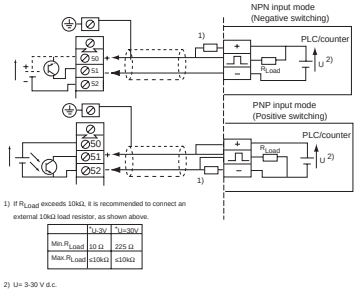
Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

Electrical connection mag 6000 and mag 5000

Signal converter MAG 6000 and MAG 5000 integrally mounted on sensor

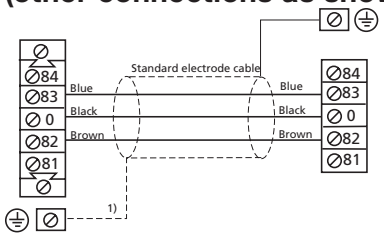


Connection of electromechanical counter (active output), current output, power supply.

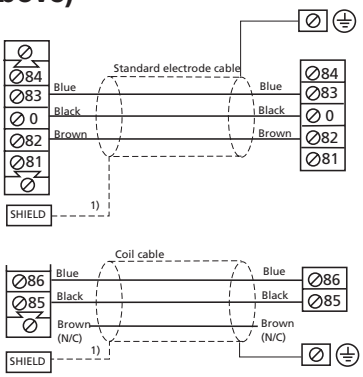


Other pulse-frequency output connection options using passive mode.

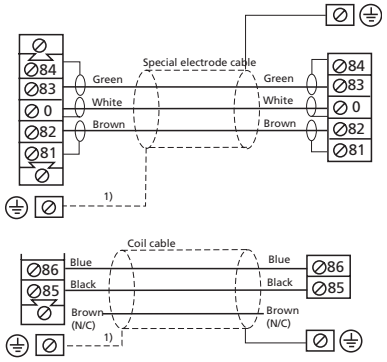
Signal converter mag 6000 and mag 5000 remote mounted on sensor (other connections as shown above)



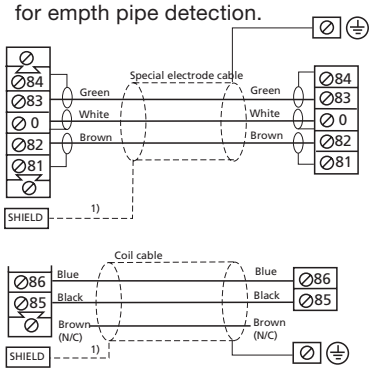
Signal converter remote mounted using a standard electrode cable.



MAG 6000 NEMA 6 version with special electrode cable for empth pipe detection.



MAG 6000 NEMA 6 version with special electrode cable for empth pipe detection.



19 insert remote mounted using special electrode cable. empty pipe detection.

1) EMC immunity: In areas with severe electrical interference, the shield on the electrode and coil cables must be grounded at both ends.

Model MAGFLO®
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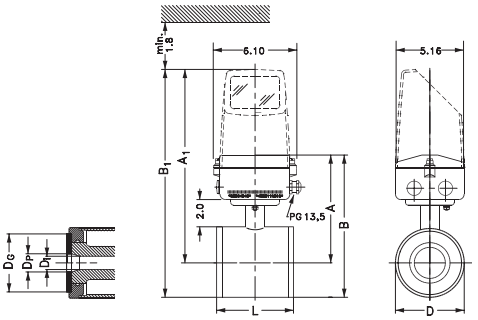
Dimensions

Sensor MAG 1100 Standard and high temperature

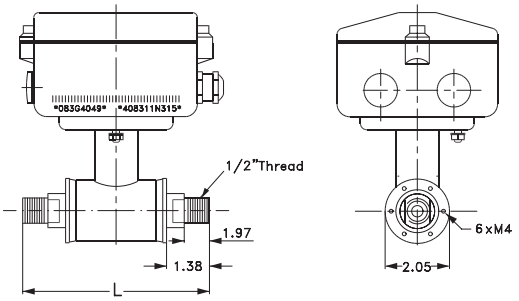
MAG 1100, integral/remote



Size	A[1]	B[1]	A_1	B_1	D	D_i (Al_2O_3)	D_p	D_G	Weight[2]	The total built-in length "L", depends on the gasket selected. EPDM	Graphite	PTFE (Teflon)	Without gasket	Earthing Ring
.25"	6.14"	7.13"	12.16"	13.15"	1.90"	0.24"	0.68"	1.34"	4.8"	2.52	2.60	2.75	2.52	3.03
.375"	6.14"	7.13"	12.16"	13.15"	1.90"	0.39"	0.68"	1.34"	4.8"	2.52	2.60	2.75	2.52	3.03
.5"	6.14"	7.13"	12.16"	13.15"	1.90"	0.59"	0.68"	1.57"	4.8"	2.56	2.60	2.75	2.52	3.03
1"	6.46"	7.72"	12.48"	13.74"	2.50"	0.98"	1.12"	2.20"	4.9"	3.15	3.19	3.35	3.10	3.62
1.5"	6.93"	8.58"	12.95"	14.61"	3.31"	1.57"	1.71"	2.95"	7.5"	3.74	3.78	3.94	3.70	4.21
2"	7.24"	9.25"	13.27"	15.27"	4.00"	1.97"	2.15"	3.54"	9.2"	4.13	4.17	4.33	4.05	4.61
2.5"	7.64"	10.00"	13.66"	16.02"	4.72"	2.56"	2.68"	4.41"	12.0"	5.12	5.15	5.31	5.05	5.59
3"	7.87"	10.47"	13.90"	16.50"	5.24"	3.15"	3.25"	4.88"	15.0"	6.10	6.14	6.30	6.00	6.57
4"	8.39"	11.50"	14.41"	17.52"	6.26"	3.94"	4.22"	5.91"	22.0"	7.28	7.31	7.48	7.20	7.76

1 0.5" shorter when the AISI terminal box is used. (High temperature version 390°F).

2 With signal converter MAG 5000 or MAG 6000 installed, weight is increased by approx. 1.8 lbs.



The MAG 1100 1/4" and 3/8" can be assembled with a 1/2" NPT SS fitting instead of wafer mount.

	Without gasket	EPDM	Graphite	Teflon
L	5.9"	5.9"	6.0"	6.1"

Model MAGFLO®
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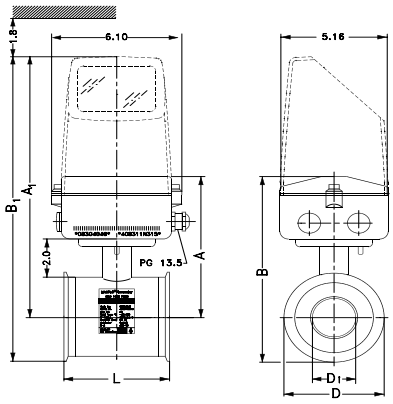
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

Dimensions

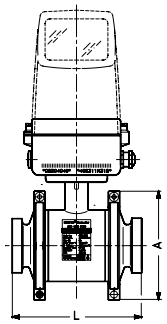
Sensor mag 1100 food



Sensor Size	L	A	B	A_1	B_1	D	Weight *
.375"	2.60"	5.63"	6.89"	11.8"	13.1"	2.52"	4.8"
.5"	2.60"	5.63"	6.89"	11.8"	13.1"	2.52"	4.8"
1	3.19"	5.94"	7.48"	12.1"	13.6"	3.05"	4.9"
1.5"	3.78"	6.34"	8.15"	12.5"	14.3"	3.58"	7.5"
2	4.17"	6.69"	9.06"	12.8"	15.2"	4.69"	9.2"
2.5"	5.24	7.01"	9.57"	13.2"	15.7"	5.12"	12"
3	6.22"	7.32"	10.40"	13.5"	16.6"	6.10"	15"
4	7.40"	8.43"	12.04"	14.6"	18.2"	7.20"	22"

* With signal converter MAG 5000 or MAG 6000 installed weight is increased by approx. 4.4 lbs.

Built-in length

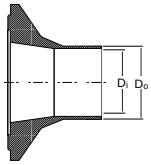


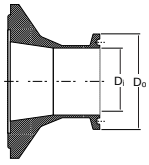
Sensor Size	A	L **
.375	3.90"	5.75"
.5	3.90"	5.75"
1	4.45"	6.34"
1.5	4.96"	6.93"
2	6.06"	7.32"
2.5	6.50"	8.78"
3	7.87"	10.5"
4	8.86"	11.34"

** The total built-in length "L" is independent of the adapter type selected.

Accessories

Mag 1100 food



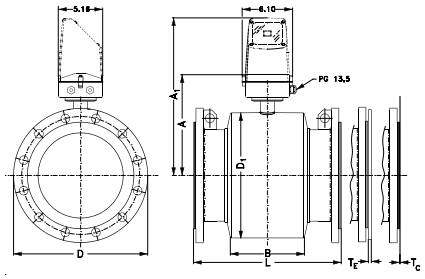


	Tri-Clover®		Tri-Clamp®	
Sensor Size	**Di**	**Do**	**Di**	**Do**
.5	0.53	0.63		
1			0.89	2
1.5	1.40	1.52	1.4	2
2	1.91	2.03	1.91	2.52
2.5	2.37	2.52	2.37	3.05
3	2.87	3.02	2.87	3.58
4	3.85	4.04	3.85	4.69

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

Dimensions

Sensor mag 3100



Size	A[1]	A_1	B	D_1	L[2] ANSI 16.5 Class 150	L[2] ANSI 16.5 Class 300	L[2] AWWA C-207 Class D	T_C[3]	T_E[3]	Weight[4]
.5"	7.36"	13.31"	2.32"	4.09"	7.87"	7.87"		-	0.24"	11"
1"	7.36"	13.31"	2.32"	4.09"	7.87"	7.87"		0.05"	0.24"	13"
1.5"	7.76"	13.70"	3.23"	4.88"	7.87"	7.87"		0.05"	0.24"	17"
2"	8.07"	14.01"	2.83"	5.47"	7.87"	7.87"		0.05"	0.24"	28"
2.5"	8.35"	14.29"	2.83"	6.06"	7.87"	10.71"		0.05"	0.24"	30"
3"	8.74"	14.69"	2.83"	6.85"	10.71"	10.71"		0.05"	0.24"	33"
4"	9.53"	15.47"	3.35"	8.43"	9.84"	12.20"		0.05"	0.24"	44"
5"	10.04"	15.98"	3.35"	9.41"	9.84"	13.10"		0.05"	0.24"	55"
6"	10.87"	16.81"	5.39"	11.10"	11.81"	11.81"		0.05"	0.24"	66"
8"	11.97"	17.91"	5.39"	13.31"	13.78"	13.78"		0.05"	0.31"	110"
10"	13.07"	19.02"	5.39"	15.47"	17.72"	17.72"		0.05"	0.31"	155"
12"	14.05"	20.00"	5.39"	17.48 "	19.69"	19.69"		0.06"	0.31"	176"
14"	14.25"	20.20"	10.63"	17.76"	21.65"	21.65"	-	0.06"	0.31"	242"
16"	15.24"	21.18"	10.63"	19.76"	23.62"	23.62"	-	0.06"	0.39"	275"
18"	16.45"	22.40"	12.20"	22.16"	23.62"	25.20"	-	0.06"	0.39"	385"
20"	17.44"	23.39"	13.78"	24.17"	26.77"	28.70"	-	0.06"	0.39"	440"
24"	19.45"	25.39"	16.93"	28.15"	32.28	33.80"	-	0.06"	0.39"	660"
28"	21.42"	27.36"	19.69"	32.13"	-	-	34.5"	0.08"	-	770"
30"	22.48"	28.43"	21.89"	34.21"	-	-	36.9"	0.08"	-	880"
32"	23.86"	29.80"	22.05"	36.50"	-	-	39.4"	0.08"	-	1045"
36"	25.71"	31.65"	24.80"	40.63"	-	-	44.3"	0.08"	-	1233"
40"	27.72"	35.67"	26.38"	44.72"	-	-	49.2"	0.08"	-	1541"
44"	29.72"	35.67"	30.31"	48.74"	-	-	-	0.08"	-	
48"	31.89"	37.83"	31.18"	53.07"	-	-	59.1"	0.08"	-	2751"
56"	36.42"	42.36"	39.37"	65.94"	-	-	68.9"	0.12"	-	3211"
60"	38.27"	44.21"	40.15"	65.83"	-	-	73.8"	0.12"	-	3731"
64"	40.35"	46.30"	44.49"	75.39"	-	-	78.7"	0.12"	-	4257"
72"	44.21"	50.16"	49.21"	77.72"	-	-	88.5"	0.12"	-	5291"
80"	48.15"	54.09"	54.13"	85.59"	-	-	98.4"	0.12"	-	7492"

1 0.5" shorter with AISI terminal box (Ex and high temperature)

2 When earthing flanges are used the thickness of the earthing flange must be added to the built-in length

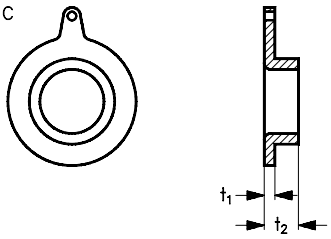
3 T_C = Type C grounding ring, T_E = Type E grounding ring

4 Weights are approx and for ANSI 150 without signal converter.

D = Outside diameter of flange, see flange tables

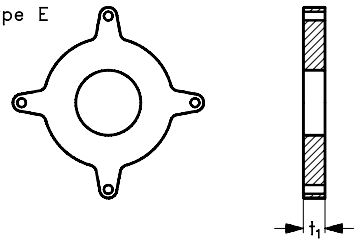
Eathing/protection flange

Type C



Size	t_1	t_2	Weight (lbs)
1" to 10"	0.05"	0.6"	0.07-0.9
12" to 24"	0.06"	0.8"	1.3-5.7
28" to 48"	0.08"	1.0"	6.6-11.0
56" to 80"	0.12"	1.6"	20.0-35.0

Type E



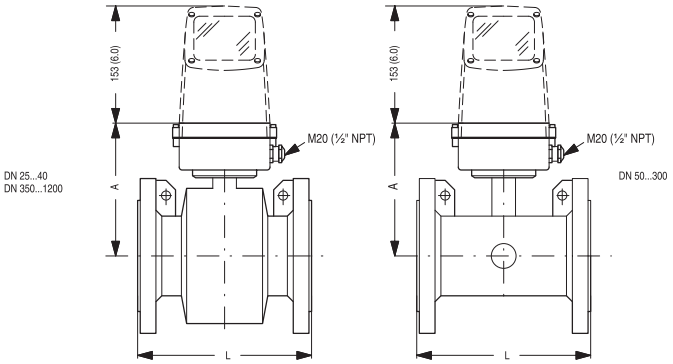
Size	t_1	Weight
.5"	0.2	0.15
1" to 6"	0.2	0.7-3.0
8" to 14"	0.3	3.7-9.0
16" to 24"	0.4	14.0-28.0

Type C flanges for liners of neoprene, EPDM, linatex® and ebonite.
Type E flanges for liners of PTFE.
MAG 3100 high temperature (PTFE) is always equipped with 2 pcs. type E earthing flanges.

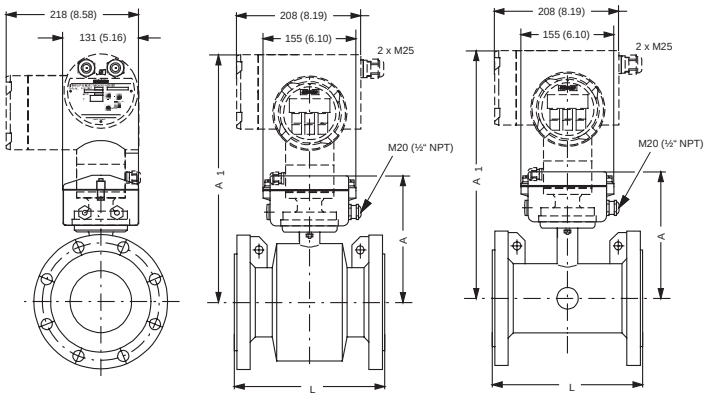
Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

Dimensions

MAG 5100 W



MAG 5100 W / 6000 I Compact



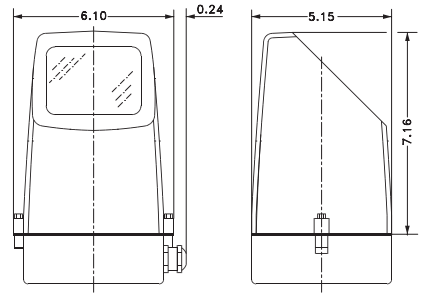
Nominal size		A		A_1		L									
						PN 10		PN 16		PN 40		Class 150/AWWA		AS	
[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
25	1	187	7.4	340	13.4	-	-	-	-	200	7.9	200	7.9	200	7.87
40	1½	197	7.8	350	13.8	-	-	-	-	200	7.9	200	7.9	200	7.87
50	2	188	7.4	341	13.4	-	-	200	7.9	-	-	200	7.9	200	7.87
65	2½	194	7.6	347	13.7	-	-	200	7.9	-	-	200	7.9	200	7.87
80	3	200	7.9	353	13.9	-	-	200	7.9	-	-	200	7.9	200	7.87
100	4	207	8.1	360	14.2	-	-	250	9.8	-	-	250	9.8	250	9.84
125	5	217	8.5	370	14.6	-	-	250	9.8	-	-	250	9.8	250	9.84
150	6	232	9.1	385	15.2	-	-	300	11.8	-	-	300	11.8	300	11.81
200	8	257	10.1	410	16.1	350	13.8	350	13.8	-	-	350	13.8	350	13.78
250	10	284	11.2	437	17.2	450	17.7	450	17.7	-	-	450	17.7	450	17.72
300	12	310	12.2	463	18.2	500	19.7	500	19.7	-	-	500	19.7	500	19.69
350	14	382	15.0	535	21.1	550	21.7	550	21.7	-	-	550	21.7	550	21.65
400	16	407	16.0	560	22.1	600	23.6	600	23.6	-	-	600	23.6	600	23.62
450	18	438	17.2	591	23.3	600	23.6	600	23.6	-	-	600	23.6	600	23.62
500	20	463	18.2	616	24.3	600	23.6	600	23.6	-	-	600	23.6	600	23.6
600	24	514	20.2	667	26.3	600	23.6	600	23.6	-	-	600	23.6	600	23.6
700	28	564	22.2	717	28.2	700	27.6	700	27.6	-	-	700	27.6	700	27.6
750	30	591	23.3	744	29.3	-	-	-	-	-	-	750	29.5	750	-
800	32	616	24.3	779	30.7	800	31.5	800	31.5	-	-	800	31.5	800	31.5
900	36	663	26.1	826	32.5	900	35.4	900	35.4	-	-	900	35.4	900	35.4
1000	40	714	28.1	877	34.5	1000	39.4	1000	39.4	-	-	1000	39.4	1000	39.4
	42	714	28.1	877	34.5	-	-	-	-	-	-	1000	39.4	-	-
	44	765	30.1	928	36.5	-	-	-	-	-	-	1100	43.3	-	-
1200	48	820	32.3	983	38.7	1200	47.2	1200	47.2	-	-	1200	47.2	1200	47.2

- not available

Model MAGFLO®
Sensor Model Mag 1100, MAG 1100 Food and MAG 3100
Signal Converter Model MAG 6000 and MAG 5000 MAG 5100 W

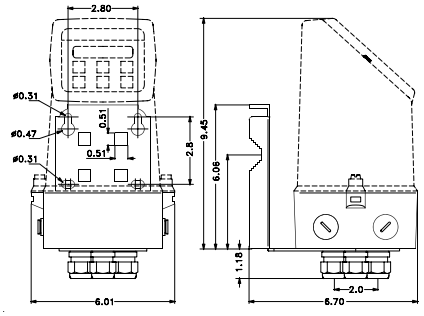
Signal converter compact polyamid—standard

Signal converter installed in compact mode



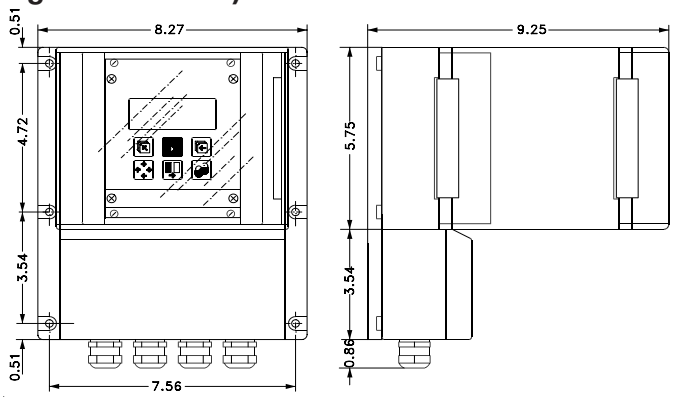
weight: mag 6000
and mag 5000: 1.65 lbs

Signal converter installed remote



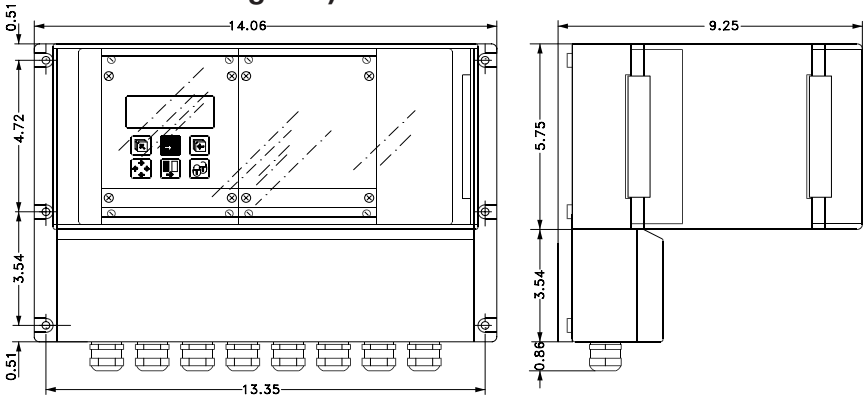
weight: wall bracket: 2.0 lbs

Wall mounting box 21 TE (for optional 19" insert signal converter)



Weight excl. signal converter: 7.56 lbs

Wall mounting box 42 TE (for optional 19" insert signal converter and electrode cleaning unit)



Weight excl. signal converter: 6.4 lbs

MAGFLO MAG 5100 W

Benefits
- DN 25 to DN 1200 (1" to 48")
- Connection flanges EN 1092-1 (DIN 2501), ANSI, AWWA and AS.
- Ebonite Hard Rubber liner for all water applications
- Hastelloy Integrated grounding and measuring electrodes
- Increased low flow accuracy for water leak detection, due to coned liner design.
- Drinking water approvals
- Suitable for direct burial and constant flooding
- Build-in length according to ISO 13359
- Easy commissioning, SENSORPROM unit automatically up-loads calibration values and settings
- Designed that patented in-situ verification can be conducted. Using SENSORPROM fingerprint.

Application
The main applications of the MAGFLO electromagnetic flow sensors can be found in the following fields:
- Water abstraction
- Water treatment
- Water distribution network (leak detection management)
- Custody transfer water meters
- Irrigation
- Waste water treatment
- Filtration plant (e.g. reverse osmosis and ultra filtration
- Industrial Water applications

Mode of operation
The flow measuring principle is based on Faradays law of electromagnetic Induction were the sensor converts the flow into an electrical voltage proportional to the velocity of the flow.

Function
- Highly resistant to a wide range of chemicals
  - — OIML R49 and PTB approved
  - — Conforms to ISO 4064 and EN 14154
  - — MI-0001 Custody Transfer approval for billing
- Meets EEC directives: PED, 97/23/EC pressure directive for #N 1092-1 flanges
- Simple onsite of factory upgrade to IP68/NEMA 6P of standard sensor.

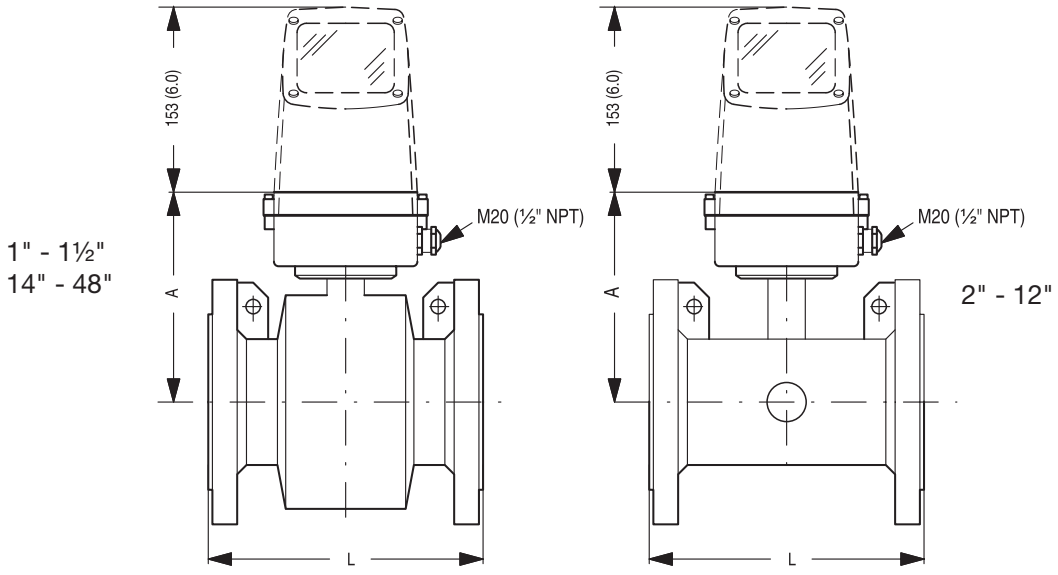
Integration
The complete flow meter consists of a flow sensor and an associated transmitter MAGFLO MAG 5000 or MAG 6000

MAGFLO MAG 5100 W

Technical Specifications

Design	**Full bore sensor**	**Coned bore sensor**	**Full bore sensor**
Nominal size	DN 25 …40 (1" …1 ½")	DN 50 …300 (2" …12")	DN 350 …1200 (14"…48")
Measuring principle	Electromagnetic induction		
Excitation frequency	12.5 Hz	• 50… 65mm (2" …2 ½"): 12.5 Hz • 80 …150mm (3" …6"): 6.25 Hz • 200 … 300mm (8" …12"): 3.125 Hz	DN 350 … 450 (14" …18"): 3.125Hz DN 500… 1200 (20" …48"): 1.5625 Hz
Process connection			
Flanges			
• ANSI B 16.5	Class 150 lb	Class 150 lb ~20 bar (290 psi)	
• AWWA C-207	-	-	28" …48": Class D
Rated Operation Conditions			
Ambient temperature • Sensor • With Compact transmitter MAG 5000/6000	 -40... +70 °C (-40… +158 °F) -20… +50 °C (-4 … +122 °F)		
Operating pressure	0.01 …40bar (0.15 …580 psi)	0.03 …20 bar (0.44…290psi)	0.01...16 bar (0.15 …232psi)
Enclosure rating • Standard • Optiion	 IP67 to EN 60529 / NEMA 4x/6 (1 mH_2O for 30 minutes) IP68 to EN 60529 / NEMA 6P (40 mH_2O continously)		
Pressure drop at 3 m/s (10 ft/s)	As straight pipe	Max. 25 mbar (0.36 psi)	As straight pipe
Medium conditions			
Temperature of medium			
• Ebonite	-10 … +70 ºC {14 … +158ºF)		
EMC	89/336 EEC		
Design			
Weight	See dimensional drawings		
Material • Housing and flanges • Terminal box • Measuring pipe • Liner • Electrodes • Grounding electrodes standard	 Carbon steel, St 37.2 Standard Fibre glass reinforced polyamide AISI 304 (1.4301) Ebonite Hard Rubber (hydro carbon resistent) Hastelloy C276 Hastelloy C276		
Certificates and approvals			
Custody Transfer (only together with MAG 5000/6000 CT) Approvals	OIML R 49 cold water (2” …12”) MI 001 cold water (2” …12”) FM Class 1, Div 2 CSA Class 1, Div 2		
Approvals	CRN		

MAGFLO MAG 5100 W



Nominal Size		A	L		Weight
			Class 150 / AWWA		Class 150 / AWWA
[mm]	[inch]	[inch]	[inch]		[lbs]
25	1	7.4	7.9		9
40	1½	7.8	7.9		13
50	2	7.4	7.9		20
65	2½	7.6	7.9		24
80	3	7.9	7.9		28
100	4	8.1	9.8		41
125	5	8.5	9.8		52
150	6	9.1	11.8		64
200	8	10.1	13.8		124
250	10	11.2	17.7		174
300	12	12.2	19.7		243
350	14	15.0	21.7		307
400	16	16.0	23.6		351
450	18	17.2	23.6		400
500	20	18.2	23.6		495
600	24	20.2	23.6		704
700	28	22.2	27.6		602
750	30	23.3	29.5		725
800	32	24.3	31.5		804
900	36	26.1	35.4		1089
1000	40	28.1	39.4		1282
	42	28.1	39.4		1512
	44	30.1	43.3		1680
1200	48	32.3	47.2		1896

MAGFLO MAG 5100 W

Model Code MAG 5100 W			
DESCRIPTION	**SIZE (IN.)**	**CODE No**	**FLANGE**
Sensor MAG 5100 W - Hard Rubber Liner (ebonite)			
Liner: Ebonite	1”	7ME6580-2DJ14-2AA2	150# ANSI
Accuracy: 0.5% of rate	1 ½ “	7ME6580-2RJ14-2AA2	150# ANSI
Electrodes:Hastelloy C	2”	7ME6580-2YJ14-2AA2	150# ANSI
Enclosure: NEMA 4X, NEMA 6*	2 ½ “	7ME6580-2FJ14-2AA2	150# ANSI
(3-ft. submersible up to 72 hours)	3”	7ME6580-3MJ14-2AA2	150# ANSI
Flange Material: Carbon Steel	4”	7ME6580-3TJ14-2AA2	150# ANSI
Sizes 1” to 24” : ANSI 16.5B, Class 150	5”	7ME6580-4BJ14-2AA2	150# ANSI
Sizes 28” to 48” : AWWA C-207, Class D	6”	7ME6580-4HJ14-2AA2	150# ANSI
Max Temp: 158° F (70°C)	8”	7ME6580-4PJ14-2AA2	150# ANSI
*NEMA 6P when applying submersible kit part # 085U0220	10”	7ME6580-4VJ14-2AA2	150# ANSI
	12”	7ME6580-5DJ14-2AA2	150# ANSI
Code numbers in Bold Type indicate items ordinarily in stock.	14”	7ME6580-5KJ14-2AA2	150# ANSI
Consult factory for confirmation.	16”	7ME6580-5RJ14-2AA2	150# ANSI
	18”	7ME6580-5YJ14-2AA2	150# ANSI
	20”	7ME6580-6FJ14-2AA2	150# ANSI
Coned Design	24”	7ME6580-6PJ14-2AA2	150# ANSI
	28”	7ME6580-6YL14-2AA2	AWWA
	30”	7ME6580-7DL14-2AA2	AWWA
	32”	7ME6580-7HL14-2AA2	AWWA
	36”	7ME6580-7ML14-2AA2	AWWA
	40”	7ME6580-7RL14-2AA2	AWWA
	42”	7ME6580-7UL14-2AA2	AWWA
	44”	7ME6580-7VL14-2AA2	AWWA
	48”	7ME6580-8BL14-2AA2	AWWA

Hydro-Flow 1200
Inline Vortex Flow Meter

Description

The Hydro-Flow Model 1200 inline vortex flow meter was designed specifically for water flow measurement, containing no moving parts like traditional paddlewheel and impeller-type flow meters. Specifically designed for line sizes of 1 to 3 inches (25 to 76 mm), the Hydro-Flow Model 1200 is a full bore, inline flow meter that measures water, water/glycol mixtures, and condensate.

Benefits

- Fast and easy installation
- Rugged and maintenance-free with no moving parts
- Fits line sizes from 1 to 3” (25 to 76 mm)
- Reliable and accurate flow readings—provides ±0.5% of full-scale accuracy and 15:1 turndown ratio

Features

- 2-year extended warranty is the best in the industry
- Ultra low-flow measurement capability
- Reliably processes vortex signals smaller than permitted by other technologies

Applications

- The Hydro-Flow Model 1200 flow meter is ideally suited for:
  - Water
  - Water/Glycol Mixtures
  - Condensate

Ultra Low-Flow Measurement Capability

Hydro-Flow’s unique and proprietary microprocessor based piezo-resistive sensor can accurately and reliably process vortex signals that are 25 times smaller than permitted by other technologies, producing a flow meter of unequal performance and reliability.

Condensate and Hot Water

The Hydro-Flow 1200 is ideal for measuring condensate, withstanding process temperatures up to 160°F (71°C). The Hydro-Flow 1200 contains no moving parts, so excessive mechanical loads on the flow meter (caused by continuous start-stop flow) do not affect the accuracy or mechanical reliability of the flow meter. Additionally, the flow meter is not affected by possible iron, salt, or other deposits found in the water flow.

Hydro-Flow 1200

Specifications

Performance	
Accuracy	Combined linearity and repeatability is ±0.5% of full scale.

Electrical	
Enclosure	Reinforced polycarbonate, NEMA 6
Output Signal Options	
Pulse Output	Frequency proportional to flow rate.
	Power supply: 10 to 32 VDC with current limited by series resistance to between 5 and 20 mA.
	Maximum pulse width is 5 ms. Other settings can be configured by the factory or reconfigured in the field using Hydro-Flow Field-Pro software.
Analog Output	4 to 20 mA analog current loop. Current proportional to flow rate.
	Power supply: 10 to 32 VDC compliance
	4 mA = zero flow; 20 mA = maximum flow. Other 20 mA settings can be reconfigured in the field using Hydro-Flow Field-Pro software.
No Output	Display only
	Power supply: 8 to 32 VDC
	4 mA maximum
Display Option	LCD display alternately shows 4-digit rate and 8-digit total flow.

Mechanical					
Type	Full bore, inline				
Measurable Fluids	Water, water/glycol mixtures, condensate				
Pipe Sizes	1" (25 mm)	1.5" (38 mm)	2" (51 mm)	2.5" (64 mm)	3" (76 mm)
Fluid Temperature	32 to 160°F (0 to 71°C)				
Fluid Pressure	150 psi (10.3 bar) maximum				
Ambient Temperature	-20 to 140°F (-20 to 60°C)				
Flow Range	1' (0.3 m) per second, minimum				
	15' (4.5 m) per second, maximum				
Measuring Units	English = gallons				
	Metric = cubic meters				
	Other measuring units available upon request or measuring units can be reconfigured using Hydro-Flow's Field-Pro, PC compatible configuration software.				
Wetted Parts					
Vortex Sensor	Ultem® (plastic)				
Shedder Bar	316 stainless steel				
Flow Meter Body	Brass				
Stem	Brass				
O-rings	EPDM				
Pipe Connection	Brass—NPTF				
Straight Run Piping	Typical 10 diameters upstream, 5 diameters downstream				

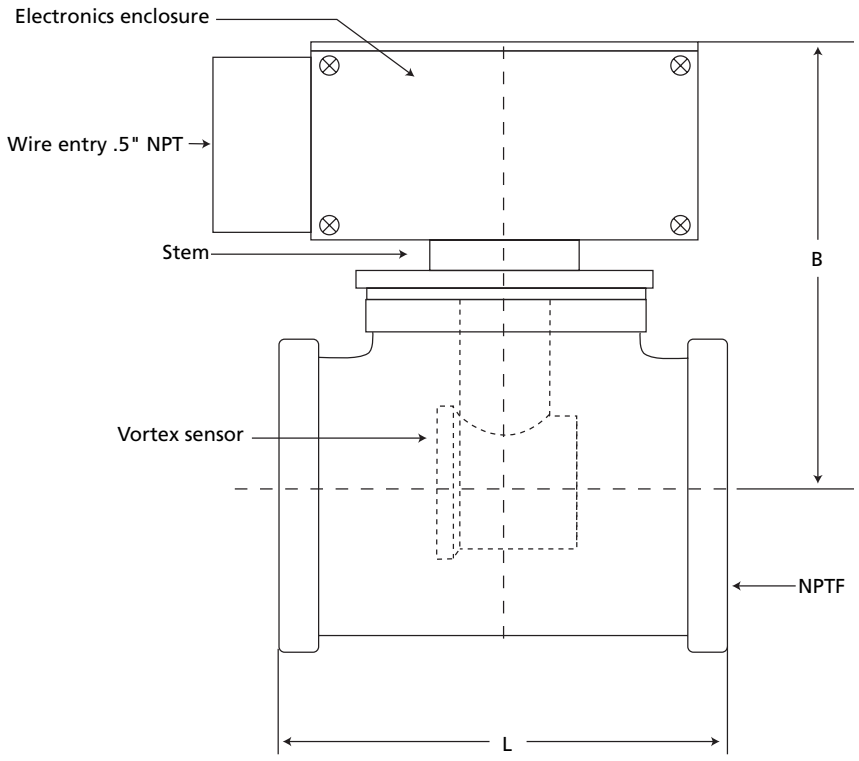
Hydro-Flow 1200

Measurable Flow Rates

Line Size	1" (25 mm)	1.5" (38 mm)	2" (51 mm)	2.5" (64 mm)	3" (76 mm)
Gallons Per Minute					
Minimum Flow	2.6	5.4	10.6	14.0	23.4
Maximum Flow	40	80	160	210	350
Cubic Meters Per Hour					
Minimum Flow	0.60	1.22	2.42	3.18	5.30
Maximum Flow	9.1	18.2	36.3	47.7	79.5
Pulses/Gallon[1]	250	100	50	50	25
Pulses/Cubic Meters[1]	75000	25000	15000	15000	6000

1 When flow meter is configured for pulse output.

Dimensions



Meter Size	L	B
1.0" (25 mm)	3.44" (87.4 mm)	3.85" (97.8 mm)
1.5" (38 mm)	3.63" (92.2 mm)	4.25" (108.0 mm)
2.0" (51 mm)	3.82" (97.0 mm)	4.40" (111.8 mm)
2.5" (64 mm)	4.31" (109.5 mm)	4.90" (124.5 mm)
3.0" (76 mm)	4.55" (115.6 mm)	5.20" (132.1 mm)

Hydro-Flow 1200

Model and Suffix Codes

Category	Suffix Codes					
Type						
Inline	1200					
Line Size						
1.0" (25 mm)		10				
1.5" (38 mm)		15				
2.0" (51 mm)		20				
2.5" (64 mm)		25				
3.0" (76 mm)		30				
Connection						
Brass-NPTF			1			
Output						
Pulse				1		
Current: 4 to 20 mA				2		
No Output				3		
Display						
No Display					1	
Rate/Total Display					2	
Measuring Units						
English						1
Metric						2
Example	**1200-**	**20-**	**1-**	**2-**	**2-**	**2**
	Hydro-Flow 1200-20-1-2-2-2 represents a 2" inline flow meter with a brass tee fitting, 4 to 20 mA analog output and a rate/total display with Metric measuring units					

1 Standard English measuring units for flow rate and totalized flow are gallons per minute (gpm) and gallons, respectively. Standard Metric measuring units for flow rate and totalized flow are cubic meters per hour (m^3/h) and cubic meters (m^3), respectively. Please specify other desired measuring units for which the flow meter should be configured. Other units, such as acre-feet, cubic feet, barrels, and liters are available and can be set by the factory.

2 Watertight cable connector and direct burial lead wires are available. See Accessories section for more information.

Accessories/Options

Description	Part Number
BTU-121 BTU/Energy Measurement System for Chilled and Hot Water	Contact rep or factory
Field-Pro Configuration Program: Software	011110
Communicator Hardware	011113
Hydro-Flow Relay Output Module	011121
AC to DC Converter/Power Supplies	011138
Water-Tight Cable Connector and 18" Direct Burial Cable	011142
Aluminum enclosure	Add **AL** to end of product string

Hydro-Flow 2200
Fixed Insertion Vortex Flow Meter

Description

The Hydro-Flow Model 2200 fixed insertion vortex flow meter was designed specifically for water flow measurement, containing no moving parts like traditional paddlewheel and impeller-type flow meters. Specifically designed for line sizes of 2 to 20 inches (51 to 508 mm), the Hydro-Flow Model 2200 is a fixed insertion flow meter that measures water, water/glycol mixtures, and agriculture/Reuse water.

Benefits

- Fast and easy installation
- Rugged and maintenance-free with no moving parts
- Fits line sizes from 2 to 20” (51 to 508 mm)
- Reliable and accurate flow readings—provides ±1.0% of full-scale accuracy and 15:1 turndown ratio

Features

- 2-year extended warranty is the best in the industry
- Reliably processes vortex signals smaller than permitted by other technologies

Applications

- The Hydro-Flow Model 2200 flow meter is ideally suited for:
  - Water
  - Water/glycol mixtures
  - Agriculture/Reuse water

Ultra Low-Flow Measurement Capability

Hydro-Flow’s unique and proprietary microprocessor based piezo-resistive sensor can accurately and reliably process vortex signals that are 25 times smaller than permitted by other technologies, producing a flow meter of unequal performance and reliability.

Diverse Water Applications

The Hydro-Flow 2200 is ideal for measuring water applications, withstanding process temperatures 32-160°F (0-71°C). The Hydro-Flow 2200 contains no moving parts, so excessive mechanical loads on the flow meter (caused by continuous start-stop flow) do not affect the accuracy or mechanical reliability of the flow meter. An optional aluminum electronics enclosure can ensure performance in wet environments. Additionally, the flow meter is not affected by possible iron, salt, or other deposits found in the water flow.

Hydro-Flow 2200 Fixed Insertion Vortex Flow Meter

Specifications

Performance	
Accuracy	Combined linearity and repeatability is ±1.0% of full scale.

Electrical	
Enclosure	Reinforced polycarbonate, NEMA 4X
Output Signal Options	
Pulse Output	Frequency proportional to flow rate.
	Power supply: 10 to 32 VDC with current limited by series resistance to between 5 and 20 mA.
	Maximum pulse width is 5 ms. Other pulse output settings can be configured by the factory or reconfigured in the field using Hydro-Flow Field-Pro software.
Analog Output	4 to 20 mA analog current loop. Current proportional to flow rate.
	Power Supply: 10 to 32 VDC compliance
	4 mA = zero flow; 20 mA = maximum flow.
No Output	Display only
	Power supply: 8 to 32 VDC
	4 mA maximum
Display Option	LCD display alternately shows 4-digit rate and 8-digit total flow.

Mechanical	
Type	Fixed Insertion
Measurable Fluids	Water, water/glycol mixtures, condensate
Pipe Sizes	2 to 20" (51 to 508 mm)
Fluid Temperature	32 to 160°F (0 to 71°C) all connections
Fluid Pressure	400 psi (27.5 bar) maximum for thread-o-let
	300 psi (20.7 bar) maximum for saddle connection
	150 psi (10.3 bar) maximum for tee connection
Process Temperature	32 to 160°F (0 to 71°C)
Flow Range	1' (0.3 m) per second, minimum
	15' (4.5 m) per second, maximum
Measuring Units	English = gallons
	Metric = cubic meters
	Other measuring units available upon request or measuring units can be reconfigured using Hydro-Flow's Filed-Pro, PC compatible configuration software.
Wetted Parts	
Vortex Sensor	Ultem® (plastic)
Shedder Bar	316 stainless steel
Compression Fitting	Brass
Stem	316 Stainless Steel
O-rings	EPDM
Straight Run Piping	Typical 10 diameters upstream, 5 diameters downstream
Mounting Options	Carbon steel saddle for steel or PVC pipes
	Carbon steel thread-o-let
	Brass tee fitting
	Pipe connection – 1.5" NPTF

Hydro-Flow 2200 Fixed Insertion Vortex Flow Meter

Measurable Flow Ranges

Line Size	2" (51 mm)	3" (76 mm)	4" (102 mm)	6" (152 mm)	8" (203 mm)	10" (254 mm)
Gallons per Minute						
Minimum Flow	10.6	23.4	40.0	100.0	166.6	266.6
Maximum Flow	160	350	600	1500	2500	4000
Cubic Meters per Hour						
Minimum Flow	2.4	5.4	9.2	22.8	38.0	60.6
Maximum Flow	36.3	79.5	136.3	340.7	556.8	908.5
Pulses/Gallon[1]	50	25	15	6	4	2
Pulses/Cubic Meters[1]	15000	6000	5000	2000	1000	500

Line Size	12" (305 mm)	14" (356 mm)	16" (406 mm)	18" (457 mm)	20" (508 mm)
Gallons Per Minute					
Minimum Flow	368	418	568	734	934
Maximum Flow	5500	6250	8500	11000	14000
Cubic Meters per Hour					
Minimum Flow	83.4	94.8	128.8	166.6	212
Maximum Flow	1249.2	1419.5	1930.6	2498.4	3179.7
Pulses/Gallon[1]	2	1	1	1	0.5
Pulses/Cubic Meters[1]	500	500	200	200	200

1 When flow meter is configured for pulse output.

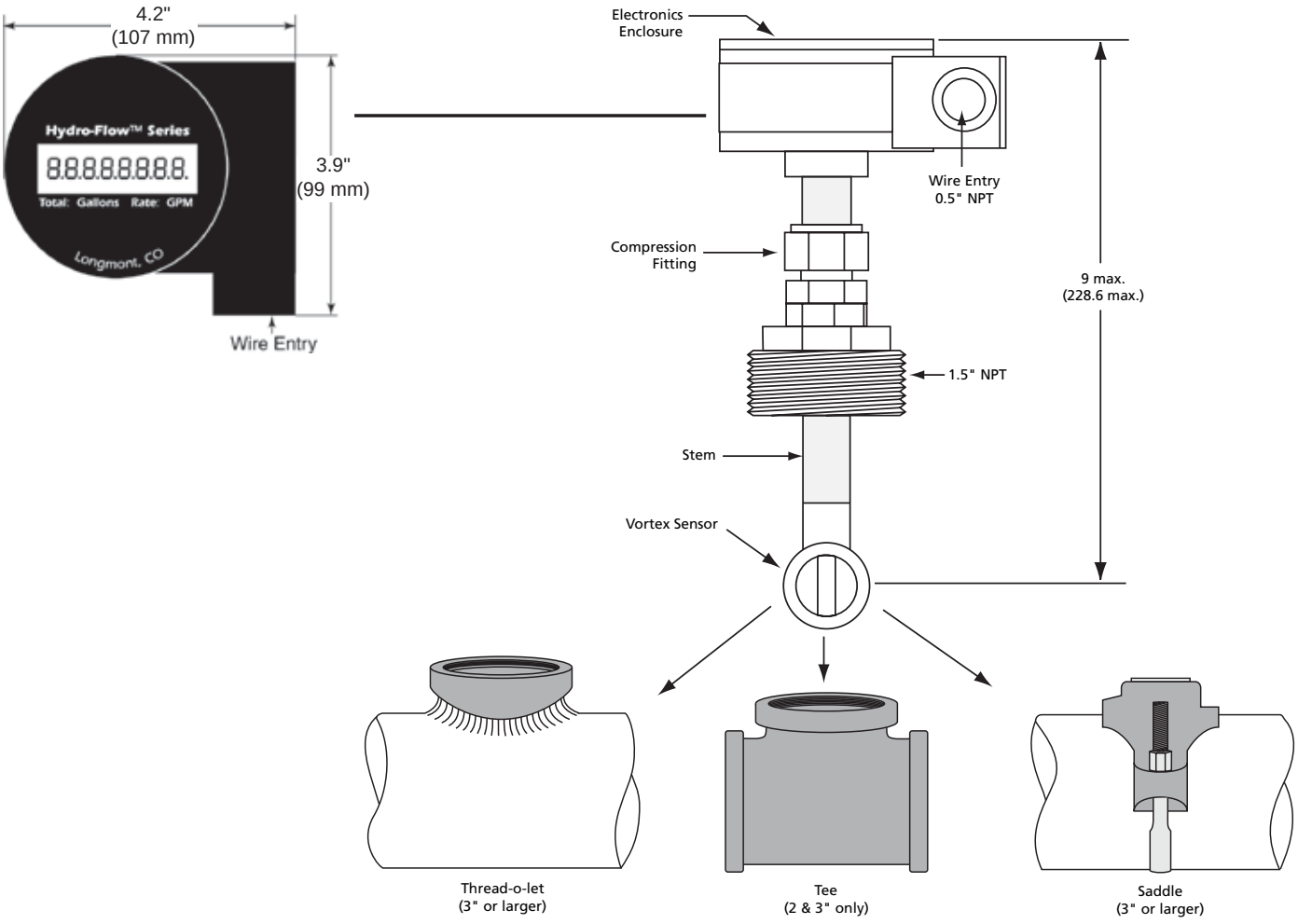
Hydro-Flow 2200 Fixed Insertion Vortex Flow Meter

Hardware Installation

The Hydro-Flow model 2200 is a fixed insertion flow meter with a 1-½'' NPT mounting thread. The pipe must be depressurized prior to flow meter installation and/or removal. Three standard accessory mounting fittings are recommended for flow meter installation.

- **Thread-o-let:** The thread-o-let is recommended for permanent installation requiring minimal service and is good for high-pressure (up to 400 psi) applications.
- **Tee Fitting:** The tee fitting is installed only for 2'' and 3'' pipe sizes. Installation requires no special machining, hole cutting or welding. Pressure is limited to 150 psi
- **Saddle Clamp:** The saddle clamp is recommended when welding is not feasible. Saddles can be used for steel and PVC pipe. Pressure is limited to 300 psi.

Model 2200 Hydro-Flow mechanical drawing with condulet detail



Hydro-Flow 2200 Fixed Insertion Vortex Flow Meter

Making Electrical Connections

Cabling (Pulse Output)

The cable may be up to 2000 feet of #20 AWG or larger shielded two-conductor cable. The shield lead from the meter may be connected to an earth ground, such as a copper cold water pipe. The shield improves noise immunity and provides a return path for electrical surges. Its use is optional in installations in which electrical transients and noise are not a problem.

Current Limiting Resistor (Pulse Output)

The current limiting resistor is required to limit the normal operating current in the flow meter to a value between 5 mA and 20 mA (with a meter voltage of 8 volts and less than 25 mA). The value of the resistor is determined by the power supply voltage, the operating meter current, and the cable resistance.

Table 1 lists standard ½ watt 5% resistor values which will work in most installations. For power supply voltages between those in the table, use the lower value of resistor.

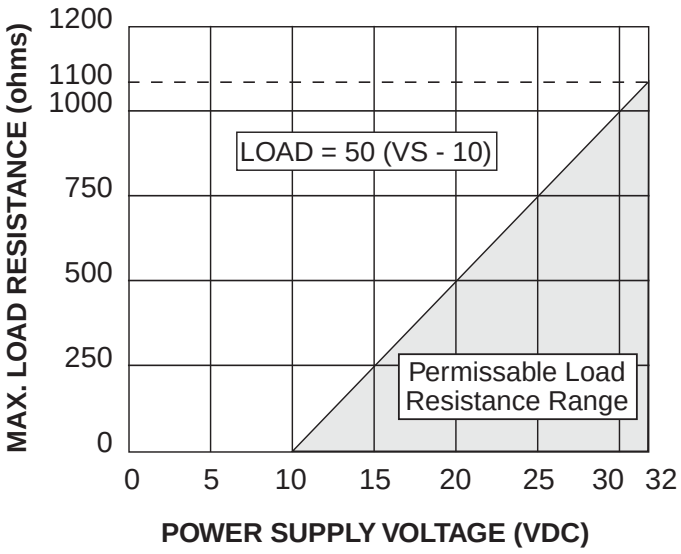
Caution: If the flow meter is wired backwards to the current-limited power source, the flow meter will not be damaged but it will not function properly.

Supply Voltage (DC)	Current Limiting Resister Values (Ω)	
	Minimum	Maximum
10	400	400
12	480	800
14	560	1200
16	640	1600
18	720	2000
20	800	2400
22	880	2800
24	960	3200
26	1040	3600
28	1120	4000
30	1200	4400
32	1280	4800

Table 1. Current limiting resistor for pulse output

Cabling (4 mA to 20 mA Output or No Output)

The flow meter may be connected with up to 2000 feet of #22 AWG or larger cable. Shielded cable may be necessary in some environments to reduce electrical noise; if used, the shield should be connected at one end only to an earth ground point, such as a copper cold water pipe.



Hydro-Flow 2200 Fixed Insertion Vortex Flow Meter

Category	Suffix Codes					
Type						
Fixed Insertion	2200					
Line Size						
2" (51 mm) through 20" (508 mm)		02 to 20				
Mounting						
Thread-o-let (3" and larger)			1			
Saddle for Steel Pipe (3" and larger)			2			
Saddle for PVC Pipe (3" and larger)			3			
Tee (2" and 3" only)			4			
None (retrofit)			5			
Output						
Pulse				1		
Current: 4 to 20 mA				2		
No Output				3		
Display						
No Display					1	
Rate/Total Display					2	
Measuring Units						
English						1
Metric						2
Example	2200-	08-	3-	1-	2-	1
	Hydro-Flow 2200-08-3-1-2-1 represents an 8" fixed insertion flow meter with saddle mounting for PVC pipe, pulse output and a rate/total display with English measuring units.					

1 Standard English measuring units for flow rate and totalized flow are gallons per minute (gpm) and gallons, respectively. Standard metric measuring units for flow rate and totalized flow are cubic meters per hour (m^3/h) and cubic meters (m^3), respectively. Please specify other desired measuring units for which the flow meter should be configured. Other units, such as acre-feet, cubic feet, barrels, and liters are available and can be set by the factory.

2 Watertight cable connector and direct burial lead wires are available. See Accessories section for more information.

3 Please specify pipe size, material, and schedule (or outside and inside diameter of pipe).

4 To order the Aluminum electronics enclosure put AL on the end of the product string.

Aluminum Electronics Enclosure Advantages and Uses:

- Solid Enclosure—NEMA 6P environmental protection (prolonged submersion)
- Field Serviceable
- Designed to withstand wet environments, direct burial, and heavy industrial installations
- Fluid Temperature 32 to 160°F (0 to 71°C)
- Accuracy ±1% of full scale
- Line size 2 to 20" (50 to 500mm)

Accessories

Description	Part Number
BTU-121 BTU/Energy Measurement System for Chilled and Hot Water	Contact rep or factory
Field-Pro Configuration Program: Software	011110
Communicator Hardware	011113
Hydro-Flow Relay Output Module	011121
AC to DC Converter/Power Supplies	011138
Water-Tight Cable Connector and 18" Direct Burial Cable	011142

Hydro-Flow 2300
Fixed Insertion Vortex Flow Meter

Description

The Hydro-Flow Model 2300 insertion vortex flow meter was designed specifically for water flow measurement, containing no moving parts like traditional paddlewheel and impeller-type flow meters. Specifically designed for line sizes of 0.5 to 8 inches (13 to 203 mm), the Hydro-Flow Model 2300 is an insertion flow meter that measures ultrapure water, dionized water, acids, and solvents.

Benefits

- Fast and easy installation
- Fits line sizes from 0.5 to 8” (13 to 203 mm)
- Rugged and maintenance-free with no moving parts
- Reliable and accurate flow readings—provides ±1.0% of full-scale accuracy and 15:1 turndown ratio

Features

- 2-year extended warranty is the best in the industry
- Ultra low-flow measurement capability
- Reliably processes vortex signals smaller than permitted by other technologies

Applications

- The Hydro-Flow Model 2300 flow meter is ideally suited for:
  - Ultrapure Water
  - Dionized water
  - Acids
  - Solvents
  - Water

Ultra Low-Flow Measurement Capability

Hydro-Flow’s unique and proprietary microprocessor based piezo-resistive sensor can accurately and reliably process vortex signals that are 25 times smaller than permitted by other technologies, producing a flow meter of unequal performance and reliability.

Ultrapure Water, Deionized Water, Acids, and Solvents

The Model 2300 is manufactured from PVDF for flow measurement of ultrapure water, deionized water, acids, solvents, and other corrosive fluids, making it an idea solution for use in semi-conductor and chemical wet processes. The Model 2300 design has no internal crevices, or “dead space”, eliminating the risk of bacterial growth and contamination. Unlike traditional paddlewheel and impeller type flow meters, which can wear over time or shed particles into the system, Hydro-Flow’s no moving parts technology eliminates the possibility of fluid and process contamination. The Model 2300 is designed to retrofit into most +GF+ Signet fittings without modifications to the existing piping system.

Hydro-Flow 2300 Fixed Insertion Vortex Flow Meter

Specifications

Performance	
Accuracy	Combined linearity and repeatability is ±1.0% of full scale.

Electrical	
Enclosure	Reinforced polycarbonate, NEMA 6
Output Signal Options	
Pulse Output	Frequency proportional to flow rate.
	Power supply: 10 to 32 VDC with current limited by series resistance to between 5 and 20 mA.
	Maximum pulse width is 5 ms. Other pulse output settings can be configured by the factory or reconfigured in the field using Hydro-Flow Field-Pro software.
Analog Output	4 to 20 mA analog current loop. Current proportional to flow rate.
	Power Supply: 10 to 32 VDC compliance
	4 mA = zero flow; 20 mA = maximum flow.
Display Option	LCD display alternately shows 4-digit rate and 8-digit total flow.

Mechanical	
Type	Insertion
Measurable Fluids	Ultrapure water, dionized water, acids, solvents, water
Pipe Sizes	0.5 to 8" (13 to 203 mm)
Fluid Temperature	32 to 160°F (0 to 71°C) (See Graph 1)
Ambient Temperature	-20 to 140°F (-29 to 60°C)
Flow Range	1' (0.3 m) per second, minimum
	15' (4.5 m) per second, maximum
Measuring Units	English = gallons
	Metric = cubic meters
	Other measuring units available upon request or measuring units can be reconfigured using Hydro-Flow's Field-Pro, PC compatible configuration software.
Wetted Parts	
Sensor/Bar/Stem	PVDF
O-rings	Viton®
Straight Run Piping	Typical 10 diameters upstream, 5 diameters downstream
Mounting Options	Retrofit: Fits existing +GF+ Signet tee fitting
	Union tee fitting: PVDF or PP for 0.5 to 2"
	Tee fitting: CPVC or PVC for 0.5 to 1.5"

Hydro-Flow 2300 Fixed Insertion Vortex Flow Meter

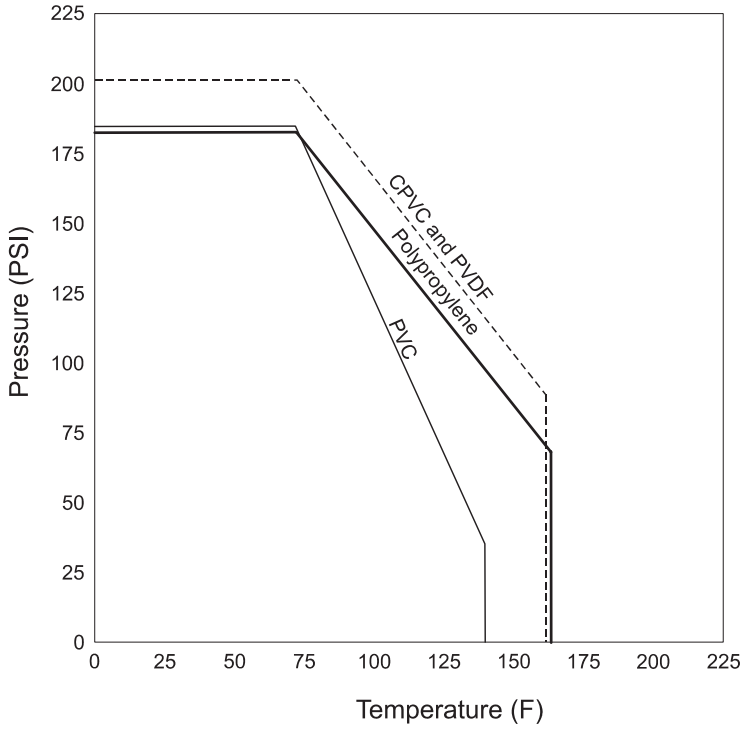
Measurable Flow Ranges

Line Size	0.5" (13 mm)	0.75" (19 mm)	1" (25 mm)	1.25" (32 mm)	1.5" (38 mm)	2" (51 mm)
Gallons per minute						
Minimum Flow	1.0	1.6	2.6	4.0	7.0	11.4
Maximum Flow	13.7	23	40	60	103	168
Cubic Meters per Hour						
Minimum Flow	0.24	0.36	0.6	0.9	1.6	2.6
Maximum Flow	3.1	5.2	9.1	13.8	23.5	38.1
Pulses/Gallon[1]	550	330	200	125	75	45
Pulses/Cubic Meters[1]	150000	85000	55000	35000	20000	12000

Line Size	2.5" (64 mm)	3" (76 mm)	4" (102 mm)	5" (127 mm)	6" (152 mm)	8" (203 mm)
Gallons Per Minute						
Minimum Flow	15.4	23.4	36.6	56.6	81.6	146.6
Maximum Flow	228	348	558	855	1226	2204
Cubic Meters per Hour						
Minimum Flow	3.6	5.4	8.4	13.0	18.6	33.4
Maximum Flow	51.9	78.1	126.7	194.4	278.5	500.6
Pulses/Gallon[1]	35	20	15	10	5	3
Pulses/Cubic Meters[1]	9000	6000	3500	2500	1500	1000

1 When flow meter is configured for pulse output.

Graph 1. Process Pressure/Temperature



Hydro-Flow 2300 Fixed Insertion Vortex Flow Meter

Cabling (Pulse Output)

The cable may be up to 2000 feet of #20 AWG or larger shielded two-conductor cable. The shield lead from the meter may be connected to an earth ground, such as a copper cold water pipe. The shield improves noise immunity and provides a return path for electrical surges. Its use is optional in installations in which electrical transients and noise are not a problem.

Current Limiting Resistor (Pulse Output)

The current limiting resistor is required to limit the normal operating current in the flow meter to a value between 5 mA and 20 mA (with a meter voltage of 8 volts and less than 25 mA). The value of the resistor is determined by the power supply voltage, the operating meter current, and the cable resistance.

Table 1 lists standard 1/2 watt 5% resistor values which will work in most installations. For power supply voltages between those in the table, use the lower value of resistor.

Load Resistances (4 mA to 20 mA Output)

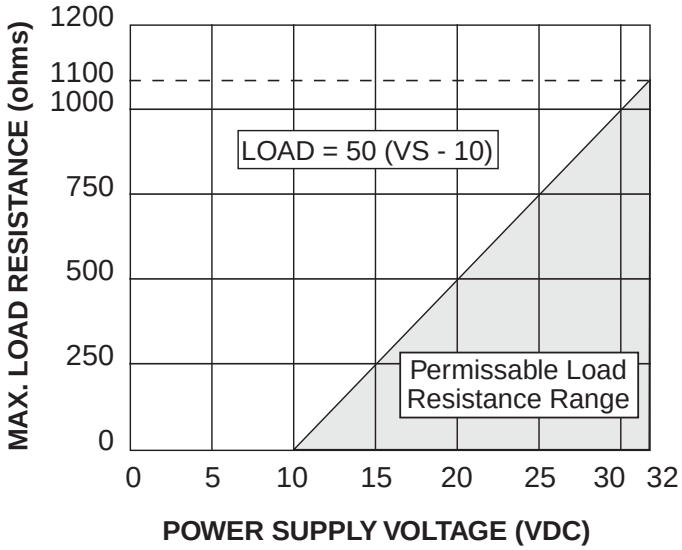
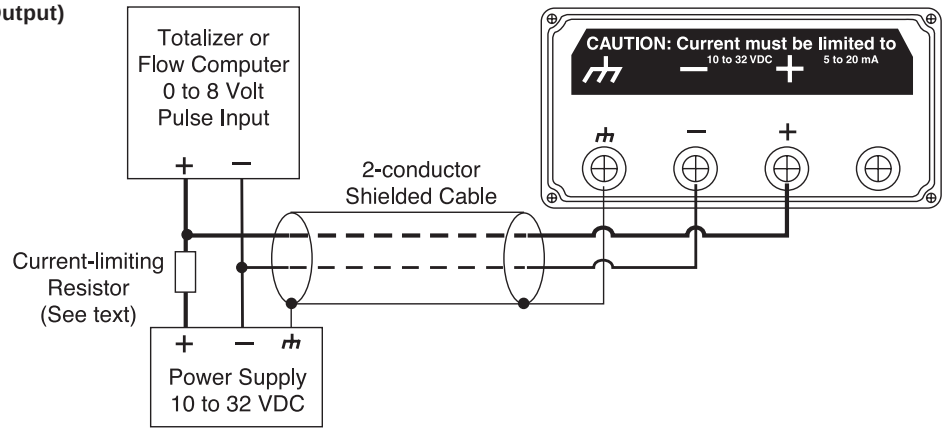


Table 1. Current limiting resistor (pulse output)

Supply Voltage (DC)	Current Limiting Resister Values (Ω)	
	Minimum	Maximum
10	400	400
12	480	800
14	560	1200
16	640	1600
18	720	2000
20	800	2400
22	880	2800
24	960	3200
26	1040	3600
28	1120	4000
30	1200	4400
32	1280	4800

Figure 1. Wiring Diagram (Pulse Output)



Hydro-Flow 2300 Fixed Insertion Vortex Flow Meter

Mechanical Illustrations

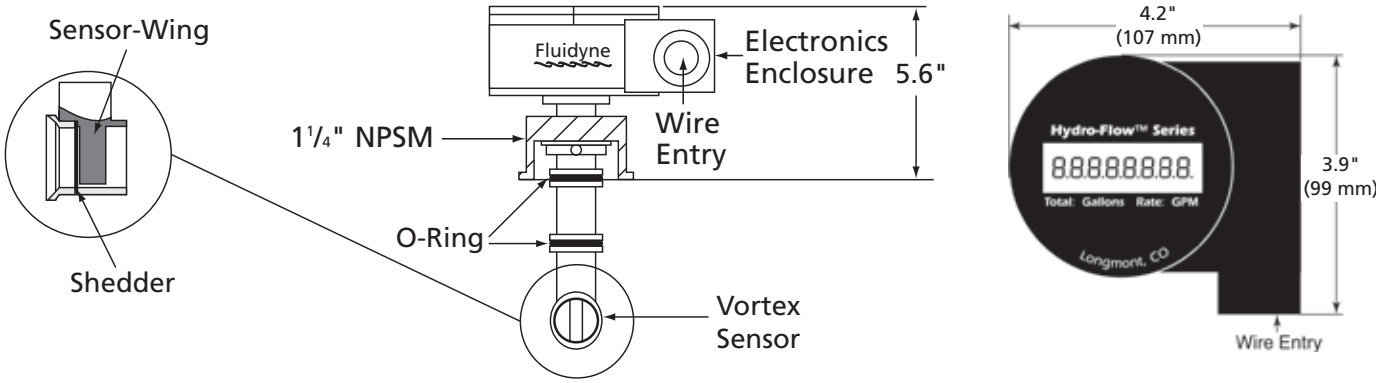
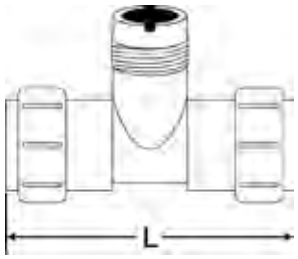


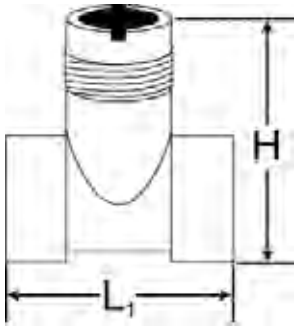
Figure 3. Model 2300 mechanical drawing and condulet (with display) dimensions

Union Tee Fitting



Meter Size Inches (mm)	0.5" (15)	0.75" (20)	1" (25)	1.25" (30)	1.5" (40)	2" (50)
L	5.05 (128)	5.59 (142)	6.14 (156)	6.33 (161)	6.93 (156)	7.64 (194)
H	3.43 (87)	3.57 (91)	4.17 (106)	4.35 (111)	6.26 (159)	5.75 (146)

Tee Fitting



Meter Size Inches (mm)	0.5" (15)	0.75" (20)	1" (25)	1.25" (30)	1.5" (40)
H	3.73 (95)	3.93 (100)	4.30 (109)	4.35 (111)	4.90 (124)
W	3.81 (97)	4.06 (103)	4.17 (106)	4.38 (111)	4.60 (117)

Hydro-Flow 2300 Fixed Insertion Vortex Flow Meter

Retrofit Compatibility to Signet Fittings

Size	Material*			
	CPVC	PVC	PVDF	Polypropylene
0.5" (13 mm)	Not compatible	Not compatible	SFMT005 Union Tee	PPMT005 Union Tee
0.75" (19 mm)	Not compatible	Not compatible	SFMT007 Union Tee	PPMT007 Union Tee
1" (25 mm)	Not compatible	Not compatible	SFMT010 Union Tee	PPMT010 Union Tee
1.25" (32 mm)	CPV8T012F Tee CPV8T012 Saddle	CPV8T012F Tee CPV8T012 Saddle	SFMT012 Union Tee	PPMT012 Union Tee
1.5" (38 mm)	CPV8T015F Tee CPV8T015 Saddle	CPV8T015F Tee CPV8T015 Saddle	SFMT015 Union Tee	PPMT015 Union Tee
2" (51 mm)	N/A	N/A	SFMT020 Union Tee	PPMT020 Union Tee
2.5" (64 mm)	N/A	N/A	SFMT025 Wafer	PPMT025 Wafer
3" (76 mm)	N/A	N/A	SFMT035 Wafer	PPMT030 Wafer
4" (102 mm)	N/A	N/A	SFMT040 Wafer	PPMT040 Wafer
5" (127 mm)	N/A	N/A	SFMT050 Wafer	PPMT050 Wafer
6" (152 mm)	N/A	N/A	SFMT060 Wafer	PPMT060 Wafer
8" (203 mm)	N/A	N/A	SFMT080 Wafer	PPMT080 Wafer

Accessories

Description	Part Number
BTU-121 BTU/Energy Measurement System for Chilled and Hot Water	Contact rep or factory
Field-Pro Configuration Program: Software	011110
Communicator Hardware	011113
Hydro-Flow Relay Output Module	011121
AC to DC Converter/Power Supplies	011138
Water-Tight Cable Connector and 18" Direct Burial Cable	011142

* Consult factory for stainless steel tee fitting retrofits.

Hydro-Flow 2300 Fixed Insertion Vortex Flow Meter

Model and Suffix Codes

Category	Suffix Codes				
Type					
Fixed Insertion - PVDF	2300				
Line Size					
0.5" (13 mm)		05			
0.75" (19 mm)		07			
1" (25 mm)		10			
1.25" (32 mm)		12			
1.5" (38 mm)		15			
2" (51 mm)		20			
2.5" (64 mm)		25			
3" (76 mm)		30			
4" (102 mm)		40			
5" (127 mm)		50			
6" (152 mm)		60			
8" (203 mm)		80			
Mounting					
Supplied by EMCO					
EMCO CPVC (0.5" to 1.5" line sizes only)			02		
EMCO PVC (0.5" to 1.5" line sizes only)			03		
EMCO PVDF (0.5" to 2.0" line sizes only)			04		
EMCO Polypropylene (0.5" to 2.0" line sizes only)			05		
Retrofit to +GF+Signet fitting and no EMCO mountings required					
Retrofit to +GF+Signet CPVC fitting			2R		
Retrofit to +GF+Signet PVC fitting			3R		
Retrofit to +GF+Signet PVDF fitting			4R		
Retrofit to +GF+Signet polypropylene fitting			5R		
Output/Display					
Pulse/No Display				1	
4 to 20 mA/Rate and Total Display				2	
Pulse Rate and Total Display				3	
4 to 20 mA/No Display				4	
Measuring Units					
English					1
Metric					2
Example	**2300-**	**12-**	**04-**	**2-**	

Hydro-Flow 2300-12-04-2-1 represents a 1.25" PVDF fixed insertion flow meter with a PVDF union tee fitting and 4 to 20 mA analog output with a rate/total display with English measuring units.

Retrofit Example: Hydro-Flow 2300-40-4R-2-1 represents a 4" PVDF fixed insertion vortex flow meter to be retrofit to existing PVDF fitting (Signet p/n SFMT040 wafer) with current, 4 to 20 mA output, with a rate/total display with English measuring units.

Ordering Considerations

1 Consult factory for stainless steel tee fitting retrofits.

2 Standard English measuring units for flow rate and totalized flow are gallons per minute (gpm) and gallons, respectively. Standard metric measuring units for flow rate and totalized flow are cubic meters per hour (m^3/h) and cubic meters (m^3), respectively. Please specify other desired measuring units for which the flow meter should be configured. Other units, such as acre-feet, cubic feet, barrels, and liters are available and can be set by the factory.

3 Watertight cable connector and direct burial lead wires are available. See Accessories section for more information.

4 Please specify pipe size/material and pipe schedule and OUTSIDE AND INSIDE DIAMETER OF PIPE.

Hydro-Flow 3100
Retractable Insertion Vortex Flow Meter

Description

The Hydro-Flow Model 3100 Retractable Insertion Vortex Flow Meter was designed specifically for water flow measurement, containing no moving parts like traditional paddlewheel and impeller-type flow meters. Specifically designed for line sizes of 3 to 20 inches (50 to 500 mm), the Hydro-Flow Model 3100 is a fixed insertion flow meter that measures water, water/glycol mixtures, and condensate.

Benefits

- Fast and easy installation
- Rugged and maintenance-free with no moving parts
- Fits line sizes from 3 to 20" (80 to 500 mm)
- Reliable and accurate flow readings—provides ±1.0% of full-scale accuracy and 15:1 turndown ratio

Features

- 2-year extended warranty is the best in the industry
- Ultra low-flow measurement capability
- Reliably processes vortex signals smaller than permitted by other technologies

Applications

- The Hydro-Flow Model 3100 flow meter is ideally suited for:
  - Water
  - Water/glycol mixtures
  - Condensate

Ultra Low-Flow Measurement Capability

Hydro-Flow's unique and proprietary microprocessor based piezo-resistive sensor can accurately and reliably process vortex signals that are 25 times smaller than permitted by other technologies, producing a flow meter of unequal performance and reliability.

Condensate and Hot Water

The Hydro-Flow 3100 is ideal for measuring condensate, withstanding process temperatures up to 160°F (71°C). The Hydro-Flow 3100 contains no moving parts, so excessive mechanical loads on the flow meter (caused by continuous start-stop flow) do not affect the accuracy or mechanical reliability of the flow meter. Additionally, the flow meter is not affected by possible iron, salt, or other deposits found in the water flow.

Hydro-Flow 3100 Retractable Insertion Vortex Flow Meter

Specifications

Performance	
Accuracy	Combined linearity and repeatability is ±1.0% of full scale.

Electrical	
Enclosure	Reinforced polycarbonate, NEMA 6
Output Signal Options	
Pulse Output	Frequency proportional to flow rate.
	Power supply: 10 to 32 VDC with current limited by series resistance to between 5 and 20 mA.
	Maximum pulse width is 5 ms. Other pulse output settings can be configured by the factory or reconfigured in the field using Hydro-Flow Field-Pro software.
Analog Output	4 to 20 mA analog current loop. Current proportional to flow rate.
	Power Supply: 10 to 32 VDC compliance
	4 mA = zero flow; 20 mA = maximum flow.
No Output	Display only
	Power supply: 8 to 32 VDC
	4 mA maximum
Display Option	LCD display alternately shows 4-digit rate and 8-digit total flow.

Mechanical	
Type	Retractable Insertion
Measurable Fluids	Water, water/glycol mixtures, condensate
Pipe Sizes	3 to 20" (80 to 500 mm)
Fluid Temperature	32 to 160°F (0 to 71°C) all connections
Fluid Pressure	400 psi (27.5 bar) maximum for thread-o-let
	300 psi (20.7 bar) maximum for saddle connection
Ambient Temperature	-20 to 140°F (-29 to 60°C)
Flow Range	1' (0.3 m) per second, minimum
	15' (4.5 m) per second, maximum
Measuring Units	English = gallons
	Metric = cubic meters
	Other measuring units available upon request or measuring units can be reconfigured using Hydro-Flow's Filed-Pro, PC compatible configuration software.
Wetted Parts	
Vortex Sensor	Ultem® (plastic)
Shedder Bar	316 stainless steel
Valve	Brass
Stem	316 Stainless Steel
O-rings	EPDM
Straight Run Piping	Typical 10 diameters upstream, 5 diameters downstream
Mounting Options	Carbon steel saddle for steel pipes
	Carbon steel thread-o-let
	Pipe connection – 2" NPTF

Hydro-Flow 3100 Retractable Insertion Vortex Flow Meter

Measurable Flow Ranges

Line Size	3" (80 mm)	4" (100 mm)	6" (150 mm)	8" (200 mm)	10" (250 mm)
Gallons per Minute					
Minimum Flow	23.4	40.0	100.0	166.6	266.6
Maximum Flow	350	600	1500	2500	4000
Cubic Meters per Hour					
Minimum Flow	5.4	9.2	22.8	38.0	60.6
Maximum Flow	79.5	136.3	340.7	556.8	908.5
Pulses/Gallon[1]	25	15	6	4	2
Pulses/Cubic Meters[1]	6000	5000	2000	1000	500

Line Size	12" (300 mm)	14" (350 mm)	16" (400 mm)	18" (450 mm)	20" (500 mm)
Gallons Per Minute					
Minimum Flow	368	418	568	734	934
Maximum Flow	5500	6250	8500	11000	14000
Cubic Meters per Hour					
Minimum Flow	83.4	94.8	128.8	166.6	212
Maximum Flow	1249.2	1419.5	1930.6	2498.4	3179.7
Pulses/Gallon[1]	2	1	1	1	0.5
Pulses/Cubic Meters[1]	500	500	200	200	200

1 When flow meter is configured for pulse output.

Hydro-Flow 3100 Retractable Insertion Vortex Flow Meter

Category	Suffix Codes					
Type						
Retractable Insertion	3100					
Line Size						
3" (80 mm) through 20" (500 mm)		03 to 20				
Mounting						
Thread-o-let (3" and larger)			1			
Saddle for Steel Pipe (3" and larger)			2			
Output						
Pulse				1		
Current: 4 to 20 mA				2		
No Output				3		
Display						
No Display					1	
Rate/Total Display					2	
Measuring Units						
English						1
Metric						2
Example	2200-	08-	3-	1-	2-	1
	Hydro-Flow 3100-08-2-1-2-1 represents an 8" retractable insertion flow meter with saddle mounting for steel pipe, pulse output and a rate/total display with English measuring units.					

1 Standard English measuring units for flow rate and totalized flow are gallons per minute (gpm) and gallons, respectively. Standard metric measuring units for flow rate and totalized flow are cubic meters per hour (m^3/h) and cubic meters (m^3), respectively. Please specify other desired measuring units for which the flow meter should be configured. Other units, such as acre-feet, cubic feet, barrels, and liters are available and can be set by the factory.

2 Watertight cable connector and direct burial lead wires are available. See Accessories section for more information.

3 Please specify pipe size, material, and schedule (or outside and inside diameter of pipe).

Accessories

Description	Part Number
BTU-121 BTU/Energy Measurement System for Chilled and Hot Water	
Field-Pro Configuration Program: Software	
Hydro-Flow Relay Output Module	
AC to DC Converter/Power Supplies	
Water-Tight Cable Connector and 18" Direct Burial Cable	011142

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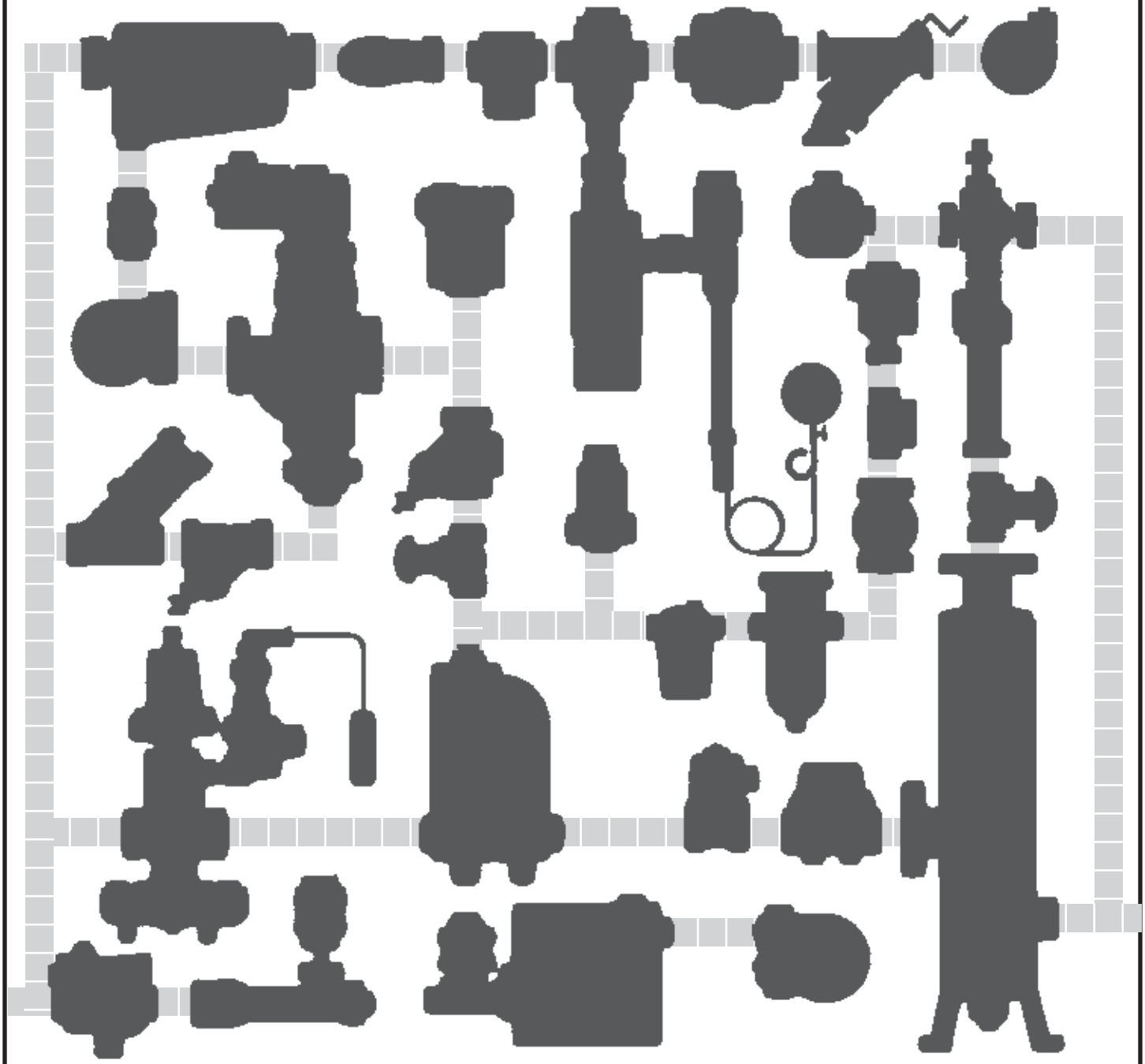
Engineering Data



Properties of Saturated Steam

Gauge Pressure psig	Temperature °F	Heat in Btu/lb Sensible	Latent	Total	Specific Volume ft³/lb
INS. VAC. 25	134	102	1017	1119	142
20	162	129	1001	1130	73.9
15	179	147	990	1137	51.3
10	192	160	982	1142	39.4
5	203	171	976	1147	31.8
0	212	180	970	1150	26.8
1	215	183	968	1151	25.2
2	219	187	966	1153	23.5
3	222	190	964	1154	22.3
4	224	192	962	1154	21.4
5	227	195	960	1155	20.1
6	230	198	959	1157	19.4
7	232	200	957	1157	18.7
8	233	201	956	1157	18.4
9	237	205	954	1159	17.1
10	239	207	953	1160	16.5
12	244	212	949	1161	15.3
14	248	216	947	1163	14.3
16	252	220	944	1164	13.4
18	256	224	941	1165	12.6
20	259	227	939	1166	11.9
22	262	230	937	1167	11.3
24	265	233	934	1167	10.8
25	267	234	933	1169	10.3
26	268	236	933	1169	10.3
28	271	239	930	1169	9.85
30	274	243	929	1172	9.46
32	277	246	927	1173	9.10
34	279	248	925	1173	8.75
35	281	250	924	1174	8.6
36	282	251	923	1174	8.42
38	284	253	922	1175	8.08
40	286	256	920	1176	7.82
42	289	258	918	1176	7.57
44	291	260	917	1177	7.31
45	292	261	916	1177	7.21
46	293	262	915	1177	7.14
48	295	264	914	1178	6.94
50	298	267	912	1179	6.68
55	300	271	909	1180	6.27
60	307	277	906	1183	5.84
65	312	282	901	1183	5.49
70	316	286	898	1184	5.18
75	320	290	895	1185	4.91
80	324	294	891	1185	4.67
85	328	298	889	1187	4.44
90	331	302	886	1188	4.24
95	335	305	883	1188	4.05
100	338	309	880	1189	3.89
105	341	312	878	1190	3.74
110	344	316	875	1191	3.59
115	347	319	873	1192	3.46
120	350	322	871	1193	3.34
125	353	325	868	1193	3.23
130	356	328	866	1194	3.12
140	361	333	861	1194	2.92
145	363	336	859	1195	2.84
150	366	339	857	1196	2.74
155	368	341	855	1196	2.68

Gauge Pressure psig	Temperature °F	Heat in Btu/lb Sensible	Latent	Total	Specific Volume ft³/lb
160	371	344	853	1197	2.60
165	373	346	851	1197	2.54
170	375	348	849	1197	2.47
175	377	351	847	1198	2.41
180	380	353	845	1198	2.34
185	382	355	843	1198	2.29
190	384	358	841	1199	2.24
195	386	360	839	1199	2.19
200	388	362	837	1199	2.14
205	390	364	836	1200	2.09
210	392	366	834	1200	2.05
215	394	368	832	1200	2.00
220	396	370	830	1200	1.96
225	397	372	828	1200	1.92
230	399	374	827	1201	1.89
235	401	376	825	1201	1.85
240	403	378	823	1201	1.81
245	404	380	822	1202	1.78
250	406	382	820	1202	1.75
255	408	383	819	1202	1.72
260	409	385	817	1202	1.69
265	411	387	815	1202	1.66
270	413	389	814	1203	1.63
275	414	391	812	1203	1.60
280	416	392	811	1203	1.57
285	417	394	809	1203	1.55
290	418	395	808	1203	1.53
295	420	397	806	1203	1.49
300	421	398	805	1203	1.47
305	423	400	803	1203	1.45
310	425	402	802	1204	1.43
320	427	405	799	1204	1.38
330	430	408	796	1204	1.34
340	433	411	793	1204	1.31
350	435	414	790	1204	1.28
360	438	417	788	1205	1.24
370	441	420	785	1205	1.20
380	443	422	783	1205	1.18
390	446	425	780	1205	1.14
400	448	428	777	1205	1.12
450	460	439	766	1205	1.00
500	470	453	751	1204	.89
550	479	464	740	1204	.82
600	489	473	730	1203	.75
650	497	483	719	1202	.69
700	505	491	710	1201	.64
750	513	504	696	1200	.60
800	520	512	686	1198	.56
900	534	529	666	1195	.49
1000	546	544	647	1191	.44
1250	574	580	600	1180	.34
1500	597	610	557	1167	.23
1750	618	642	509	1151	.22
2000	636	672	462	1134	.19
2250	654	701	413	1114	.16
2500	669	733	358	1091	.13
2750	683	764	295	1059	.11
3000	696	804	213	1017	.08

Calculating Condensate Loads

When the normal condensate load is not known, the load can be approximately determined by calculations using the following formulae.

General Usage Formulae

Heating water with steam (Exchangers)*

$$\text{lb/h Condensate} = \frac{\text{GPM}}{2} \times (1.1) \times \text{Temperature Rise } ^\circ\text{F}$$

Heating fuel oil with steam

$$\text{lb/h Condensate} = \frac{\text{GPM}}{4} \times (1.1) \times \text{Temperature Rise } ^\circ\text{F}$$

Heating air with steam coils

$$\text{lb/h Condensate} = \frac{\text{CFM}}{800} \times \text{Temperature Rise } ^\circ\text{F}$$

Steam Radiation

$$\text{lb/h Condensate} = \frac{\text{Sq. Ft. E. D. R.}}{4}$$

$$\text{lb/h Condensate} = \frac{\text{BTU/HR}}{\text{Latent Heat at Operating Pressure}}$$

$$\text{lb/h Condensate} = \frac{\text{MBH} \times 1{,}000}{\text{Latent Heat at Operating Pressure}}$$

*Delete the (1.1) factor when steam is injected directly into water.

Specialized Applications

Sterilizers, Autoclaves, Retorts Heating Solid Material

$$\text{lb/h Condensate} = \frac{W \times Cp \times \Delta T}{L \times t}$$

W = Weight of material — lbs.
Cp = Specific heat of the material
ΔT = Temperature rise of the material ˚F
L = Latent heat of steam Btu/lb
t = Time in hours

Steam Jacketed Dryers

$$\text{lb/h Condensate} = \frac{1000\,(Wi - Wf) + (Wi \times \Delta T)}{L}$$

Wi = Initial weight of the material — pounds per hour
Wf = Final wether of the material — pounds per hour
ΔT = Temperature rise of the material ˚F
L = Latent heat of steam Btu/lb

Heating Liquids in Steam Jacketed Kettles and Steam Heated Tanks

$$\text{lb/h Condensate} = \frac{G \times s.g. \times Cp \times \Delta T \times 8.3}{L \times t}$$

G = Gallons of liquid to be heated
s.g. = Specific gravity of the liquid
Cp = Specific heat of the liquid
ΔT = Temperature rise of the liquid ˚F
L = Latent heat of the steam Btu/lb
t = Time in hours

Heating Air with Steam; Pipe Coils and Radiation

$$\text{lb/h Condensate} = \frac{A \times U \times \Delta T}{L}$$

A = Area of the heating surface in square feet
U = Heat transfer coefficient (2 for free convection)
ΔT = Steam temperature minus the air temperature ˚F
L = Latent heat of the steam Btu/lb

Note: The condensate load to heat the equipment must be added to the condensate load for heating the material. Use same formula

Steam Tracing Lines:

Approximate load is 10 to 50 lb/h for each 100 ft. of tracer

Recommended Safety Factors for Steam Traps

The actual safety factor to use for any particular application will depend upon accuracy of:
1. Estimated load
2. Estimated pressure at trap
3. Estimated backpressure

Any unusual or abnormal conditions must be taken into consideration.

Safety Factor by Type of Trap	Safety Factor
Balanced-Pressure Thermostatic Traps	2 to 4
Thermo-Matic ThermostaticTraps	1.5 to 2.5
Liquid Expansion Traps	2 to 4
Bimetallic Traps	2 to 3
Float and Thermostatic Traps	1.5 to 2.5
Inverted Bucket Traps	2 to 3
Thermo-Dynamic® Traps	1.2 to 2

Safety Factor by Application	General	With Temp. Control
Mains Drainage	x 2	—
Storage Heaters	x 2	—
Unit Heaters	x 2	x 3
Air Heating Coils	x 2	x 4
Submerged Coils (low level drain)	x 2	—
Submerged Coils (siphon drain)	x 3	—
Rotating Cylinders	x 3	—
Tracing Lines	x 2	—
Platen Presses	x 2	—

Rule of Thumb: Use factor of 2 on everything except Temperature Controlled Air Heater Coils and Converters, and Siphon applications

Effect of Backpressure on Steam Trap Capacity

% Reduction in Capacity

Backpressure % of Inlet	Inlet Pressure PSIG 5	25	100	200
25%	6%	3%	0%	0%
50	20	12	10	5
75	38	30	28	23

Warm-up and Condensate Load Tables

Warm-up Load in Pounds of Steam per 100 ft of Steam Main (based on a start-up timer of 1 hour)

Ambient Temperature 70˚F. Based on Sch. 40 Pipe to 250 psi, Sch. 80 Above 250 Except Sch. 120 5" and Larger Above 800 psi.

Steam Pressure Pressure (psig)	2"	2-1/2"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"	0˚F Correction Factor*
0	6.2	9.7	12.8	18.2	24.6	31.9	48	68	90	107	140	176	207	208	1.50
5	6.9	11.0	14.4	20.4	27.7	35.9	48	77	101	120	157	198	233	324	1.44
10	7.5	11.8	15.5	22.0	29.9	38.8	58	83	109	130	169	213	251	350	1.41
20	8.4	13.4	17.5	24.9	38.8	44	66	93	124	146	191	241	284	396	1.37
40	9.9	15.8	20.6	29.3	39.7	52	78	110	145	172	225	284	334	465	1.32
60	11.0	17.5	22.9	32.6	44	57	86	122	162	192	250	316	372	518	1.29
80	12.0	19.0	24.9	35.3	48	62	93	132	175	208	271	342	403	561	1.27
100	12.8	20.3	26.6	37.8	51	67	100	142	188	222	290	366	431	600	1.26
125	13.7	21.7	28.4	40	55	71	107	152	200	238	310	391	461	642	1.25
150	14.5	23.0	30.0	43	58	75	113	160	212	251	328	414	487	679	1.24
175	15.3	24.2	31.7	45	61	79	119	169	224	265	347	437	514	716	1.23
200	16.0	25.3	33.1	47	64	83	125	177	234	277	362	456	537	748	1.22
250	17.2	27.3	35.8	51	69	89	134	191	252	299	390	492	579	807	1.21
300	25.0	38.3	51	75	104	143	217	322	443	531	682	854	1045	1182	1.20
400	27.8	43	57	83	116	159	241	358	493	590	759	971	1163	1650	1.18
500	30.2	46	62	91	126	173	262	389	535	642	825	1033	1263	1793	1.17
600	32.7	50	67	98	136	187	284	421	579	694	893	1118	1367	1939	1.16
800	38	58	77	113	203	274	455	670	943	1133	1445	1835	2227	3227	1.156
1000	42	72	86	126	227	305	508	748	1052	1264	1613	2048	2485	3601	1.147
1200	47	72	96	140	253	340	566	833	1172	1407	1796	2280	2768	4010	1.140
1400	52	79	106	155	280	376	627	922	1298	1558	1988	2525	3064	4440	1.135
1600	57	87	117	171	309	415	692	1018	1432	1720	2195	2787	3383	4901	1.130
1750	62	94	126	184	333	448	746	1098	1545	1855	2367	3006	3648	5286	1.128
1800	63	97	129	189	341	459	765	1126	1584	1902	2427	3082	3741	5420	1.127

*For outdoor temperature of 0˚F, multiply load value in table for each main size by correction factor shown.

Condensate Load in Pounds per Hour per 100 ft. of Insulated Steam Main

Ambient Temperature 70˚F — Insulation 80% Efficient. Load Due to Radiation and Convection for Saturated Steam

Steam Pressure Pressure (psig)	2"	2-1/2"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"	0˚F Correction Factor*
10	6	7	9	11	13	16	20	24	29	32	36	39	44	53	1.58
40	8	9	11	14	17	20	26	32	38	42	48	51	57	68	1.50
60	10	12	14	18	24	27	33	41	49	54	62	67	74	89	1.45
100	12	15	18	22	28	33	41	51	61	67	77	83	93	111	1.41
125	13	16	20	24	30	36	45	56	66	73	84	90	101	121	1.36
175	16	19	23	26	33	38	53	66	78	86	98	107	119	142	1.38
250	18	22	27	34	42	50	62	77	92	101	116	126	140	168	1.36
300	20	25	30	37	46	54	68	85	101	111	126	138	154	184	1.33
400	23	28	34	43	53	63	80	99	118	130	148	162	180	216	1.32
500	27	33	39	49	61	73	91	114	135	148	170	185	206	246	1.32
600	30	37	44	55	68	82	103	128	152	167	191	208	232	277	1.31
800	36	44	53	69	85	101	131	164	194	214	244	274	305	365	1.30
1000	43	52	63	82	101	120	156	195	231	254	290	326	363	435	1.27
1200	51	62	75	97	119	142	185	230	274	301	343	386	430	515	1.26
1400	60	73	89	114	141	168	219	273	324	356	407	457	509	610	1.25
1600	70	85	103	132	163	195	253	315	375	412	470	528	588	704	1.22
1750	77	93	113	145	179	213	278	346	411	452	516	580	645	773	1.22
1800	79	96	117	150	185	221	288	358	425	467	534	600	667	800	1.21

*For outdoor temperature of 0˚F, multiply load value in table for each main size by correction factor shown.

Heat Transfer Calculations

Heat Emission Rates from Pipes Submerged in Water

Published Overall Heat Transfer Rates	Btu/ft² h ˚F
Tank Coils, Steam/Water (Temperature difference 50˚F)	100 to 225
Tank Coils, Steam/Water (Temperature difference 100˚F)	175 to 300
Tank Coils, Steam/Water Temperature difference 200˚F	225 to 475
Reasonable Practical Heat Transfer Rates	
Tank Coils, low pressure with natural circulation	100
Tank Coils, high pressure with natural circulation	200
Tank Coils, low pressure with assisted circulation	200
Tank Coils, high pressure with assisted circulation	300

Heat Emission Coefficients from Pipes Submerged in Miscellaneous Fluids

The viscosity of fluids has a considerable bearing on heat transfer characteristics and this varies in any case with temperature. The following figures will therefore serve only as a rough guide.

Immersed steam coil, medium pressure, natural convection

	Btu/ft² h ˚F difference
Light Oils	30
Heavy Oils	15 to 20
*Fats	5 to 10

Immersed steam coil, medium pressure, natural convection

	Btu/ft² h ˚F difference
Light Oils (220 SSU at 100˚F)	100
Medium Oils (1100 SSU at 100˚F)	60
Heavy Oils (3833 SSU at 100˚F)	30

Average Heat Loss from Oil in Storage Tanks and Pipe Lines

	Position	Oil Temperature	* Heat Transfer Rate in Btu/ft² h ˚F temperature difference between oil and surrounding air Exposed	Insulated
Tank	Sheltered	Up to 50˚F	1.2	.3
		Up to 80˚F	1.3	.325
		Up to 100˚F	1.4	.35
Tank	Exposed	Up to 50˚F	1.4	.35
		Up to 80˚F	1.5	.375
		Up to 100˚F	1.6	.4
Tank	In Pit	All Temperatures	1.2	—
Pipe Line	Sheltered	Up to 80˚F	1.5	.375
		80 to 260˚F	2.3	.575
Pipe Line	Exposed	Up to 80˚F	1.8	.45
		80 to 260˚F	2.75	.7

* For maximum heat loss the "surrounding air temperature" may be 25˚F higher or lower according to country and locality.

For rough calculations it may be taken that 1 ton of fuel oil occupies 36 .4 ft³. The specific heat capacity of heavy fuel is 0.45 to 0.48 Btu/lb ˚F.

Heat Transfer from Steam Coils

Approximately 20 Btu/h per square foot of heating surface per ˚F difference between oil and steam temperature.

Heat Transfer from Hot Water Coils

Approximately 10 Btu/h per square foot of heating surface per ˚F difference between oil and steam temperature.

Heat Loss from Open Tanks

Liquid Temp. ˚F	Heat Loss from Liquid Surface Btu/ft² h			Heat Lost through Tank Wall Btu/ft² h			
	Evap. Loss	Rad. Loss	Total	Bare Steel	Insulation 1"	2"	3"
90	80	50	130	50	12	6	4
100	160	70	230	70	15	8	6
110	240	90	330	90	19	10	7
120	360	110	470	110	23	12	9
130	480	135	615	135	27	14	10
140	660	160	820	160	31	16	12
150	860	180	1040	180	34	18	13
160	1100	210	1310	210	38	21	15
170	1380	235	1615	235	42	23	16
180	1740	260	2000	260	46	25	17
190	2160	290	2450	290	50	27	19
200	2680	320	3000	320	53	29	20
210	3240	360	3590	360	57	31	22

The above values are for open tanks in 60˚F still ambient air.

Steam Tracing

Designing of Steam Tracing

Recommended number of 1/2” tracers to meet average requirements

Product Line Size	**Type A** General frost protection or where solidification may occur at temps. below 75˚F Number of 1/2” Tracers	**Type B** Where solidification may occur at temps. between 75 - 150˚F Number of 1/2” Tracers	**Type C** When solidification may occur at temps. between 150 - 300˚F Number of 1/2” Tracers
1”	1	1	1
1-1/2”	1	1	2
2”	1	1	2
3”	1	1	3
4”	1	2	3
6”	2	2	3
8”	2	2	3
10”-12”	2	3	6
14”-16”	2	3	8
18”-20”	2	3	10

As a general rule, length of tracers to 3/8” size should not exceed 60 ft. Larger size tracers should not exceed 150 ft. in length.

Steam Size Connections for Jacketed Lines

Product Line	Jacket Diameter	Steam Connection
2-1/2”	4”	1/2”
3”	6”	3/4”
4”	6”	3/4”
6”	8”	3/4”
8”	10”	1”
10”	12”	1”

Length of jacket should not exceed 20 ft. In most cases 1/2” condensate outlet would be adequate but it is usual to make this same size as the steam connection as it simplifies installation.

Recommended Header Size for Supplying Steam Tracer Lines

Header Size	Number of 1/2” Tracers
3/4”	2
1”	3 to 5
1-1/2”	6 to 15
2”	16 to 30

Recommended Header Size for Condensate Lines

Header Size	Number of 1/2” Tracers
1”	Up to 5
1-1/2”	6 to 10
2”	11 to 25

Steam Pipe Sizing

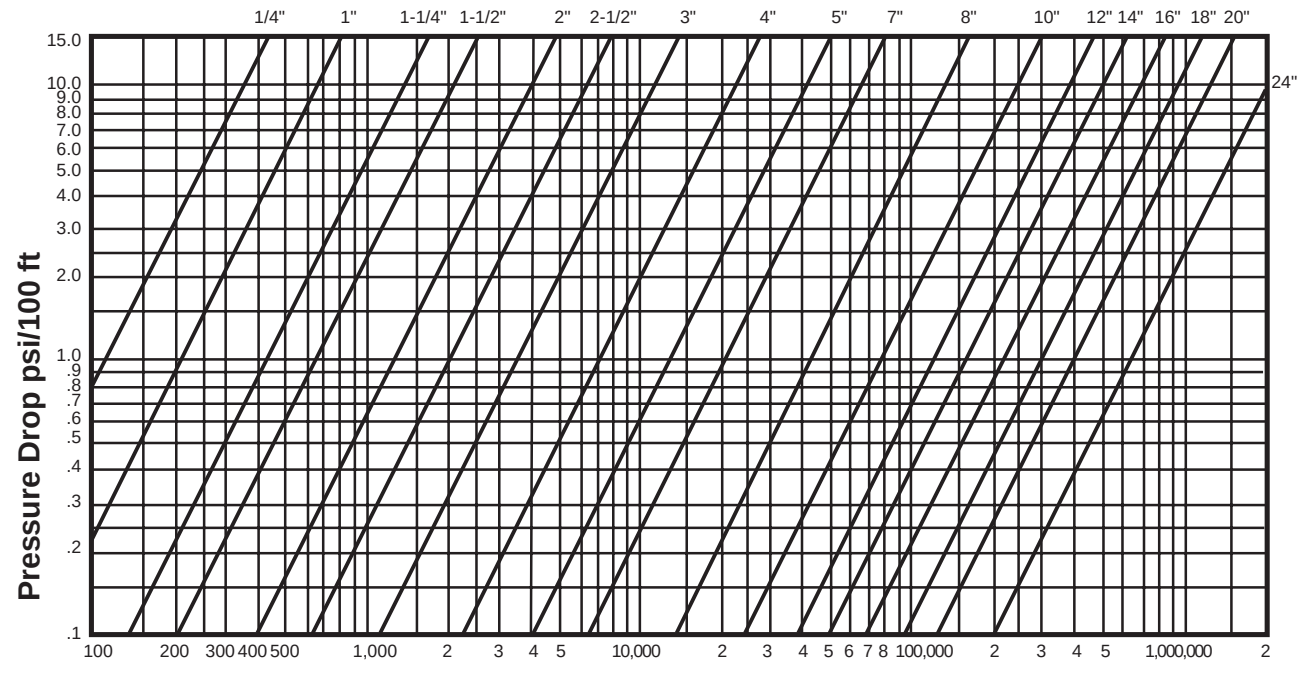
Sizing for Pressure Drop per 100 ft. in Schedule 40 Pipe

Divide “Allowable Drop” by pressure factor and use chart to select pipe size.

Based on 100 psig saturated steam

For other pressures, multiply chart ΔP by factor below

psig	0	2	5	10	15	20	30	40	60	75	90	100	110	125	150	175	200	225	250	300	350	400	500	600
factor	6.9	6.0	5.2	4.3	3.6	3.1	2.4	2.0	1.5	1.3	1.1	1.0	0.92	0.83	0.70	0.62	0.55	0.49	0.45	0.38	0.33	0.29	0.23	0.19



How to Size Steam Pipes for Various Pressure and Velocity Conditions

To select pipe size in long mains and wherever supply pressure is critical, use the pressure drop chart to assure it is within allowable limits. Most saturated steam lines may be sized for a velocity of 4800 to 7200 ft/min; higher velocities should be avoided unless appreciable superheat is present.

Piping at pressure reducing stations should be sized for the same velocity on both sides of the PRV. This generally results in a valve smaller than the supply piping with still larger downstream pressure piping due to the increase in steam volume (see example below.)

Trap discharge piping contains a bi-phase flash steam/condensate mixture, and a lower velocity of 4000 to 6000 ft/min to the receiver encourages gravity separation. The receiver vent line is sized for the amount of flash vented at atmospheric pressure at a velocity of 3000 to 4000 ft/min.

Velocity Chart Example
Given a steam heating piping system with a 100 psig inlet pressure ahead of a control valve with a capacity of 1,000 lb/h of steam reduced to 25 psig, find the smallest sizes of upstream and downstream piping for reasonable quiet steam velocities.

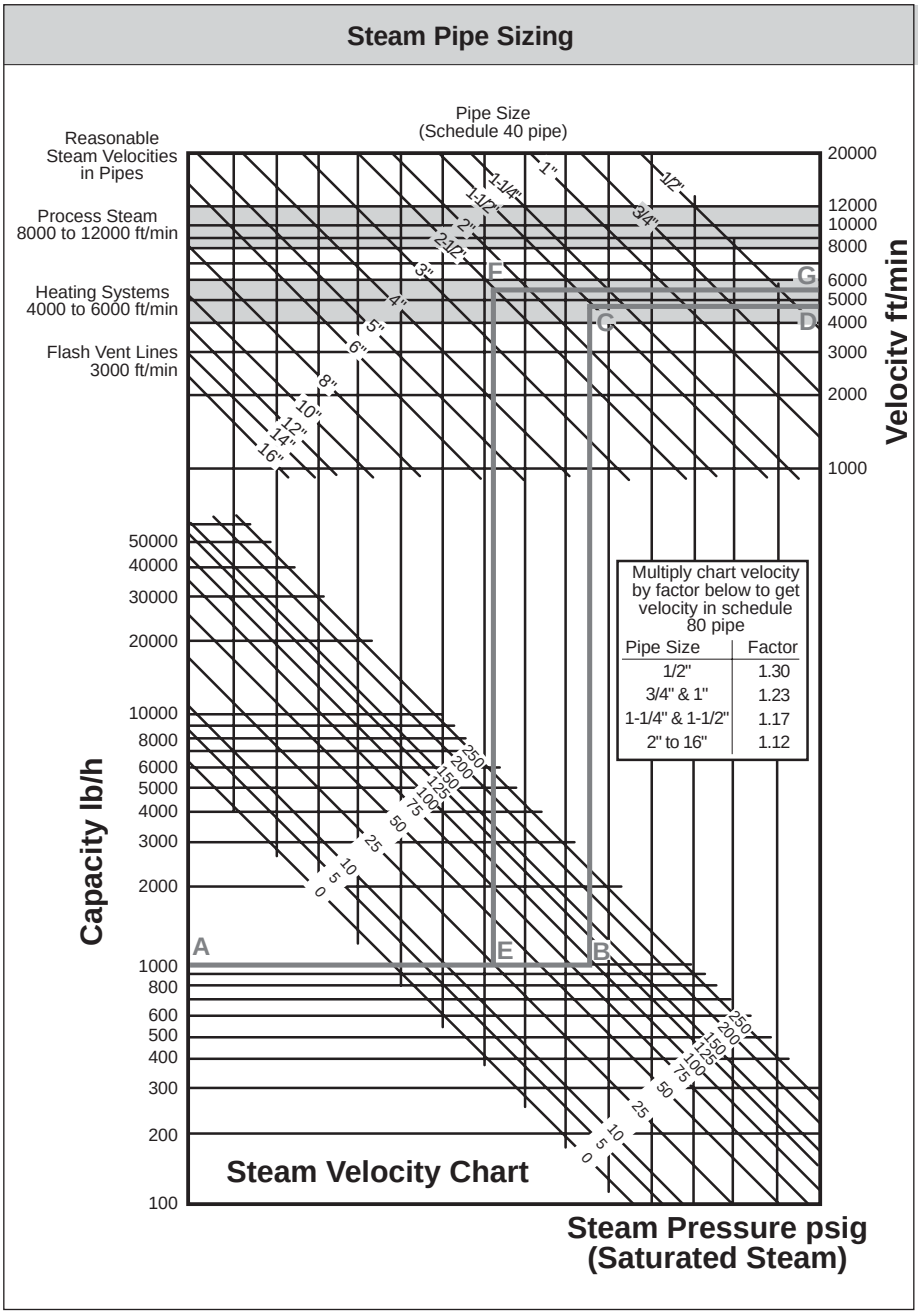
Upstream Pressure Piping Sizing
Enter the velocity chart above at A for steam flow of 1,000 lb/h. Go over to point B where the 100 psig diagonal line intersects. Follow up vertically to C where an intersection with a diagonal line falls inside the 4,000-to-6,000 ft/min velocity band. Actual velocity at D is about 4,800 ft/min for 1-1/2" upstream piping. Selecting a smaller pipe size results in greater steam velocity and noise level.

Downstream Piping Sizing
Enter the velocity chart at A for 1,000 lb/h. Go over to point E where the 25 psig diagonal line intersects. Follow up vertically to F where an intersection with a diagonal line falls inside the 4,000-to-6,000 ft/min velocity band. Actual velocity at G is 5,500 ft/min for 2-1/2" downstream piping.

Formula for Velocity of Steam in Pipes:

$$V = \frac{2.4Q\ Vs}{A}$$

Where:
V = Velocity in ft/min
Q = Flow lb/h steam
Vs = Sp. Vol. in cu. ft^3/lb at the flowing pressure
A = Internal area of the pipe — in^2



Condensate Line Sizing

Condensate return lines on the discharge side of steam traps must be able to accomodate the flow of both water and flash steam. While the percentage, by weight, of flash steam may be rather low, its overall volume in comparison to the liquid is very large. By determining the quantity of flash steam and sizing the return line for velocities between 4,000 and 6,000 ft/min, the two-phase flow within the pipe can be accomodated. The information required for sizing is the condensate load in lb/h, inlet pressure to steam trap(s) in psig and return line system pressure.

Example:
Size a condensate return line from a 160 psig steam trap discharging to 20 psig. flash tank. Load is 3,000 lb/h.

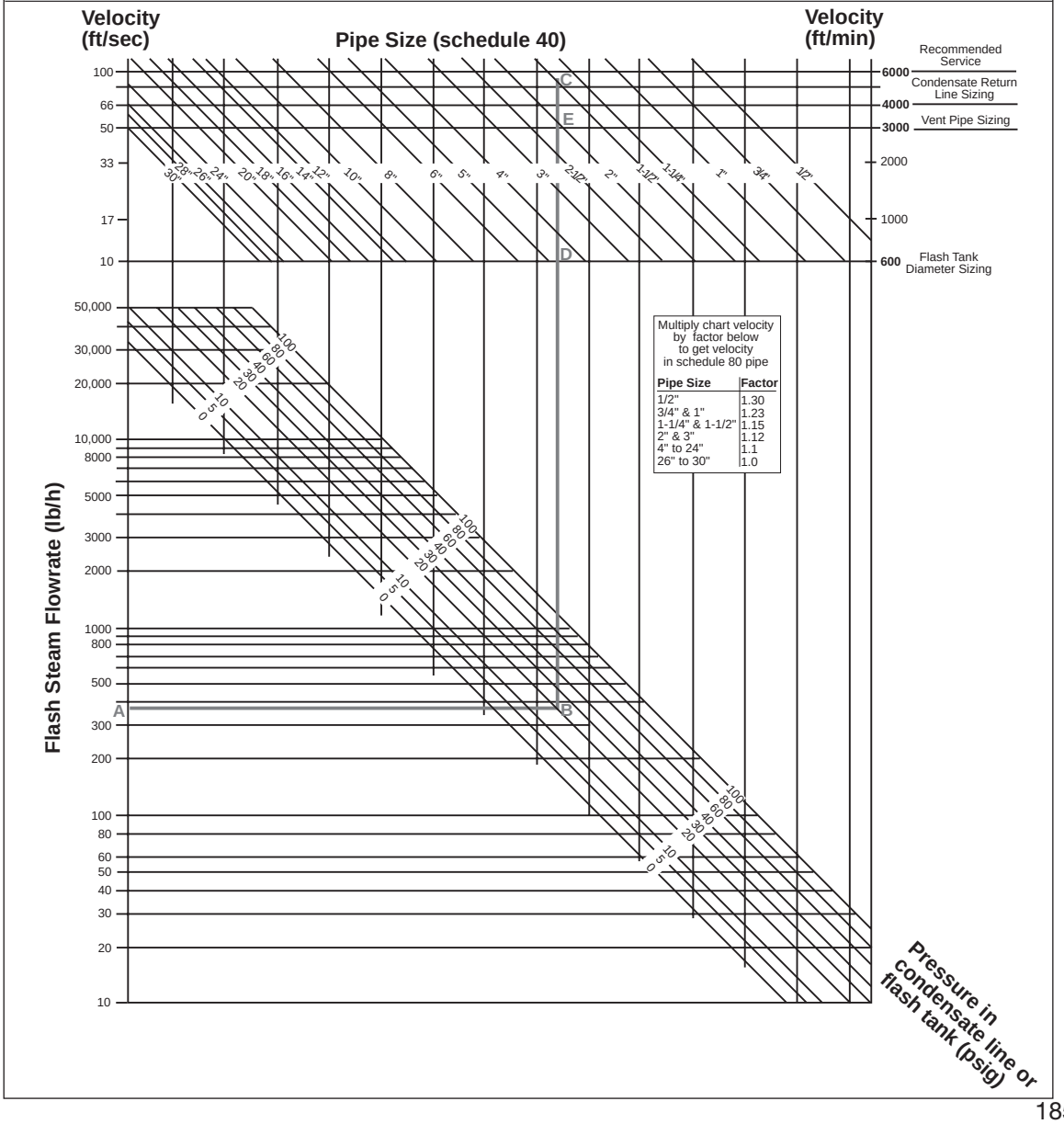
1. Determine percent flash steam produced using table. With a steam pressure of 160 psig and a flash tank pressure of 20 psig read a value of 12.4%.
2. Next, multiply the condensate load by the percent flash from step #1 to determine the flowrate, of flash steam produced.
   3,000 lb/h x .124 = 372 lb/h.
3. Enter Condensate Recovery Sizing chart at the flash steam flowrate of 372 lb/h at "A" and move horizontally to the right to the flash tank pressure of 20 psig "B". Rise vertically to choose a condensate return line size which will give a velocity between 4,000 and 6,000 ft/min, "C". In this example, an 1-1/2" schedule 40 pipe with a velocity of approximately 5,000 ft/min. If schedule 80 pipe is to be used, refer to table within body of chart. Multiply the velocity by the factor to determine whether the velocity is within acceptable limits.

Percent Flash Steam

Produced when Condensate is discharged to atmosphere or into a flash tank controlled at various pressures.

Pressure psig	Atmo-sphere 0	Flash Tank Pressure — psig 2	5	10	15	20	30	40	60	80	100
5	1.7	1.0	0								
10	2.9	2.2	1.4	0							
15	4.0	3.2	2.4	1.1	0						
20	4.9	4.2	3.4	2.1	1.1	0					
30	6.5	5.8	5.0	3.8	2.6	1.7	0				
40	7.8	7.1	6.4	5.1	4.0	3.1	1.3	0			
60	10.0	9.3	8.6	7.3	6.3	5.4	3.6	2.2	0		
80	11.7	11.1	10.3	9.0	8.1	7.1	5.5	4.0	1.9	0	
100	13.3	12.6	11.8	10.6	9.7	8.8	7.0	5.7	3.5	1.7	0
125	14.8	14.2	13.4	12.2	11.3	10.3	8.6	7.4	5.2	3.4	1.8
160	16.8	16.2	15.4	14.1	13.2	12.4	10.6	9.5	7.4	5.6	4.0
200	18.6	18.0	17.3	16.1	15.2	14.3	12.8	11.5	9.3	7.5	5.9
250	20.6	20.0	19.3	18.1	17.2	16.3	14.7	13.6	11.2	9.8	8.2
300	22.7	21.8	21.1	19.9	19.0	18.2	16.7	15.4	13.4	11.8	10.1
350	24.0	23.3	22.6	21.6	20.5	19.8	18.3	17.2	15.1	13.5	11.9
400	25.3	24.7	24.0	22.9	22.0	21.1	19.7	18.5	16.5	15.0	13.4

Condensate Recovery Sizing



Model Designation Index

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