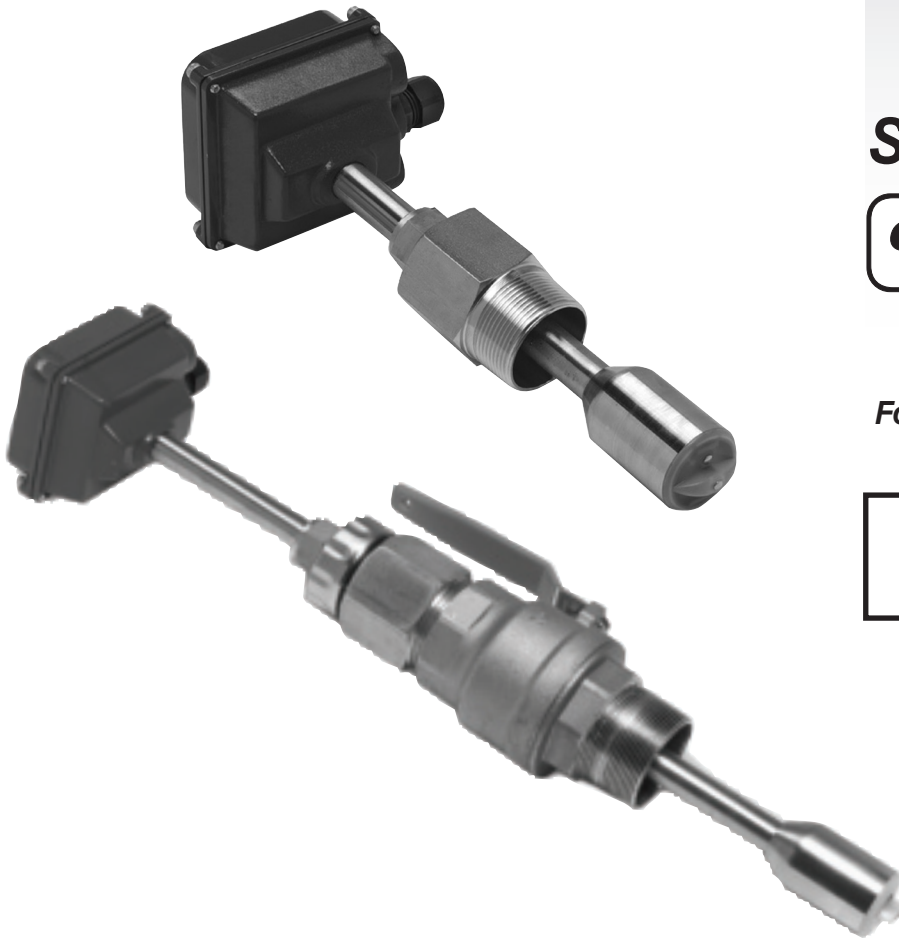


User's Guide



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FMG900 SERIES **Insertion Magnetic Flow Meter**



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The information contained in this document is believed to be correct, but OMEGA accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

WARNING: These products are not designed for use in, and should not be used for, human applications.

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GENERAL INFORMATION, FEATURES and SPECIFICATIONS

The complete lack of moving parts of the **FMG900 Series** insertion flow sensor is the source of its reliability. Brass and stainless steel models withstand a variety of temperature, pressure, and chemical conditions. The FMG900 Series has no rotor to stop turning in dirty water and there are no bearings to wear out.

A rapidly reversing magnetic field is produced in the lower housing. As the fluid moves through this field, a voltage is generated that is measured and translated into a frequency signal proportional to flow rate.

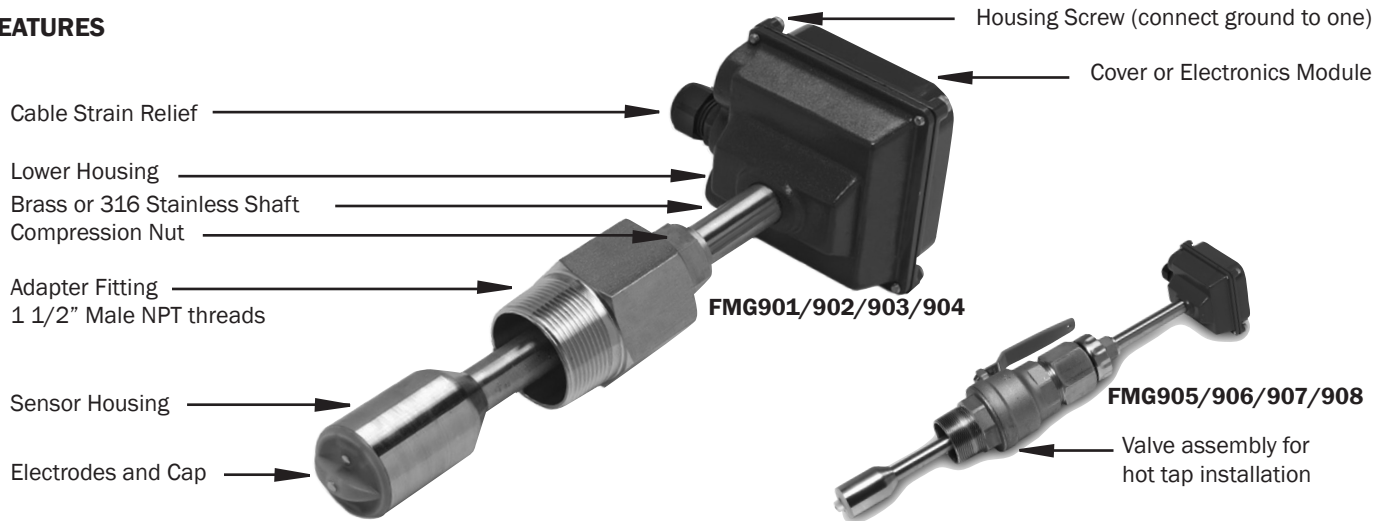
This square wave signal can be sent directly to a PLC or other control

or can be converted using any of the Omega family of indicators and converters.

The adapter fitting of the sensor is standard male NPT, and can be directly threaded into ordinary saddles or threaded weld fittings. The FMG905/906/907/908 include an isolation valve, allowing hot-tap installation, or installation and removal under pressure; a bronze ball valve is standard, with a 316 stainless steel valve option if needed.

Reverse flow output and immersibility are optional.

FEATURES



SPECIFICATIONS*

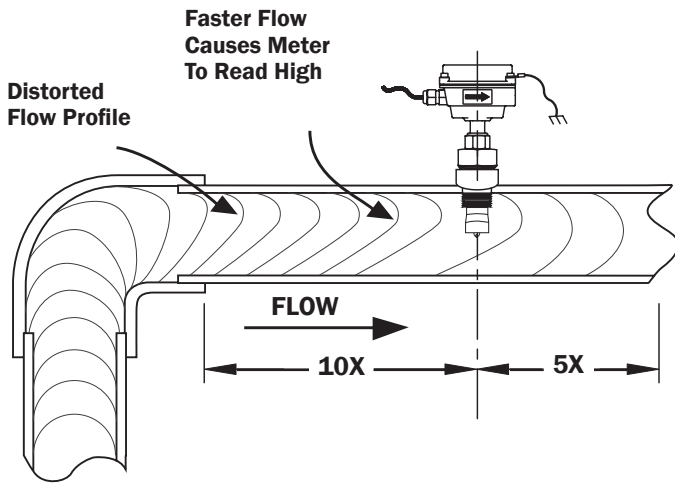
Pipe Sizes	3" to 48" (up to 72" optional)	
Materials	Shaft/Fitting	316 SS or Brass
	Electrodes	Hastelloy
	Electrode Cap	PVDF
	Housing	Cast powder-coated aluminum
	Valve Assembly (115/215 Only)	Bronze (stainless optional) with bronze ball valve
	O-Ring (115/215 Only)	EPDM
Power	Full Power	12-25 Vdc, 250 mA
	Low Power	12-25 Vdc, 40 mA average with 250 mA peaks
Flow Range	0.28 to 20 ft/sec (0.08 - 6.09 m/sec)	
Fitting Size	FMG901/902/903/904	FMG905/906/907/908
	1-1/2" Male NPT	2" Male NPT
Temperature	Ambient	0° to 160° F (-17° to 72° C)
	Fluid	32° to 200° F (0° to 93° C)
Pressure	200 psi (13.8 bar)	
Minimum Conductivity	20 microSiemens/cm	
Calibration Accuracy	+/- 1% of full scale	
Output	Square wave pulse, opto isolated, 550 Hz @ 20 ft/sec 6 mA max, 30 Vdc forward flow standard; reverse flow optional	
Empty Pipe Detection	Software, defaults to zero flow	
Regulatory	CE Mark	

*Specifications subject to change.

INSTALLATION

Piping. For best results, the sensor should be installed with at least ten diameters of straight pipe upstream and five downstream. Certain extreme situations such as partially-opened valves are particularly difficult and may require more straight diameters upstream (see page 6 for straight pipe recommendations).

DISTORTED FLOWS



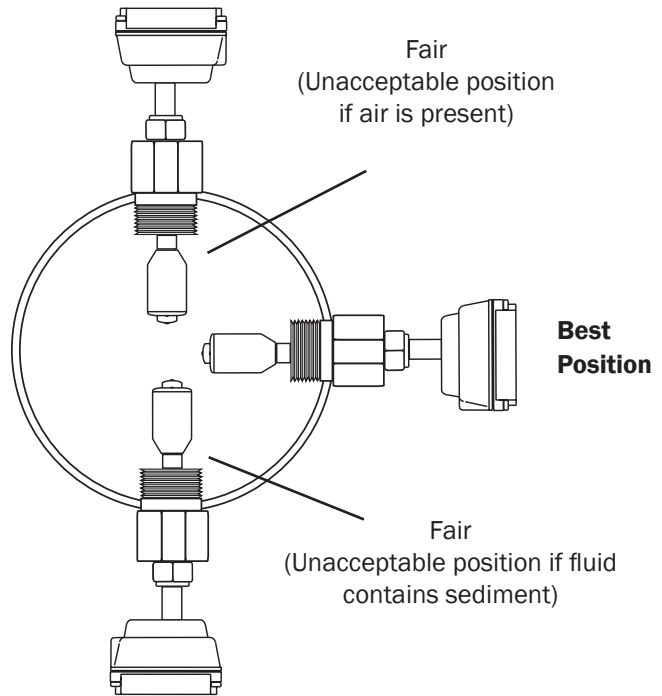
Immersion. The FMG900 Series sensors are not designed for underwater operation. Even occasional immersion can cause damage. If occasional immersion is possible, such as when a vault floods, then the -40 option, (immersion) is recommended.

Chemical Injection or Fertigation. When any magmeter, by any manufacturer, is used in a chemical injection application (including fertigation), the chemical line must be placed downstream of the magmeter OR far enough upstream for complete mixing to occur before the fluid reaches the meter. When unmixed chemical or fertilizer alternates with water passing through the meter, the rapid changes in conductivity may cause sudden spikes and drops in the meter's reading, resulting in inaccurate measurement. The magmeter will restabilize, however, with a steady flow of fluid of uniform conductivity.



Caution: In chemical injection or fertigation applications, install chemical line downstream of magmeter, or far enough upstream to allow complete mixing of fluids before the meter.

POSITIONING THE METER



Vertical flow in upward direction is the preferred installation orientation, since it improves low-flow performance and avoids problems with trapped air and sediment. Bottom, top, and vertical pipe installations are all acceptable if required by the piping layout.



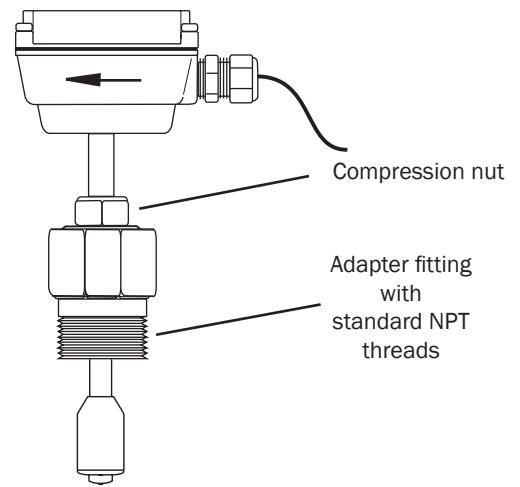
Caution: These flow sensors are not recommended for installation downstream of a boiler feedwater pump where installation fault may expose the flow sensor to boiler pressure and temperature. Maximum recommended temperature is 200 °F.

INSTALLATION

FMG901/902/903/904 INSTALLATION

Fitting Installation. FMG901/902 sensors come with a 1-1/2" male NPT pipe thread adapter fitting. Any fitting that provides the matching NPT female thread may be used. Installation procedure compensates for fitting height differences. Cut a minimum 1-3/4" hole in the pipe. If possible, measure the wall thickness and write it down for use in depth setting. Then install the threaded fitting (saddle, weldolet, etc.) on the pipe.

Meter Installation. Loosen the compression nut so that the adapter slides freely. Pull the meter fully upward and finger-tighten the compression nut. Using a thread sealant, install the adapter in the pipe fitting. Do not over-tighten. Now loosen the compression nut, lower the meter to the appropriate depth setting (see diagram and instructions that follow). Be sure flow is in the direction of the arrow on the housing. Tighten compression nut fully.



FMG905/906/907/908 INSTALLATION

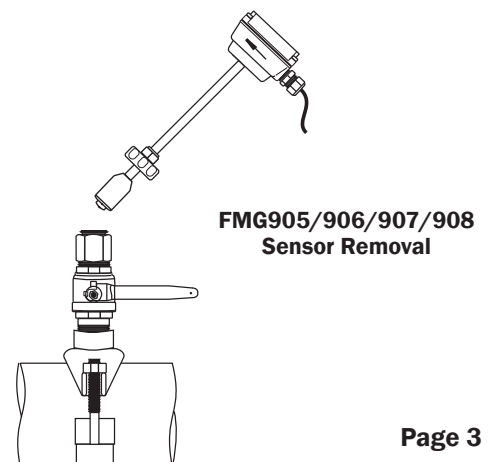
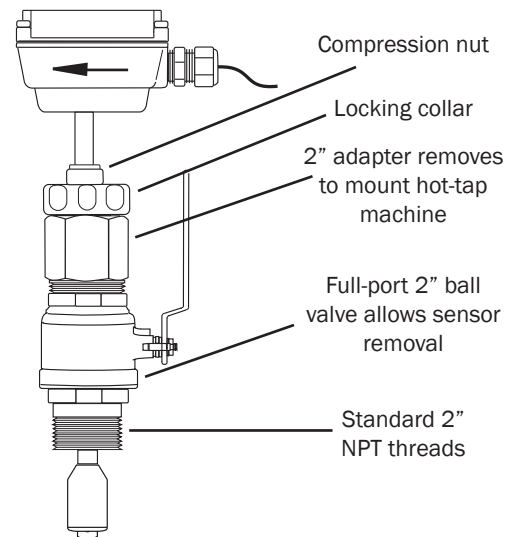
'Hot tap' meters are designed so they can be installed and serviced without depressurizing the pipe.

Fitting Installation. The FMG905/906/907/908 sensors have a 2" NPT thread for compatibility with the 2" isolation valve. Any fitting that provides matching NPT female thread may be used. The installation procedure compensates for differences in fitting height.

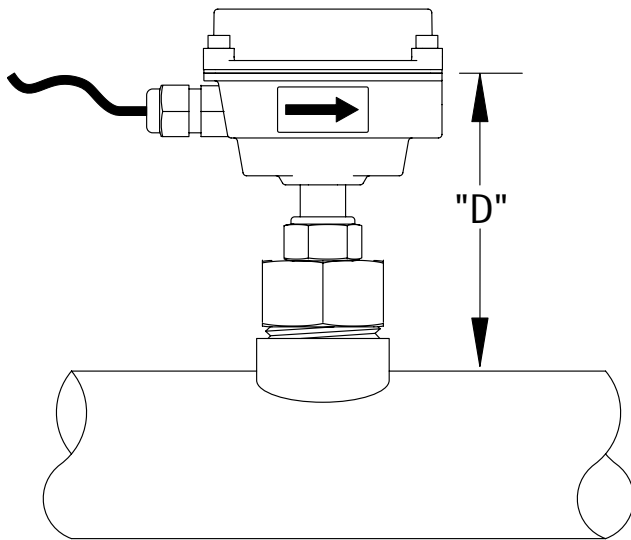
If initial installation is performed on an unpressurized pipe, cut a minimum 1-3/4" hole in the pipe. If possible, measure the wall thickness and write it down for use in depth setting. Then install the threaded fitting (saddle, weldolet, etc.) on the pipe.

If it is necessary to do the initial installation under pressure, any standard hot tap drilling machine with 2" NPT adapter, such as a Transmate or a Mueller, can be used. Ordinarily, it is not necessary to use an installation tool, due to the small diameter tube the meter can be installed by hand at all but the highest pressures.

Meter Installation. Remove the sensor unit from the valve assembly. Using a thread sealant, install the valve assembly on the pipe fitting. If the initial installation is a pressure ("hot") tap, remove the 1-1/2" x 2" adapter bushing at the back of the valve. Thread the tapping machine on, open the valve, and tap using a minimum of 1-3/4" or maximum 1-7/8" cutter. After retracting the machine and closing the valve, reinstall the flow sensor. When the sensor is secure, open the valve and adjust depth setting (see diagram and instructions that follow). Be sure flow is in the direction of the arrow on the housing. Tighten locking collar and compression nut fully.



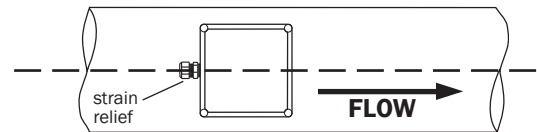
PROPER DEPTH SETTING



Caution! Never attempt to remove a flow sensor when there is pressure in the pipe unless it is specifically designed for hot tap installation and removal. Loosen the compression nut slowly to release any trapped pressure. If fluid sprays out when removing the sensor, stop turning and depressurize the pipe. Failure to do so could result in the sensor being thrown from the pipe, resulting in damage or serious injury.

Depth Setting. It is important for accuracy that the sensor be inserted to the correct depth into the pipe.

1. In Table 1, find Dimension C for your sensor model and pipe size. Subtract wall thickness of your pipe (Table 2) to find Dimension D.
2. Measuring from the outside of the pipe to the joint in the housing, as shown in the diagram, adjust the sensor to Dimension D and hand-tighten compression nut.
3. Align the conduit housing with the centerline of the pipe, as shown. Be sure the arrow on the housing points in the direction of flow.



4. Check Dimension D one more time.
5. Tighten the compression nut fully.

INSTALLATION

TABLE 1: DIMENSION “C”

	NOMINAL PIPE SIZE												
	3”	4”	6”	8”	10”	12”	14”	16”	18”	20”	24”	30”	36”
FMG901/903	10.04	9.93	9.69	9.46	9.22	8.99	8.75	8.52	8.28	8.05	7.58	6.87	6.17
FMG902/904	15.04	14.93	14.69	14.46	14.22	13.99	13.75	13.52	13.28	13.05	12.58	11.87	11.17
FMG905/907	17.04	16.93	16.69	16.46	16.22	15.99	15.75	15.52	15.28	15.05	14.58	13.87	13.17
FMG906/908	21.04	20.93	20.69	20.46	20.22	19.99	19.75	19.52	19.28	19.05	18.58	17.87	17.17

TABLE 2: PIPE WALL THICKNESS

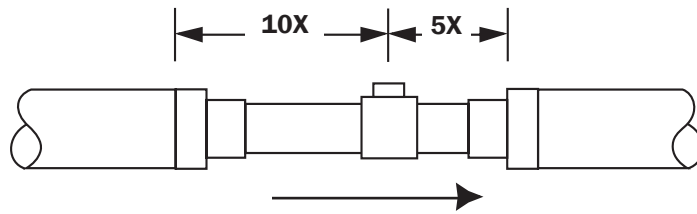
	NOMINAL PIPE SIZE												
	3”	4”	6”	8”	10”	12”	14”	16”	18”	20”	24”	30”	36”
PVC/Steel Sch. 40	0.216	0.237	0.280	0.322	0.365	0.406	0.438	0.500	0.562	0.593	0.687		
PVC/Steel Sch. 80	0.300	0.337	0.432	0.500	0.593	0.687	0.750	0.843	0.937	1.031	1.218		
Stainless Steel (10S)	0.120	0.120	0.134	0.148	0.165	0.180	0.188	0.188	0.188	0.218	0.250	0.312	0.312
Stainless Steel (40S)	0.216	0.237	0.280	0.322	0.365	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375
Copper Tubing (Type L)	0.090	0.110	0.140	0.200	0.250	0.280							
Copper Tubing (Type K)	0.109	0.134	0.192	0.271	0.338	0.405							
Brass Pipe	0.219	0.250	0.250	0.312	0.365	0.375							
Duct. Iron (Class 52)	0.280	0.290	0.310	0.330	0.350	0.370	0.390	0.400	0.410	0.420	0.440	0.470	0.530

INSTALLATION

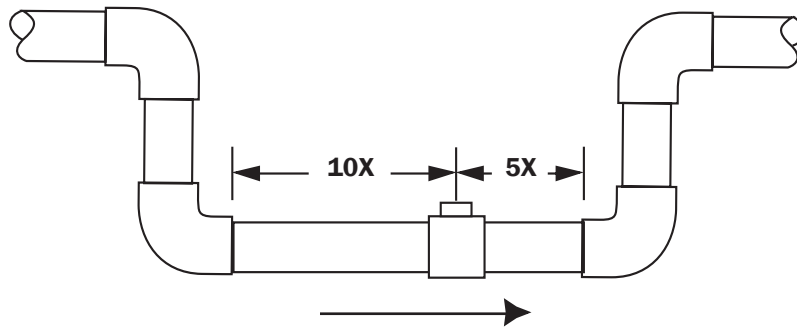
STRAIGHT PIPE RECOMMENDATIONS

(X = diameter)

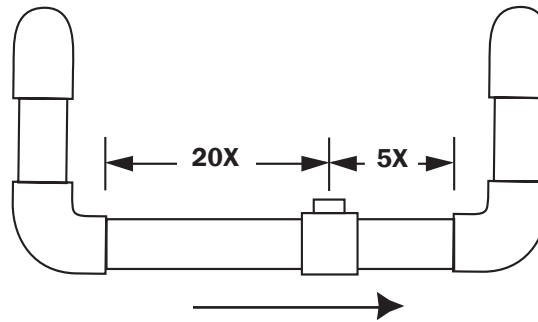
Reduced Pipe



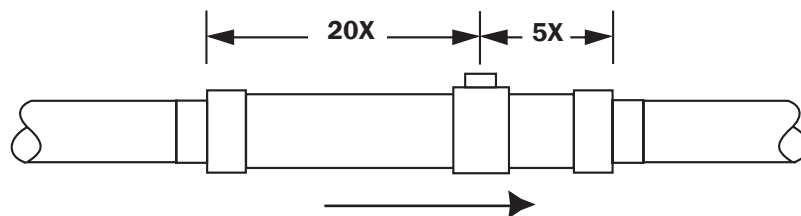
Two Elbows In Plane



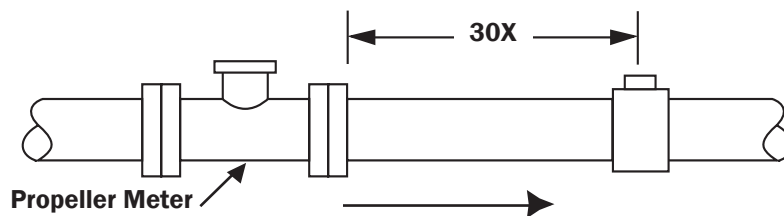
Two Elbows, Out Of Plane



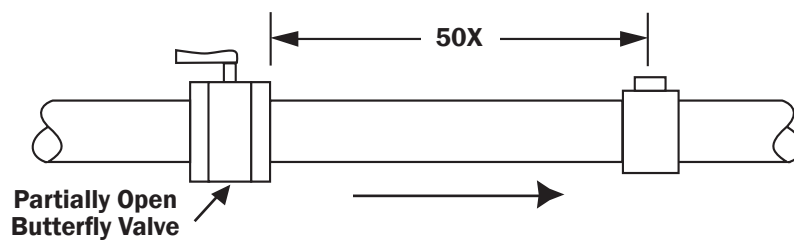
Expanded Pipe



Spiral Flow



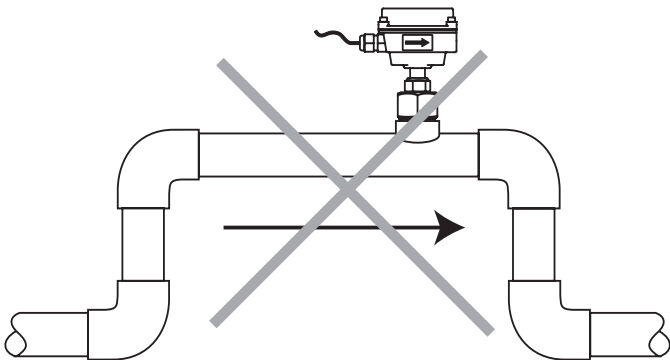
Swirling Flow



INSTALLATION

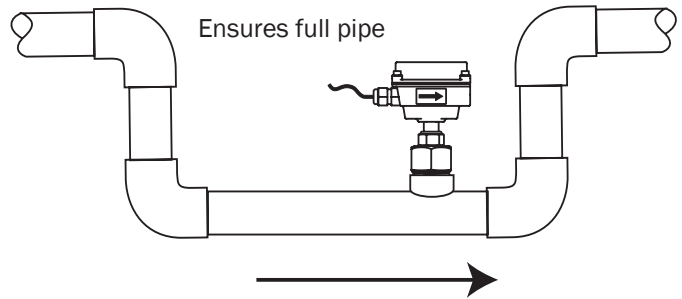
FULL PIPE RECOMMENDATIONS

Possible Problem

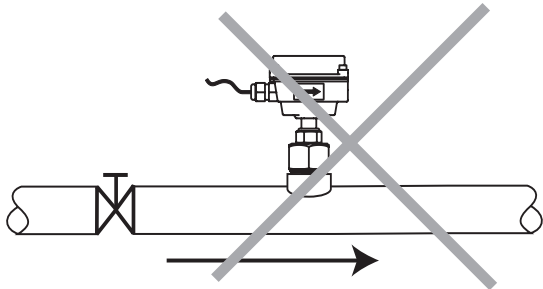


Allows air pockets to form at sensor

Better Installation

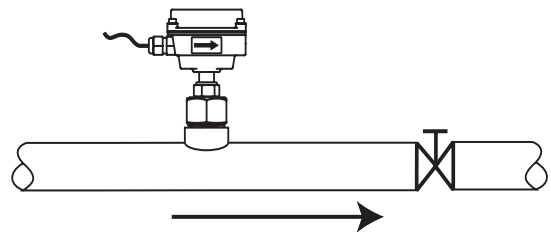


Possible Problem



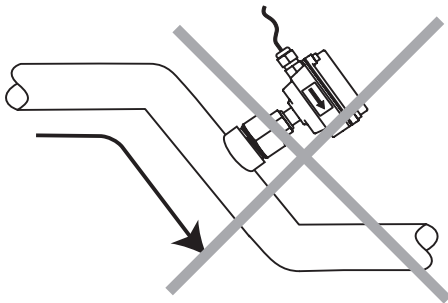
Post-valve cavitation can create air pocket

Better Installation



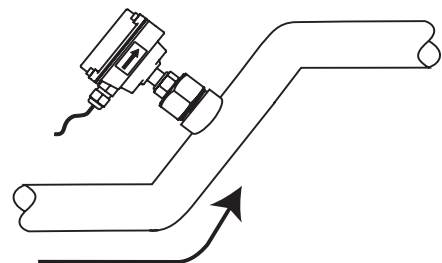
Keeps pipe full at sensor

Possible Problem



Air can be trapped

Better Installation



Allows air to bleed off



Caution: These flow sensors are not recommended for installation downstream of a boiler feedwater pump where installation fault may expose the flow sensor to boiler pressure and temperature. Maximum recommended temperature is 200°F.

ELECTRICAL CONNECTIONS

GENERAL ELECTRICAL GUIDELINES

- Whenever possible, avoid running control cables in the same conduit with AC power.
- Use shielded cable, with one end grounded.
- Avoid routing flow sensor cables in close proximity to a variable frequency drive.
- Recommended power and output wiring is shielded 18-22 AWG control cable.
- Recommended voltage is 12-24 Vdc.
Note: unregulated power supplies can vary from name-plate voltage by a considerable amount. When in doubt, use a regulated power supply.

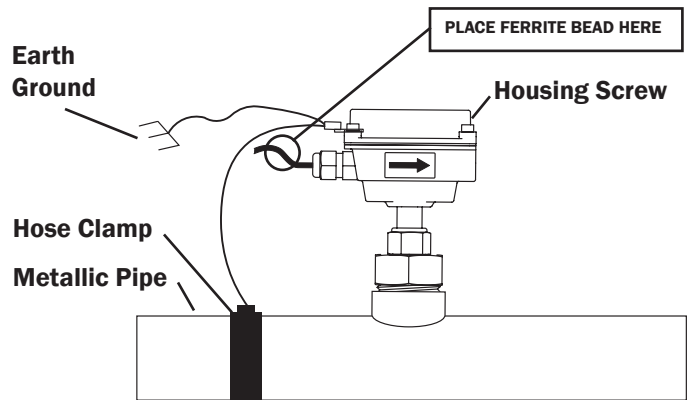
Power: A 12 - 24 Vdc power supply capable of at least 250 mA current output is needed.

Forward (and Reverse) Flow Output: This open-collector isolated output does not supply power. It functions like a polarity-sensitive switch closure. This pulse is generated in the forward flow direction on the standard unit. (Reverse flow output is available as an option). **Note:** This output is limited to 6 mA at 30 Vdc maximum.

GROUNDING GUIDELINES

For best results, use a good quality earth ground, such as metallic water piping, or a stake driven into the ground, to ensure a good connection to earth ground and good noise suppression.

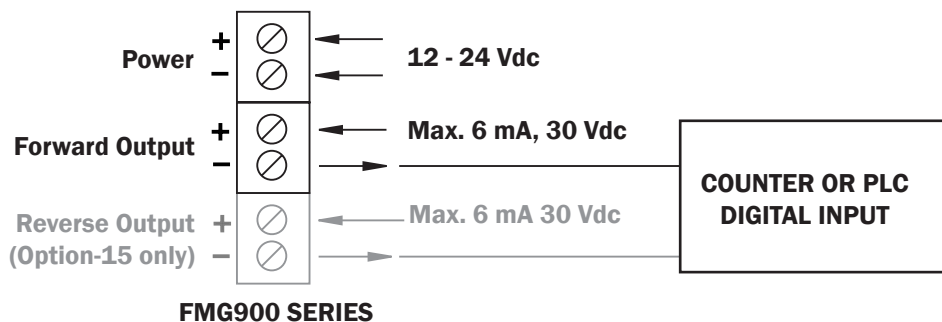
If the flow sensor is installed in metallic piping, for optimum connection clamp wire to the piping a short distance to one side of the flow sensor using a hose type clamp. Connect the wire to the earth ground and to one of the housing screws. (For non-metallic piping, this step is not needed.)



FMG900 Series meters are usually unaffected by moderate levels of electrical noise. In some applications performance may be improved by taking the following steps:

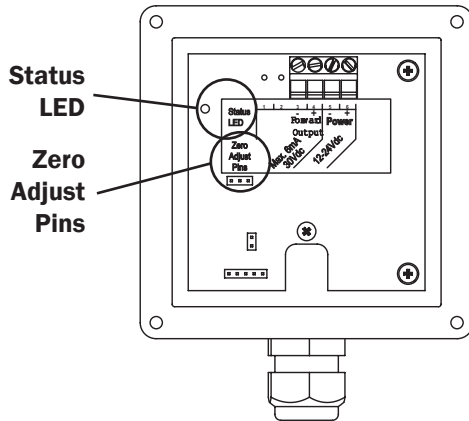
- Use shielded twisted pair cable (Belden 8723 or equivalent above ground or Alpha 35482 or equivalent burial).
- Clamp a ferrite bead (Steward 28A2029-OAO or equivalent) on meter signal/power wire within 3/4" of the meter strain relief (tape or tie wrap in place if necessary). See diagram above.
- **IMPORTANT** - Connect the cable shield ground wire to ground, **ONLY** at power supply end of cable.

CONNECTION DIAGRAM



OPERATION & MAINTENANCE

Zero Adjustment. When the FMG900 Series meter is powered up and there is no flow, there should be no output pulses (or, if connected to a display or controller, flow rate should read “0”). If there are pulses, it may be necessary to adjust the flow meter under no-flow conditions after it has been installed. **This should only be done if the indicated flow is low, near the lower cutoff.**



To perform the adjustment, after determining that there is a full pipe with no flow, short between the two pins marked “Zero Adjust”. A red LED light will come on for approximately 50 seconds and then go out. The zero adjustment is completed.


Minimum Flow. As with any other flow sensor, there is a rate below which the FMG900 Series sensor cannot read. Check the table below for the minimum flow rate detectable by the sensor for a given pipe size. Minimum flow is 0.28 ft/sec.

Presence of Flow Indication. To assist in troubleshooting, the “Status LED” has two blinking modes in normal operation. When there is no flow detectable by the meter (below minimum threshold) the LED blinks every 8.0 seconds. When there is detectable flow, the same indicator blinks every 3.0 seconds (Pulses are being output when indicator is blinking every 3 seconds).

Filtering. The software of the FMG900 Series filters out electrical noise and averages sudden variations in the flow to smooth the output. It takes a matter of seconds for the flow sensor to get up to full output when it is powered up or when flow begins.

Electrode Coating. Grease or other adhering, non-conductive materials can stop flow detection if the electrodes become heavily coated. To clean the electrodes, remove the sensor from the pipe and gently scrub the electrodes (three silver bumps) on the reading face of the flow sensor. A mild soap (dishwashing liquid for example) can be used to aid the cleaning process.

Calibration (“K-Factor”). In order to properly process pulses from the flow sensor, a number must be entered into the control to which the sensor is connected. This number, called the K-factor, is the number of pulses the sensor puts out per unit of fluid passing through the pipe. **Find the K-factor for your pipe size and type in the table on the following page and enter it into your display or controller.** These numbers are based on extensive testing, which has shown close agreement among different FMG900 sensors in the same installation. Typically, most K-factor error can be attributed to installation variables, such as depth setting and fitting configuration.



CAUTION! Never attempt to remove a flow sensor when there is pressure in the pipe unless it is specifically designed for hot tap installation and removal. Loosen the compression nut slowly to release any trapped pressure. If fluid sprays out when removing the sensor, stop turning and depressurize the pipe. Failure to do so could result in the sensor being thrown from the pipe, resulting in damage or serious injury.

FLOW RATES (IN GALLONS PER MINUTE)

Feet Per Second	NOMINAL PIPE SIZE													
	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"	48"
Min 0.2	6	11	25	44	69	99	134	175	222	274	395	617	888	1580
Max 20.0	440	783	1,762	3,133	4,895	7,050	9,596	12,533	15,863	19,584	28,200	44,064	63,452	112,804

K-FACTOR CHART

FMG900 SERIES K-FACTORS FOR VARIOUS PIPE SIZES

	NOMINAL PIPE SIZE												
	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"
PVC/Steel Sch. 40	70.397	40.985	18.130	10.497	6.674	4.709	3.900	2.989	2.364	1.904	1.319		
PVC/Steel Sch. 80	78.748	45.360	20.084	11.495	7.322	5.184	4.297	3.281	2.588	2.094	1.451		
Stainless Steel (10S)	62.385	36.626	16.510	9.642	6.173	4.373	3.620	2.756	2.169	1.762	1.223	0.784	0.576
Stainless Steel (40S)	70.397	40.985	18.130	10.497	6.674	4.661	3.827	2.893	2.263	1.819	1.249	0.791	0.580
Copper Tubing (Type L)	76.371	43.552	19.513	11.201	7.230	5.016							
Copper Tubing (Type K)	78.371	44.638	20.223	11.622	7.500	5.239							
Brass Pipe	70.672	41.517	17.778	10.445	6.674	4.661							
Duct. Iron (Class 52)	57.376	37.320	16.915	9.503	6.197	4.325	3.189	2.443	1.931	1.565	1.088	0.747	0.520

Note: These K-Factors are calculated using actual pipe diameters and wall thicknesses for each pipe type. They are based on the most current testing at the time of printing.

TROUBLESHOOTING

Problem	Probable Cause	Try...
No pulse output	Unit not grounded Below minimum flow cutoff Flow reversed Output connections reversed Pipe not full Excessive electrical noise No power Power reversed Fluid conductivity <20 microSiemens/cm	Connect to earth ground Check the Presence of Flow LED (see p. 12) Note flow direction arrow, reverse direction to meter Change output connections Check plumbing Check for proper electrical wiring Check for power across power input terminals Reverse connections Select another flow meter
Output pulses incorrect	Missing or incorrect ground wire Incorrect depth setting Fluid conductivity <20 microSiemens/cm Empty pipe Not enough straight pipe Excessive electrical noise	Check for proper ground Check depth setting from Dimension "C" table (page 4) Select another flow meter Check for full pipe or install meter in the vertical position Check for air pockets or turbulence. Refer to installation, page 6 Check for proper electrical wiring
Jumpy reading	Rapidly changing conductivity (in chemical injection or fertigation applications)	Install chemical injection line downstream of magmeter (or far enough upstream to allow complete mixing of fluids before meter)



WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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