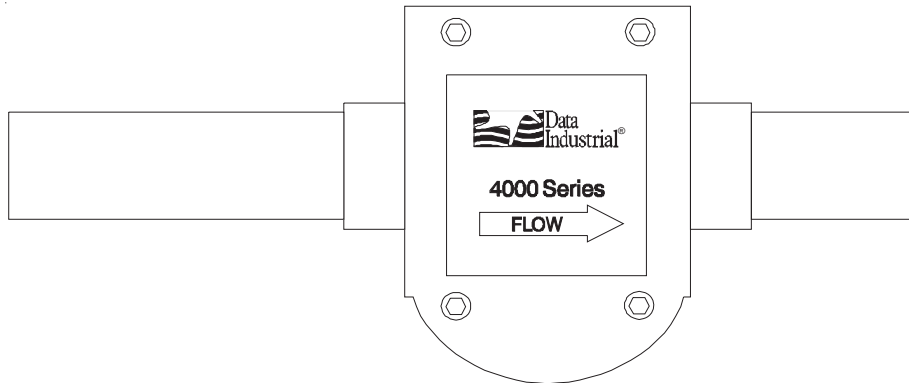




Badger Meter

Series 4000
Flow Sensor



IMPORTANT:
This manual contains important information.
READ AND KEEP FOR REFERENCE.

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INTRODUCTION

Data Industrial® nonmagnetic flow sensors by Badger Meter provide an accurate measurement of liquid flow. The Series 4000 flow sensor covers applications for ½" to 1" pipe sizes and a wide range of pressure/temperature specifications. When used in conjunction with Badger Meter Series 1500, Series 2000, and Series 300 electronics, the measurement may be displayed or transmitted as a rate or total.

The Series 4000 sensors consist of a molded housing, rotating impeller, and externally mounted electronics housing using a proprietary, nonmagnetic sensing technology. The closed six-bladed impeller design provides higher and more constant torque than four-bladed designs, and is less prone to fouling by water borne debris. The shape of the impeller and the absence of magnetic drag provides improved operation and repeatability even at low flow rates. The housing design allows the impeller, bearings, shaft, or o-rings to be cleaned or replaced without removing the sensor from the piping system.

Two signal output options are available. One option is a five volt DC square wave frequency proportional to flow rate. Power for the circuit is provided by a Badger Meter flow monitor or other external source via a three-wire shielded cable. An internal preamplifier allows the signal to travel 2,000 feet without amplification, 20 feet of three conductor cable is provided with this option. The second output option is a 4-20mA current analog signal. Power is provided by the two wire loop so the distance from the receiver is a function of power supply voltage and wire resistance. A 30 inch connector cable is provided with the analog version.

Sensors of similar type are interchangeable, so there is no need for recalibration after servicing or replacement.

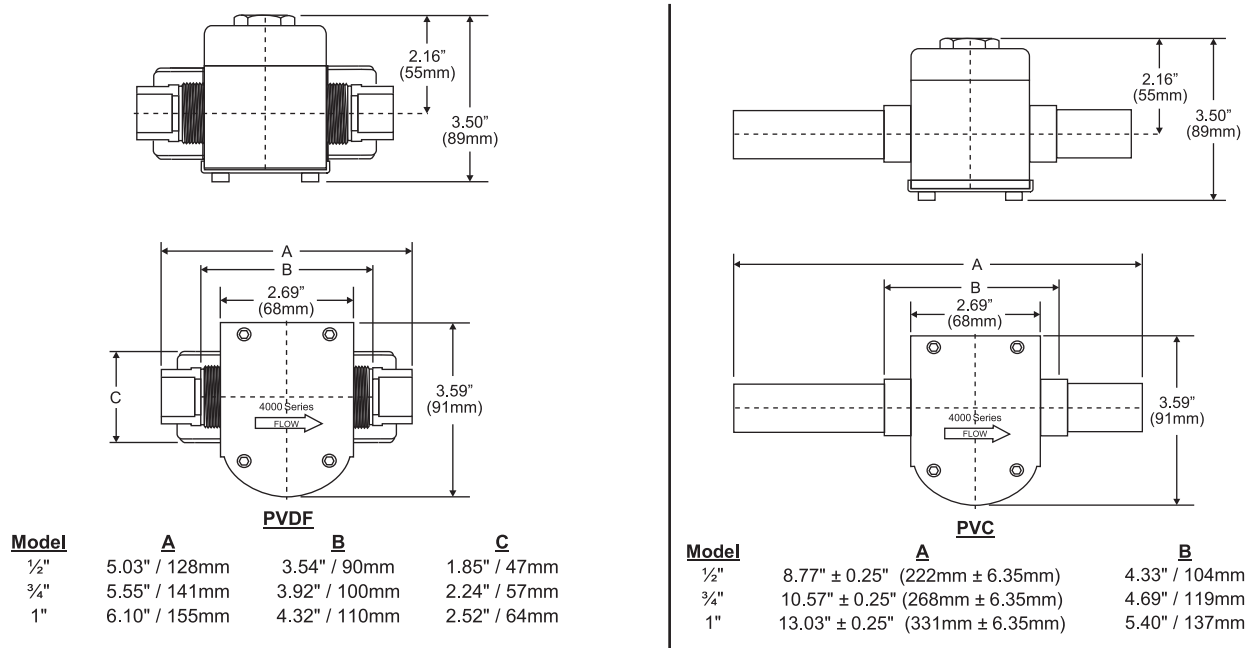


Figure 1: Models

MODELS

Badger Meter provides several basic sensor configurations using the same impeller element. This allows for a wide range of applications and pipe sizes. Standard configurations use the materials listed above for wetted parts in the housing and closure. Consult factory for availability of other materials.

All Series 4000 sensor electrical components are self-contained. They may be replaced in the field without requiring recalibration or breakdown of the piping system. Pressure/temperature ratings for the various models are contained in the Specifications section of this manual. The Series 4000 flow sensor models are summarized in the tables above.

MECHANICAL INSTALLATION

General

The accuracy of flow measurement for all flow measuring devices is highly dependent on proper location of the sensor in the piping system. Irregular flow velocity profiles caused by valves, fittings, pipe bends, etc. can lead to inaccurate overall flow rate indications even though local velocity measurement may be accurate. A sensor located in the pipe where it can be affected by air bubbles, floating debris, or sediment may not achieve full accuracy, and could be damaged. Badger Meter flow sensors are designed to operate reliably under adverse conditions, but the following recommendations should be followed to ensure maximum system accuracy:

1. Choose a location along the pipe where 10 pipe diameters of straight pipe upstream and five pipe diameters of straight pipe downstream of the sensor provide no flow disturbance. Pipe bends, valves, other fittings, pipe enlargements and reductions should not be present in this length of pipe.
2. The preferred orientation for horizontal flow is with the curved portion of the sensor housing down. Sensors installed with the curved portion in the up position could trap air causing inaccurate flow measurement, especially at low flows. Sensors installed with the curved portion pointing sideways may not only trap air, but increase impeller friction, which may also affect measurements at low flow rates. Locate sensor to facilitate servicing.
3. The preferred vertical location is with liquids flowing up. If vertical flow downward is the only option, the pipe must be completely filled with fluid. Any circumferential orientation is correct, but the sensor should be located to facilitate servicing. A vertical location may result in reduction of accuracy.
4. Sensors must be mounted in such a way to provide a minimum of 3 inches (75mm) clearance in all directions around the blue electronics assembly to prevent electro-mechanical interference. This space requirement applies to multiple 4000 sensors installed in close proximity as well as to other EMI generators such as electric motors or controls for motors, heaters, or lighting.

Installation for PVC Sensors

Ten diameters of straight pipe upstream and five diameters downstream are supplied with the PVC sensor in the form of attached schedule 80 plain end pipe nipples. Any compatible size and type of fitting or adapter may be connected to the pipe nipples by thermal or solvent welding. Be sure the fittings and method you choose to install the PVC unit complies with American Society for Testing and Materials (ASTM) standards. Proper installation has the arrow in the stainless steel cover pointing the same direction as the flow of the fluid. Do not connect directly to reducing (or enlarging) fittings. An additional 10 diameter upstream and five diameter downstream allowance should be made if this is unavoidable.

Installation of PVDF Sensors

PVDF sensors are supplied with combination end connections. A socket sized to accept most metric sized PVDF pipe may be used for direct thermal welding. In addition, there is an external thread compatible with George Fisher PVDF union fittings for use with existing fittings. PVDF flow sensors may also be purchased with George Fischer unions that terminate in metric dimension sockets, or a wide variety of threaded or flanged connections.

In PVDF sensors with the enhanced flow feature, the flow enhancement jet must be inserted before installing the sensor into the system. With the stainless steel cover facing you, insert the jet into the left socket (upstream end) and then perform the method chosen for installation. Proper sensor orientation is with the arrow on the stainless steel cover pointing in the same direction as the flow of the liquid. The same ten and five diameter upstream and downstream allowance and orientation recommendations, as described under Installation for PVC sensors above, must be followed.

ELECTRICAL INSTALLATION

The Series 4000 digital transmitter is supplied with 20 feet of 20 AWG three conductor cable with drain wire and shield. The Series 4000 analog unit is supplied with 30 inches of cable. Make electrical wiring connections according to accepted trade practices.

An electrical junction box may be attached directly to the sensor electronic module, or mounted in the vicinity of the sensor. Locate it conveniently to facilitate replacement of the electronic module assembly. The wiring connections should not be subjected to water or conductive liquids, as these may impair operations or damage the sensor circuitry.

When connecting to the electronic device, observe the wire colors and polarity to insure proper performance and to prevent damage to the sensor or electronic device.

Electrical Wiring-Digital Unit

4-20mA power must be off and all wiring should be done before turning on loop power.

1. Refer to **Figure 2** for illustration of the following instructions.
2. Wire the **Red Wire (+ Analog loop)** of the flow sensor to the **POSITIVE (+)** output of a DC power supply.
3. Wire the **Black Wire (- Analog Loop)** of the flow sensor to the **POSITIVE (+)** input of your analog device.
4. Wire the **NEGATIVE (-)** input of your analog device to the **NEGATIVE (-)** of the DC power supply.
5. Electrical installation complete.

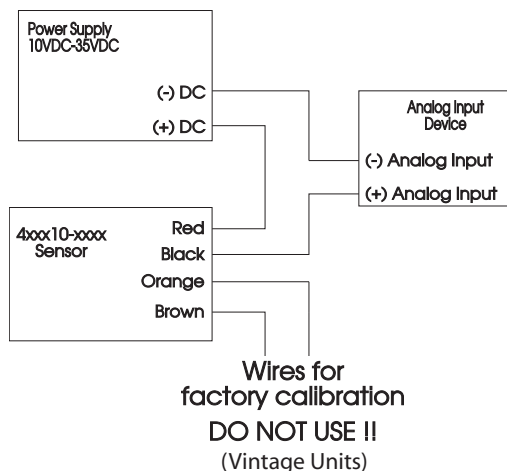


Figure 2: Wiring For Analog 4000

NOTE: THERE ARE TWO ADDITIONAL WIRES IN THE SENSOR CABLE (BROWN AND ORANGE). THESE WIRES ARE FOR FACTORY CALIBRATION ONLY, CONNECTING TO THESE WIRES MAY DAMAGE UNIT AND VOID WARRANTY.

Impeller Assembly and Shaft Replacement

The following tools are required for the replacement of the impeller and shaft: 5/32" Allen wrench, flat blade screwdriver, torque driver in "in-lb" with 5/32" male hex adapter. Units are factory calibrated at 12in-lbs.

1. Depressurize the pipe on which the sensor is to be serviced. **⚠ WARNING DO NOT REMOVE SOCKET HEAD CAP SCREWS WHILE SYSTEM IS UNDER PRESSURE.**
2. Using the Allen wrench, loosen and remove the four #10 socket head cap screws along with the stainless steel cover. It is not necessary to remove the electronics to service the impeller and shaft.
3. Utilizing the provided slots alternately, pry the impeller cover/shaft assembly from the sensor housing with the flat blade screwdriver.
4. Inspect the impeller and impeller cover/shaft assembly for signs of wear. Replace if necessary. It is good practice to replace o-rings before reassembling. Use no lubricants on o-rings.
5. To reassemble the sensor, position the impeller into the cavity of the sensor housing, making sure the six blades are pointing into the flow direction. The unit will not operate if the impeller is positioned incorrectly.
EXAMPLE: If flow direction is to the right, position impeller with blades pointing to the left. (See Figure 3 below.)
6. Orienting the keyway of the impeller cover/shaft assembly to the small slot between the two large slots and aligning the shaft to the shaft hold of the impeller, hand press the impeller cover/shaft assembly into the sensor housing cavity.
7. Fasten the stainless steel cover to the sensor housing using the #10 socket head cap screws. Torque the #10 hardware to 12 in-lb. pressurize system. **⚠ WARNING ALL FOUR SCREWS MUST BE IN PLACE AND TORQUED CORRECTLY BEFORE PRESSURING SYSTEM!**

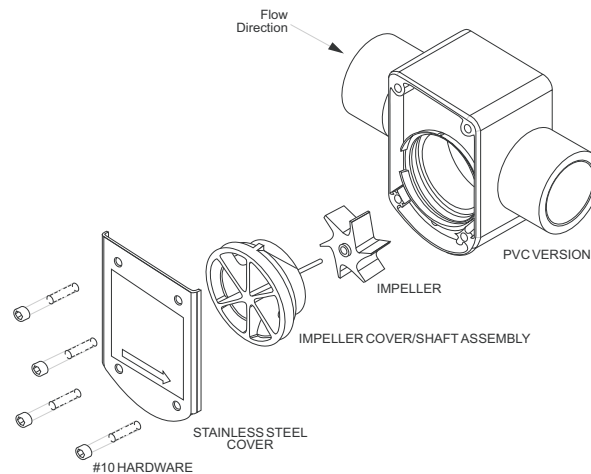


Figure 3: Assembly and Shaft Replacement

Detecting Coil and Electronic Assembly Replacement

A #1 Phillips screwdriver is required for servicing electronics. It is **not** necessary to depressurize or drain the system to service the electronics.

1. Disconnect sensor wiring from display or transmitter.
2. Using a Phillips screwdriver, loosen and remove the two #4 Phillips head screws and accompanying hardware. **⚠ CAUTION LETTING ELECTRONIC ASSEMBLY DROP FROM SENSOR COULD DAMAGE DETECTING COIL.**
3. Unplug coil from electronics **NOTE: ON ANALOG UNITS THE COIL IS PERMANENTLY ATTACHED TO ELECTRONICS.**
4. Plug coil to replacement electronics and reattach the electronics to the sensor with the two #4 Phillips screws. **⚠ CAUTION BE SURE WIRES FROM COIL ARE TUCKED IN BEFORE TIGHTENING SCREWS.** (See next page for replacement part numbers).
5. To replace detecting coil, first remove the electronic assembly per Step 1. Unplug coil from electronics. Remove the two #6 Phillips head screws, the coil retaining plate and secure to sensor housing with the #6 hardware. Plug replacement coil to electronic assembly and fasten the electronics to the sensor with the hardware (see the next page for replacement part numbers.) The coil wire orientation is not critical to the operation.

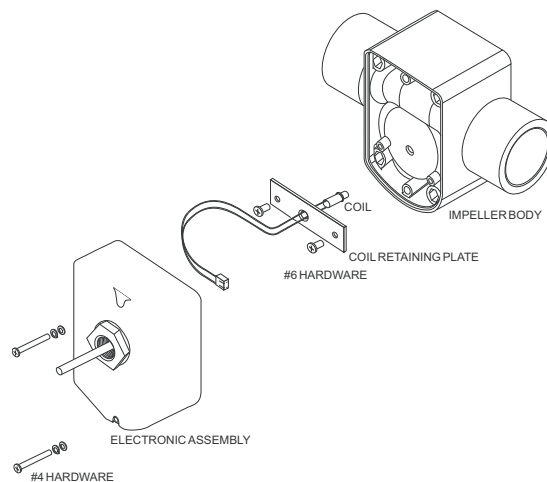


Figure 4: Coil and Electronic Assembly Replacement

REPLACEMENT PART NUMBERS

Impeller	08010
Coil Kit (for digital output unit only) (1) coil (1) retaining plate (2) #6 screws	711333
O-Ring Kit PVDF units only for use with Unions	
O-Ring Kit, EPDM O-Rings, 1/2" for 20 mm Union	4003OKE
O-Ring Kit, EPDM O-Rings, 3/4" for 25 mm Union	4013OKE
O-Ring Kit, EPDM O-Rings, 1" for 32 mm Union	4023OKE
O-Ring Kit, Viton O-Rings, 1/2" for 20 mm Union	4003OKV
O-Ring Kit, Viton O-Rings, 3/4" for 25 mm Union	4013OKV
O-Ring Kit, Viton O-Rings, 1" for 32 mm Union	4023OKV
Union Kit 1/2" (20mm) PVDF (2) PVDF Union Ends, 20 mm (2) PVDF Union Nuts, 20 mm (2) Viton O-Rings	711380
Union Kit 3/4" (25mm) PVDF (2) PVDF Union Ends, 25 mm (2) PVDF Union Nuts, 25 mm (2) Viton O-Rings	711381
Union Kit 1" (32mm) PVDF (2) PVDF Union Ends, 32 mm (2) PVDF Union Nuts, 32 mm (2) Viton O-Rings	711382

		Example: 400P	2RK	-	0	0	2	2
COVER MATERIAL								
PVC			2RK					
PVDF			3RK					
COVER O-RING								
Viton®					0			
EPDM					1			
Kalrez®					2			
Food Grade Silicon					3			
Neoprene®					4			
Chemraz®					5			
Teflon® Encapsulated Viton®					6			
Teflon Encapsulated Silicon					7			
Buna N					8			
Aflas®					9			
Kalrez Cover/TFE Encapsulated Viton					A			
SHAFT								
Zirconia Ceramic					0			
Hastalloy® C					1			
Tungsten Carbide					2			
Titanium					3			
Monel®					5			
316 Stainless Steel					6			
Tantalum					7			
Sapphire					9			
IMPELLER								
Tefzel®							2	
BEARING								
UHMWPE								1
Tefzel®								2
Teflon								3

Figure 5: Series 4000 Impeller Repair Kit

		Example: 4000EK	-	10
ELECTRONICS				
Pulse output				00
Pulse output with EFI foil shield				01
CE Pulse output				05
4-20mA analog output				10
4-20mA analog output with foil shield				11
CE 4-20mA analog output				15

Figure 6: Series 4000 Electronics Repair Kit Matrix

CALIBRATION

If you are replacing an existing Series 4000 sensor and have already calibrated your flow monitor, no calibration changes are necessary. For installation of a new flow monitor, please refer to the calibration instructions in the flow monitor manual.

The Series 4000 flow sensor, like all impeller or turbine flow meters, operates by converting kinetic energy (in the flow stream) into rotation (of an impeller). Indeed, almost all flow sensors work on the principle of converting flow energy to output signals. The only arguable exceptions are ultrasonic and electromagnetic sensors. The interaction of the flow stream and the impeller depend, to a currently unquantified extent, on fluid properties (density, viscosity, and pressure), and on physical properties of the impeller. The Badger Meter impeller design features the following:

1. A low mass polar moment of inertia
2. No magnetic drag
3. Very low eddy current drag
4. Low bearing friction

The impeller housing forms the periphery of a rotating fluid stream, the only source of drag tending to retard the impeller. The efficiency of this design is the key to the repeatability of sensor output at very low flow rates, and is the reason that the pressure drop across the installed sensor is so low.

The Series 4000 flow sensors have been calibrated on the Badger Meter flow bench, shown schematically on TD4000CAL. The calibrating fluid is untreated tap water, at ambient temperature, and at various pressures.

All calibration tests are based on average flow rate and average frequency measured during the delivery of 200 pounds of water over the time period required to deliver that weight of water at a given flow rate. Our flow bench and calibration practice conform to ASME/ANSI MFC-9M-1988, measurement of liquid flow in closed conduits by weighing method. Sensors are calibrated based on the average flow rate. Flow velocity in feet per second is calculated there from based on the theoretical pipe diameters. Data accuracy, as noted on TD4000CAL, is estimated to be the following for each individual test of sensor/flow rate combination:

+/-0.15 percent on average flow rate (q)

+/-0.10 percent on average frequency (f)

Tests on at least 12 points across the rated flow range of the specific sensor, including at least one slightly above maximum rated flow, and at least one slightly below minimum, were performed on at least six different samples of each of the basic design.

Output data points (72 minimum) for each basic model were analyzed using standard regression techniques, to find the best linear least squares fit describing flow rate (q) as a function of frequency (f) in the form:

$$q=kf+b(\text{EQ1})$$

The values of k and b are developed to produce the minimum summed squared differences between the actual flow rate at an observed frequency and the flow rate predicted by EQ1 at that observed frequency. The results of this analysis indicate that the calibration constants given below are accurate within +/- 1 percent of full scale given the following constraints:

1. Constant pressure
2. Constant temperature
3. Water as the fluid medium

This 1 percent covers the effects of non linearity in the flow rate/frequency relationship and dimensional variations from sensor to sensor.

Testing to date indicates that over a relatively broad range of operating pressure and temperature, factory calibration should be adequate to yield results accurate within +/-1 percent of full scale in fluids not markedly different in density and viscosity from water. Repeatability with most compatible fluids at constant pressure and temperature should be within 0.7 percent or less, although the actual readings may be significantly in error if the viscosity and density of the sensed fluid depart drastically from water.

PVC sensor calibration is based on flow through standard schedule 80 PVC pipe. The effects on calibration of joining the standard schedule 80 pipe terminations in a system of other than PVC schedule 80 have not been investigated. We caution you to anticipate some deviation in calibration. This effect can be minimized if an additional 10 to 20 diameter lengths of

PVC schedule 80 pipe of the appropriated diameter is installed upstream of the sensor, and a similar 5 to 10 diameter lengths downstream.

PVDF sensor calibration is based on flow through industry standard PVDF pipe. Similar action should be taken if the PVDF sensor is used in a system based on other piping technologies.

CALIBRATION TABLE-DIGITAL OUTPUT

The following table provides calibration and operational data for the various models of the Badger Series 4000 sensor. The data is organized as follows:

- Column 1: Model number, to which the data listed in the particular column pertains
- Column 2: Housing material
- Column 3: Nominal pipe size
- Column 4: Pipe O.D., per applicable standards
- Column 5: Pipe I.D., per applicable standards
- Column 6: Slope of the regression line used in calibration (K)
- Column 7: Intercept of the regression line (Offset)
- Column 8: Minimum recommended flow rate (GPM)
- Column 9: Maximum recommended flow rate (GPM)
- Column 10: Pulse rate at minimum flow (Hz)
- Column 11: Pulse rate at maximum flow (Hz)

The calibration constants in columns 6 and 7 relate frequency (Hz) to flow rate (GPM) in the equations:

$$\text{FREQ} = \frac{\text{GPM}}{K} - \text{Offset}$$

$$\text{GPM} = K (\text{FREQ} + \text{Offset})$$

SPECIFICATIONS

Wetted Materials

Sensor Housing and Enhancing Jet (If Applicable)

PVC - Virgin polyvinyl chloride, type 1, grade 1

PVDF - Virgin polyvinylidene fluoride

Sensor #	Mat'l	Nom. Pipe	Pipe OD	Pipe ID	K	Offset	GPM min	GPM max	Hz min	Hz max
400200	PVC	1/2 #80	.0840 in	0.546	0.413	0.3496	0.75	15.00	1.46	35.97
401200	PVC	3/4 #80	1.050 in	0.824	0.5735	0.2638	1.75	35.00	2.78	60.76
402000	PVC	1 #80	1.315 in	0.957	0.6134	0.1826	2.25	45.00	3.48	73.17
410200	PVC	1/2 #80	.0840 in	0.546	0.1421	0.8474	0.18	6.00	0.48	41.37
411200	PVC	3/4 #80	1.050 in	0.824	0.3287	0.2159	0.40	13.00	1.00	39.33
400300 400400 400500	PVDF	1/2"	20mm (0.787in)	16.2mm (0.638in)	0.5987	0.0008	1.00	20.00	1.66	33.40
401300 401400 401500	PVDF	3/4"	25mm (0.984in)	21.2mm (0.835in)	0.613	0.02664	1.75	35.00	2.82	57.06
402300 402400 402500	PVDF	1"	32mm (1.260in)	27.2mm (1.071in)	0.6266	0.0314	3.00	50.00	4.75	79.76
410300 410400 410500	PVDF	1/2"	20mm (0.787in)	16.2mm (0.638in)	0.1445	0.4841	0.25	8.00	1.24	54.87
411300 411400 411500	PVDF	3/4"	25mm (0.984in)	21.2mm (0.835in)	0.3195	0.4679	0.40	14.00	0.78	44.28

Figure 7: Calibration Table

Analog versions of the Series 4000 are precalibrated at the factory using the flow ranges below.

Sensor #	Mat'l	Nom. Pipe	Pipe OD	Pipe ID	4mA Flow	20mA Flow
400210	PVC	1/2 #80	.0840 in	0.546	0	20
401210	PVC	3/4 #80	1.050 in	0.824	0	30
402010	PVC	1 #80	1.315 in	0.957	0	40
410210	PVC	1/2 #80	.0840 in	0.546	0	8
411210	PVC	3/4 #80	1.050 in	0.824	0	12
400310 400410 400510	PVDF	1/2"	20mm (0.787in)	16.2mm (0.638in)	0	20
401310 401410 401510	PVDF	3/4"	25mm (0.984in)	21.2mm (0.835in)	0	30
402310 402410 402510	PVDF	1"	32mm (1.260in)	27.2mm (1.071in)	0	40
410310 410410 410510	PVDF	1/2"	20mm (0.787in)	16.2mm (0.638in)	0	8
411310 411410 411510	PVDF	3/4"	25mm (0.984in)	21.2mm (0.835in)	0	12

Figure 8: Calibration Table - Analog

O-Rings

- Viton®
- EPDM
- Kalrez®
- Silicon - food grade
- Neoprene®
- Chemraz®
- Teflon® Encapsulated Viton

Impeller Shafts

- Zirconia Ceramic
- Hastelloy® - C-276
- Tungsten Carbide - GE carboloy 883 colbalt binder
- Titanium - titanium alloy 86Ti-6AL-6V-25A
- Monel® - Grade K500
- Stainless Steel - 316 stainless steel
- Tantalum - commercial grade

Process Connections

- PVC (virgin polyvinyl chloride, type 1, grade 1) schedule 80 tail pieces
- PVDF (virgin polyvinylidene fluoride) sockets
- PVDF union thread (for joining existing piping systems with GF unions)
- PVDF union nuts with socket union ends
- PVDF union nuts with 316 stainless steel FNPT union ends
- PVDF flanges
- PVDF union nuts with CPVC socket union ends

Impeller and Bearing

- Tefzel®

Pressure, Temperature Ratings

- Depends on hardware configurations. See diagram at end of this section.

Operating Flow Range

- 0 to 20 ft/sec for standard range units
- 0 to 10 ft/sec for enhanced flow range units

Recommended Design Flow Range

- 1 to 20 ft/sec for standard range units to maintain calibration accuracy
- 0.25 to 8 ft/sec for enhanced flow range units to maintain calibration accuracy

Accuracy

- Better than +/- 1.0% of full scale over recommended design flow range with water @50-80 F and 20-40 psig

Repeatability

- +/- 0.5% of full scale over recommended design flow range

Linearity

- +/- .7% of full scale over recommended design flow range
- +/- 1.0% frequency to current conversion

Transducer Power

Digital Output Unit

- Typically provided by Badger Meter flow monitor or transmitter. Any alternate supply must be of a resistance-limited type meeting the following constraints:
- Supply voltage: 9 to 20 VDC
- Supply current: 2mA maximum

Analog Output Unit

- 10 VDC minimum to 35 VDC maximum. The combination of loop supply voltage and total loop series resistance must insure that the device voltage remains within these limits over the 4-20mA output span.

Output

Digital Output Unit

- **Pulse:** square wave (approximately) output @ 1 pulse/revolution
- **Voltage:**
 - 0.4 V maximum (output low)
 - 4.5 V minimum (output high) into high impedance load

Output is 5 volt CMOS and LSTTL compatible. The output can be forced to any logic level up to 20 volts by an external pull-up resistor.

- **Sink Current:** 2mA maximum

Analog Output Unit

- **Signal:** Loop powered 4-20mA current analog with offset compensation output for ripple less than 0.25% of full scale.

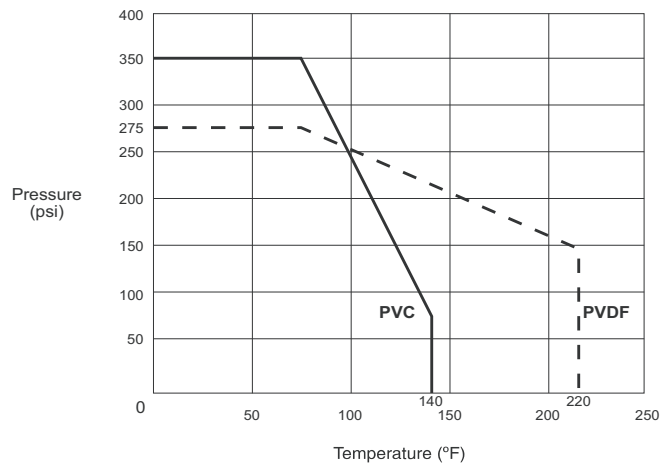


Figure 9: Pressure Temperature Diagram for Series 4000 Sensors

TROUBLESHOOTING

General

Primary consideration for troubleshooting a Series 4000 flow sensor is to first establish that the problem lies with the sensor and not with the electronic device connected to it. A simple way to help determine this is to substitute a known working sensor for the suspect unit. If the electronics react in an appropriate manner, you may conclude that the problem is sensor related. Another option would be to provide a similar, square wave pulse simulation by hooking up a frequency generator to the interface electronics and simulating as close as possible the actual sensor signal.

If you suspect a sensor problem, there are a few mechanical considerations to be addressed:

1. Make sure there is flow in the pipe line appropriate to the operations range (0.25-20 feet/second) of the sensor.
2. Make sure that the wiring between the sensor and the electronics is correct. If a junction box has been added, also make sure that all wiring connections are right.
3. Check the impeller assembly to make sure it is not mounted in the reverse direction of flow.
4. Make sure that the impeller can spin freely on the shaft and that no foreign matter of debris has lodged in the sensor housing.

TROUBLESHOOTING THE SENSOR

Digital Circuit

A sensor is a powered device, required voltage between 8VDC and 20 VDC, applied between the red (+) and black (-) sensor leads. The sensor will normally draw about 1mA for this supply. **WARNING: DO NOT EXCEED 20 VDC; SENSOR DAMAGE MAY RESULT.**

1. The white sensor wire should be disconnected. Make sure that the black, red and shield wires remain connected to the proper terminals.
2. Install a voltmeter, positive (+) to the white sensor wire and negative (-) to the black sensor wire. If flow exists, you should see a square wave switching between 0.0 VDC (low) and 4.0 VDC (high). NOTE: The pulse may be too fast for the voltmeter to recognize as a square wave, but it may appear as an unstable reading somewhere between 2.0 and 4.9 VDC. If flow is stopped, the output will hold in either a high (4.0 VDC) state or low (0.0 VDC) state, depending on the position of the impeller reflector or other factors. To simulate impeller rotation, simply pass a metal object (i.e. large screwdriver or pliers) past the back of the sensor. The output signal should then switch states.
3. If the sensor produces pulses in the above tests, reconnect the white sensor wire to the signal input terminal of the transmitter. With the voltmeter still connected, note the actual voltage levels between the output switching (such as 0.0 VDC low or 4.0 VDC high). If reconnecting the sensor to the transmitter either stops or significantly alters the voltage levels of the pulses, or if the transmitter does not respond to the pulses, consult the factory or your local representative.
4. A nonworking sensor could be the result of either a sensing coil failure or a component failure in the electronic module (blue cover). Using an ohm meter, determine the coil resistance by removing the blue electronics cover containing the encapsulated circuitry. Unplug the coil from the electronics in the cover. Connect the probes of the ohm meter to the wire terminals of the coil plug-in connector. The coil resistance should measure between 5 and 10 Ohms. A very low or very high resistance reading may indicate failed coil; if this appears, replace the coil.
5. If the coil appears to be within specification, replace the blue cover assembly from another working device. If the sensor begins working, replace the electronic assembly.
6. If the sensor switches states when a metal object is passed near the back of the sensor, but no pulse occurs when flow exists, verify that the flow meets our minimum flow requirements for the sensor. Check further the condition of the impeller and the shaft for mechanical wear or damage. If replacement is necessary, a repair kit is available containing the appropriate components.

7. If the sensor was working and a rebuild kit was installed due to a failure of the impeller or shaft and the sensor did not return to working order, check to ensure that the impeller was installed in the proper direction. If the impeller was installed backwards to the flow direction, no signal pulse will be generated even if the impeller spins freely.
8. Should you experience any other difficulties with the sensor, please consult the factory or your local representative. Please have a description of the problem, model, serial number, and application information available when you call.

Analog Circuit

1. Connect power supply and ammeter in a series loop.
2. With no flow in the pipe, check to see if the output is reading 4mA. If the output is greater or less than 4mA then the analog electronics assembly must be recalibrated at factory.
3. With flow in the pipe the output should be something higher than 4mA but not greater than 20mA. If you cannot get flow through the system you can simulate flow two ways. The first way is to blow into one side of the unit to make impeller spin and the other is to pass a metal object (nut driver, wrench, etc...) across the back of the electronics housing. Either one of the last two methods will excite the analog output to change and read greater than 4mA.
4. If the analog output does not change with any of the actions done in step three then the electronics assembly is defective.
5. If the analog changes when you pass a metal object across the rear of the electronics assembly but does not at any other time then inspect the impeller assembly.

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