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## SCOPE OF THIS MANUAL

This manual is intended to help you get the Series 735 flow sensor up and running quickly.

### IMPORTANT

*Read this manual carefully before attempting any installation or operation. Keep the manual accessible for future reference.*

## UNPACKING AND INSPECTION

Upon opening the shipping container, visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

**NOTE:** If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the purchaser.

## SAFETY

### Terminology and Symbols



Indicates a hazardous situation, which, if not avoided, is estimated to be capable of causing death or serious personal injury.



Indicates a hazardous situation, which, if not avoided, could result in severe personal injury or death.



Indicates a hazardous situation, which, if not avoided, is estimated to be capable of causing minor or moderate personal injury or damage to property.

### Considerations



**THE IMPELLER STYLE FLOW SENSOR DESCRIBED IN THIS MANUAL IS NOT INTENDED FOR USE IN SAFETY CRITICAL APPLICATIONS. USE OF THE DEVICE IN THIS MANNER IS DONE AT THE SOLE DISCRETION OF THE CUSTOMER AND/OR END USER OF THE DEVICE**



**THE IMPELLER STYLE FLOW SENSOR DESCRIBED IN THIS MANUAL IS NOT INTENDED FOR USE IN SYSTEMS WITH FLAMMABLE LIQUIDS OR GASES. ADDITIONALLY, THE DEVICE IS NOT INTENDED FOR SYSTEMS CONTAINING HAZARDOUS FLUIDS, OR FLUIDS OTHER THAN WATER.**



**THE IMPELLER STYLE FLOW SENSOR DESCRIBED IN THIS MANUAL MUST BE INSTALLED IN ACCORDANCE WITH ALL LOCAL AND FEDERAL CODES OR END USE STANDARDS AS APPLICABLE.**



**IF THE DEVICES DESCRIBED IN THIS MANUAL ARE USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.**

### IMPORTANT

*Not following instructions properly may impair safety of equipment and/or personnel.*

## INTRODUCTION

Used in conjunction with any Badger Meter® flow monitor or endpoint, Badger Meter non-magnetic Impeller flow sensors provide an accurate reading of the rate of liquid flow as well as total accumulated flow. A number of sensor models are offered, which cover applications for a wide range of pipe sizes and pressure/temperature specifications.

The flow sensors generate a frequency which is proportional to flow rate. An internal preamplifier allows the pulse signal to travel up to 2000 feet without further amplification. The impeller bearing assembly, shaft and O-rings are replaceable in the field.

The Series 735 Impeller flow sensors feature a four-blade impeller design, using a proprietary, non-magnetic sensing technology. As the liquid flow turns the impeller, a low impedance signal is transmitted with a frequency proportional to the flow rate.

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

## ELECTRONIC TYPES

Sensors are supplied with two single-conductor 18 AWG solid copper wire leads with UL Style 116666 direct burial insulation. These IR models are used in below grade applications such as irrigation, municipal and groundwater monitoring. All Badger Meter Series 735 sensor electrical components are self-contained. See "*Specifications*" on page 10 for pressure and temperature ratings.

### IR Sensor

Designed for below grade applications such as irrigation, municipal, and groundwater monitoring where the flow rates are between 2...20 ft/sec. and temperatures are below 110° F. IR sensors are supplied with two single conductor, 18 AWG solid copper wire with UL Style 116666 direct burial insulation.

### Series 735

These models feature a modified PVC tee with solvent weld socket end connections, and a removable PPS sensor insert. Available sizes are 1/2 in. (12.7 mm), 3/4 in. (19.05 mm) and 1 in. (25.4 mm). BSP threaded adapters are available.

## MECHANICAL INSTALLATION

### **⚠ CAUTION**

#### **DEPRESSURIZE AND VENT PIPING SYSTEM PRIOR TO ANY INSTALLATION OR MAINTENANCE OF THE FLOW SENSOR.**

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, and pipe bends can lead to inaccurate overall flow rate indications, even though local flow 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:

- Choose a location along the pipe with ten pipe diameters upstream and five pipe diameters 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.
- The preferred location for the sensor around the circumference of a horizontal pipe is on top. If trapped air or debris will interfere, then the sensor should be located further around the pipe from the top but not more than 45 degrees from top dead center. The sensor should never be located at the bottom of the pipe, as sediment may collect there. Locations off top dead center cause the impeller friction to increase, which may affect performance at low flow rates and increase wear. Any circumferential location is correct for installation in vertical pipes. Rising flow preferred to reduce effects of any trapped air.

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## ELECTRICAL INSTALLATION GUIDELINES

**⚠ DANGER**

**DISCONNECT POWER FROM FLOW SENSOR SOURCE AND/OR RECEIVING DEVICE PRIOR TO ANY INSTALLATION OR MAINTENANCE OF THE SYSTEM.**

**⚠ DANGER**

**FLOW SENSOR SOURCE AND/OR RECEIVING DEVICE MUST PROVIDE BASIC ISOLATION FROM MAINS FOR SAFE OPERATION OF THE SYSTEM.**

The sensor leads are supplied with watertight caps over the ends.

- Do not remove the plastic caps from the sensor leads until you are ready to splice.
- Use a twisted pair cable suitable for direct burial to connect the sensor to the endpoint, monitor, or controller. Multi-pair telecommunication cable or direct burial cables may be used.
- Make a watertight splice using a two-part epoxy type waterproof kit. Be sure the epoxy seals the ends of the cable jacket.
- Make sure the epoxy is hardened before inverting the splice or dropping it in standing water.
- Do not make an underground splice unless absolutely necessary.
- Route the cable from the sensor to a Badger Meter flow monitor or endpoint. The cable may be extended up to 2000 ft, using two-conductor shielded 20 AWG or larger stranded copper wire with appropriate ratings. Leave enough flexibility in the cable or conduit to allow for future service.
- When connecting to a Badger Meter flow monitor or endpoint, locate the section of terminal strip on the monitor labeled *SENSOR INPUT* or *SENSOR*. Connect the red wire to *IN*, *SIGNAL(+)* or *SIGNAL* terminal and the black wire to *GND*, *SIGNAL(-)* or *COM* terminal and the shield drain wire (if applicable) to *SLD*.
- When interfacing with other equipment, the signal wave forms and power requirements are as shown in "*Specifications*" on page 10.

## FLOW SENSOR INSTALLATION

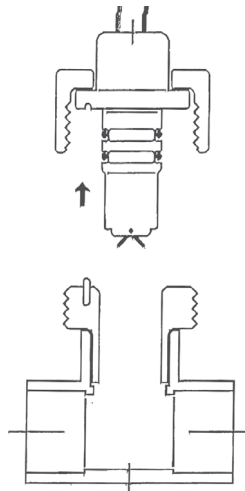
### **⚠ CAUTION**

**DEPRESSURIZE AND VENT PIPING SYSTEM PRIOR TO ANY INSTALLATION OR MAINTENANCE OF THE FLOW SENSOR.**

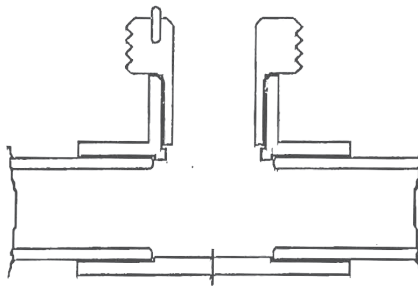
### **⚠ DANGER**

**DISCONNECT POWER FROM FLOW SENSOR SOURCE AND/OR RECEIVING DEVICE PRIOR TO ANY INSTALLATION OR MAINTENANCE OF THE SYSTEM.**

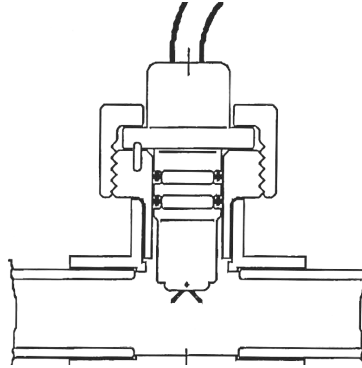
1. Remove the sensor assembly and the nut from the tee.



2. Remove burrs from the pipe ends and remove dirt and loose debris from pipe and tee sockets.
3. Glue the line pipe into the tee using an appropriate primer and cement according to the manufacturer's instructions. Do not use or leave excess glue. Glue build-up in the tee can affect the measurement performance of the unit and/or prevent the impeller from turning. Do not let the glue or primer contact the bore where the O-rings seal.



4. Insert the sensor into the tee, carefully lining up the locating hole in the sensor with the locating pin in the tee.
5. Install and hand-tighten the retaining nut.
6. Complete the wiring connections. See "*Electrical Installation Guidelines*" on page 5 for details.
7. Complete the wiring connections.



### **Additional Information**

- The unit functions best with schedule 40 or a pipe wall thinner than schedule 40.
- Keep all parts as clean as possible. Do not let the glue or primer contact the surfaces where the O-rings make their seal.
- Although the meter can measure at velocities up to 20 ft/sec, do not exceed velocities above 7.5 ft/sec.

## CALIBRATION

Badger Meter Impeller sensors use unique K and offset numbers for calibration. These numbers are derived from calibration runs using NIST traceable instruments. Using both a K and an offset number provides higher accuracy than using a K-factor alone. The K and offset numbers for each tee configuration are listed in the table below.

### Calibration Table

Size/Schedule	K	Offset
1/2" S40	0.078000	0.9
1/2" SDR 13.5	0.120119	0.1
3/4" S40	0.156300	0.9
3/4" SDR 21	0.197000	-0.6
1" S40	0.261119	1.2
1" SDR 21	0.321739	0.6

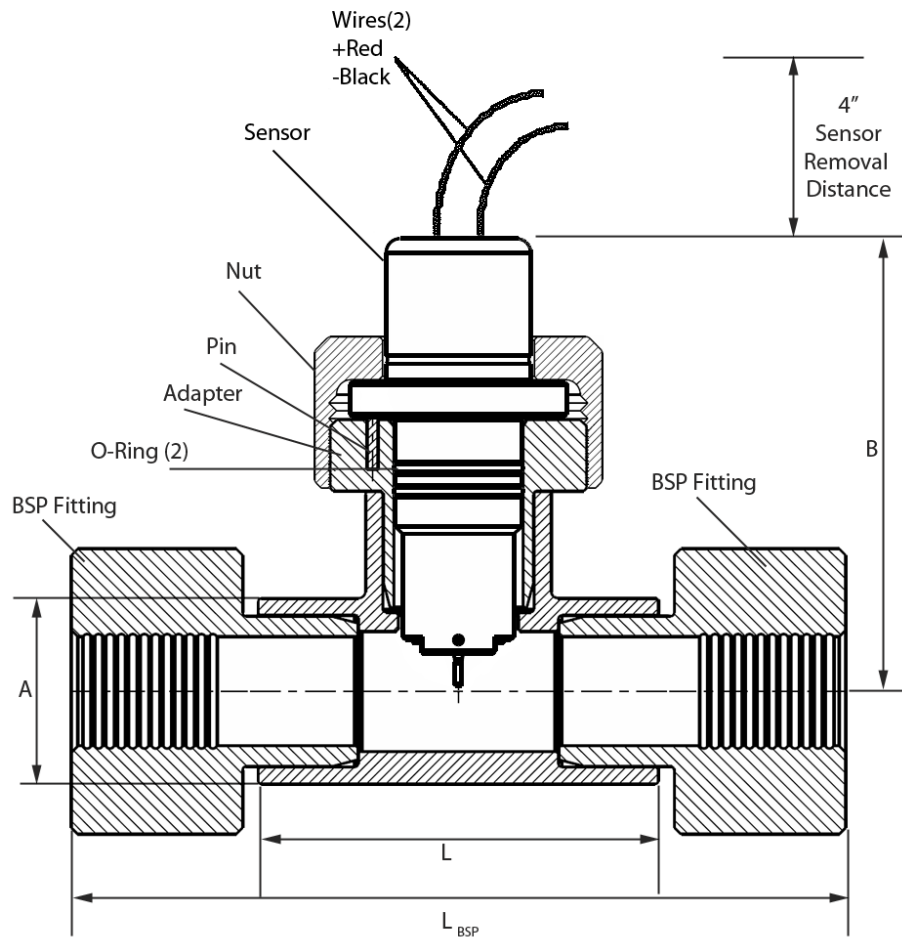
Input the information in the table above into the following equation to determine the frequency of the Series 735 Impeller flow sensors:

$$\text{Freq} = \frac{\text{gpm}}{\text{K}} - \text{offset}$$

This information is required when calibrating an output board when using the raw sensor data as direct output to interface with a device that is not a Badger Meter product.



# DIMENSIONS



<b>A</b> Soc Size, NPS	<b>B</b> Centerline to Top	<b>L</b>	<b>L<sub>BSP</sub> Optional</b>
1/2 in. [Ø 0.840"]	3.85 in. (97.8 mm)	3.06 in. (77.7 mm)	6.086 in. (154.6 mm)
3/4 in. [Ø 1.050"]	3.85 in. (97.8 mm)	3.31 in. (84.1 mm)	6.775 in. (172.1 mm)
1 in. [Ø 1.315"]	3.94 in. (100.1 mm)	3.50 in. (88.9 mm)	6.775 in. (172.1 mm)

## SPECIFICATIONS

<b>Wetted Materials (except tees)</b>	See "Ordering Matrix" on page 11 for material specifications
<b>Materials</b>	
Tee	PVC Type 1, white
Adapter	PVC Type 1, gray
BSP Fitting	PVC Type 1
Sensor Housing	PPS
Retaining Nut	Acetal copolymer, black
Locating Pin	300SST
Impeller	300SST
Shaft	Tungsten Carbide
Bearing	UHMWPE
O-Rings	EPDM
Wires	18 AWG Irrigation Wire (solid copper)
<b>Pressure/Temperature Ratings</b>	150 psig @ 73° F (22.8° C) 75 psig @ 110° F (43.3° C)
<b>Rated Temperature</b>	Operating: 35...110° F (1.67...43.3° C) Storage 14...110° F (-10...43.3° C)
<b>Recommended Design Flow Range</b>	2...20 ft/sec (0.6...6.1 m/sec)
<b>Accuracy</b>	± 3.0% of full scale over recommended design flow range
<b>Repeatability</b>	± 1.5% of full scale over recommended design flow range
<b>Linearity</b>	± 1.5% of full scale over recommended design flow range
<b>Transducer Excitation</b>	8...35V DC max. input, source limited to 100 mA Quiescent current 600 uA @ 8...35V DC max. Quiescent voltage (V <sub>high</sub> =Supply Voltage-(600 uA*Supply impedance)) ON State (V <sub>low</sub> ) Max. 1.2V DC @ 40 mA current limit (15 Ω + 0.7V DC)
<b>Output Frequency</b>	3.2...200 Hz
<b>Output Pulse Width</b>	5 msec ±25%
<b>Environmental</b>	IP 68 / NEMA 4X Suitable for pollution degree 4 environments Suitable for outdoor use above or below grade Suitable for use in 100% humidity
<b>Electrical Cable for IR Sensor Electronics</b>	UL Style 116666 copper solid AWG 18 wire w/direct burial insulation rated to 105° C

# ORDERING MATRIX

Example: 7		35	PV	05	0	6	-	1	2	0	1
<b>STYLE</b>											
Tee Mounted Insert Sensor		35									
<b>MATERIAL</b>											
PVC (.5", .75", 1" Sch 40 only)			PV								
<b>SIZE</b>											
0.5"				05							
0.75"				07							
1"				10							
0.5" with BSP Adapters				06							
0.75" with BSP Adapters				08							
1" with BSP Adapters				11							
<b>ELECTRONICS HOUSING</b>											
PPS					0						
<b>ELECTRONICS</b>											
IR-Irrigation						6					
<b>O-RING</b>											
EPDM								1			
<b>SHAFT</b>											
Tungsten Carbide									2		
<b>IMPELLER</b>											
300 SST										0	
<b>BEARING</b>											
UHMWPE											1

## Control. Manage. Optimize.

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