



SDI Series

Insert Style Flow Sensors



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INTRODUCTION

The Badger Meter SDI Series impeller flow sensor offers unparalleled performance for liquid flow measurement in closed pipe systems in an easy to install economical package. Impeller sensors offer a quick response to changes in flow rate and are well suited to flow control and batch type applications in addition to flow monitoring. The new four-bladed impeller design is rugged, non-fouling and does not require custom calibration.

Coupled with the proprietary patented digital detection circuit, the sensor measures flows from under 0.3 feet per second to over 20 fps regardless of the conductivity or turbidity of the liquid. The standard frequency output produces a low impedance square wave signal proportional to flow rate that may be transmitted up to 2000 feet without amplification. Models are available to measure flow in one or both directions.

All SDI insert sensors are mounted on the pipe using a 1 in. tap. As with any insert sensor, a pipe saddle or weld-on fitting is preferred over a service tee because it causes fewer disturbances to the flow.

MODELS AVAILABLE

Direct insert sensor models are installed in piping configurations that are not in service or under pressure.

Hot tap insert sensor models feature isolation valves and mounting hardware to install or remove the sensor from a pipeline that would be difficult to shut down or drain. In a true hot tap installation the sensor is mounted in the pipe under pressure by attaching a service saddle or weld-on fitting to the pipe and mounting the isolating valve and nipple to the threaded connection. A hole is then cut in the wall of the pipe through the valve using a commercial tapping machine with a 1 in. size cutter. Once the hole is cut, the tapping machine is removed and the valve is shut. Then the sensor assembly is mounted to the isolation valve and extended into the pipeline to measure flow.

Even in new construction a hot tap sensor may be appropriate for service considerations.

The small stem diameter allows the sensor to be inserted into the pressurized pipeline by hand without the need for an installation tool. The mounting hardware holds the sensor firmly in place at the correct depth and alignment.

ELECTRONIC OUTPUTS

Standard Frequency

Sensor output is a pulse proportional to flow. The signal is similar to all 200 Series Badger Meter impeller flow sensors and will interface with all existing Badger Meter transmitters and monitors. The power supply to the sensor and the output signal from the sensor are carried on the same two wires. Wire connections are made at screw terminals on removable headers inside the NEMA 4X housing.

Analog Output

The sensor is also available with a two-wire loop powered 4...20 mA output. The analog output is produced by an on-board micro-controller for precise, drift-free signals. The unit is programmed from a computer using Windows® based software and an A-301 connection cable. Units may be pre-programmed at the factory or field programmed. All information is stored in non-volatile memory in the flow sensor.

Scaled Pulse Output

The scaled pulse is produced by an on-board micro-controller for precise, accurate outputs. This option may be programmed to produce an isolated dry contact closure scaled to any number of engineering units of measure. Sensors may be pre-programmed at the factory or field programmed using an A-301 connection cable and a Windows based software program. All information is stored in non-volatile memory in the flow sensor. This is a four-wire option.

Bidirectional Flow, Analog Output

This option provides a programmable 4...20 mA signal proportional to flow rate and a contact closure to indicate the direction of flow. All programming is accomplished as previously mentioned. The user can program the unit for pipe size, flow scale and the direction of flow. This is a six-wire option.

Bidirectional Flow, Scaled Pulse Output

This option provides the user with a choice of outputs. In one case the sensor provides an output scaled to the required number of engineering units on one set of terminals and a contact closure to indicate the direction of flow on another. The other choice provides two isolated scaled pulse outputs, one for each direction. Programming the output choice, pipe size, output scale and direction of flow by the user are also accomplished by using a PC with Badger Meter software and A-301 connection cable. This option also requires six wires.

SDI Series Direct Insert Ordering Matrix		SDI	0	D1	N	0	0	-	0	2	0	0	0
Material													
Stainless Steel/PPS Tip	0												
Brass/PPS Tip	1												
Stainless Steel/PEEK Tip *	2												
Type													
Direct Insert for Pipe 1-1/2" thru 10" *	D1												
Direct Insert for Pipe 12" thru 36" *	D2												
Direct Insert 36" and UP*	D3												
Electronic Housing													
NEMA 4X	N												
Output													
Standard Frequency Pulse	0												
Analog 4-20mA	1												
Scaled Pulse	2												
Display													
No Display	0												
LCD Option [not available with output option 0]	1												
O-Ring													
Viton® EDPM = 1 AFLAS = 2*	0												
Shaft													
Tungsten Carbide [Standard]	2												
Hastelloy® C-276 [optional - consult factory]	1												
Zirconia Ceramic [optional - consult factory]	0												
Impeller													
Stainless Steel	0												
Bearing													
Torlon® VESPEL = 1 KETRON HPV = 2*	0												

*Pipe size for reference only-Depending on pipe material, tapping saddle, or existing hardware, longer sensor length may be required. Consult Factory

Figure 1: SDI series direct insert ordering matrix

SDI Series Hot Tap Ordering Matrix		SDI	0	H1	N	0	0	-	0	2	0	0	0
Material													
Stainless Steel/PPS Tip	0												
Stainless Steel/PEEK Tip *	2												
Type													
Hot Tap for Pipe 1-1/2" thru 10" *	H1												
Hot Tap for Pipe 12" thru 36" *	H2												
Hot Tap for Pipe 36" and UP*	H3												
Electronic Housing													
NEMA 4X	N												
Output													
Standard Frequency Pulse	0												
Analog 4-20mA	1												
Scaled Pulse	2												
Bi-Directional, 4-20mA + Direction [PPS tip Only]	5												
Bi-Directional, Scaled Pulse [PPS tip Only]	6												
Display													
No Display	0												
LCD Option [not available with output option 0]	1												
O-Ring													
Viton® EDPM = 1 AFLAS = 2*	0												
Shaft													
Tungsten Carbide [Standard]	2												
Hastelloy® C-276 [optional - consult factory]	1												
Zirconia Ceramic [optional - consult factory]	0												
Impeller													
Stainless Steel	0												
Bearing													
Torlon® VESPEL = 1 KETRON HPV = 2*	0												

*Pipe size for reference only-Depending on pipe material, tapping saddle, or existing hardware, longer sensor length may be required. Consult Factory

* = Combination for >180° F Service

Figure 2: SDI series hot tap ordering matrix

Display Options

All models except the standard frequency output version may also be equipped with a display. Integrated into the NEMA 4 housing, the 8 digit LCD may be programmed to show rate of flow, flow total or toggle between the two. Bidirectional models also show flow direction.

MECHANICAL INSTALLATION

The accuracy of flow measurement for all insert type 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 that is partially full or where it can be affected by air bubbles, floating debris or sediment may not achieve full accuracy and could be damaged.

Badger Meter impeller flow sensors are designed to operate reliably under adverse conditions, but the following recommendations should be followed to provide maximum system accuracy.

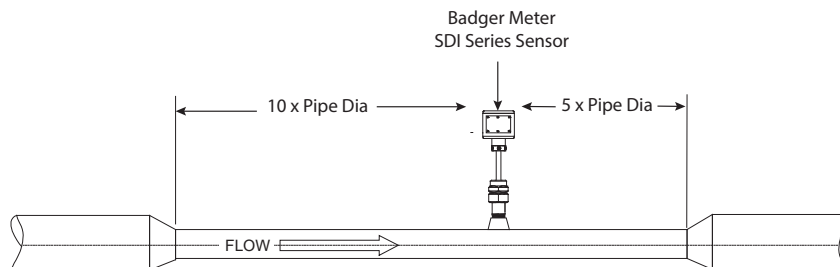


Figure 3: Minimum recommended straight run distance

- Choose a location along the pipe where there is straight pipe for a distance of 10 pipe diameters upstream and 5 pipe diameters downstream of the sensor. Pipe bends, valves, other fittings, pipe enlargements and reductions or anything else that would cause a flow disturbance should not be present in this length of pipe.
- The recommended tap location around the circumference of a horizontal pipe is on top. If trapped air or debris will interfere, then the sensor should be located around the pipe from the top preferably 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. Any circumferential location is correct for installation in vertical pipes. Insertion depth is critical to accuracy. The algorithm used to convert impeller motion into flow was developed through flow tests in an independent calibration laboratory. The impeller must be located in the same position in the pipe as it was in the calibration test for the impeller frequency to accurately describe the same liquid velocity. Detailed installation instructions on the following pages include methods for correct insertion depth.
- Alignment of the sensor is also important. The impeller shaft must be perpendicular to the flow for accuracy. Alignment instructions are also included on the following pages.

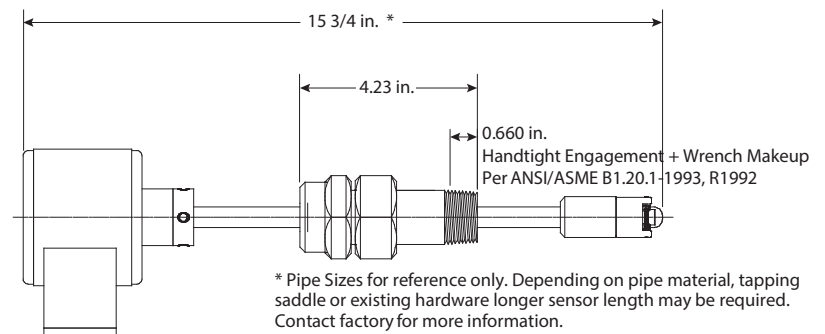


Figure 4: Direct insertion sensor dimensions

Installation for Direct Insert Models

These instructions are for the installation of flow sensors into piping systems that are not under pressure at the time of installation. If the line must be tapped under pressure, a hot tap style sensor must be used. See ["Installation for Hot Tap Models" on page 7](#) for hot tap installation instructions.

The insertion depth and alignment of the sensor are critical to the accuracy of the flow measurement. The impeller must be at the same location in the pipe as it was during calibration. Badger Meter provides sensors with different stem lengths. Longer stems are intended for use in larger diameter pipes and shorter stems for use in smaller pipelines. However stem length has no affect on the operation of the sensor provided that the impeller is positioned correctly in the pipe.

Direct insert models are available in one stem length designated D1. They are intended for nominal pipe diameters from 1-1/2...10 in. However, pipe with extra thick walls, existing linings, or unusual tapping hardware may require longer length sensors - Consult factory. For larger pipe sizes hot tap style sensors equipped with isolation valves are recommended.

The preferred method of installation is by means of a saddle with a 1 in. NPT outlet. On steel pipelines a weld-on type fitting may be substituted.

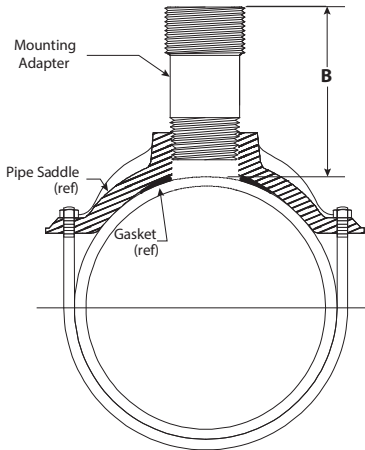


Figure 5: Dimension B

1. Attach the saddle to a section of pipe that has at least 10 diameters of straight pipe ahead and five diameters of straight pipe behind the saddle. Drill a minimum 1-1/8 in. diameter hole in the pipe.
2. Remove the sensor assembly from the mounting hardware by loosening the hex cap over the stem collar and the cover to the mounting adapter and detaching the assembly. Set aside taking care not to damage impeller/shaft assembly.
3. Attach the pipe thread end of the mounting adapter to the saddle or weld-o-let using a pipe joint compound and tighten the joint. Do not apply sealing compound to the top thread of the mounting adapter. It is sealed with an O-ring.
4. The sensor rotor assembly is to be located a fixed distance from the center of the pipe. To position the impeller at this depth, use a reference measurement for the pipe size and schedule.
 - a. Look up the pipe size and schedule number in the *"Customer Reference Number Tables"* on page 14 and note the Customer Reference Number (Customer Ref #)

NOTE: The Customer Reference Number has been calculated using the following formula:

$$\text{Ref \#} = \text{Insertion Depth} + \text{Wall Thickness} + \text{Cover Thickness}$$

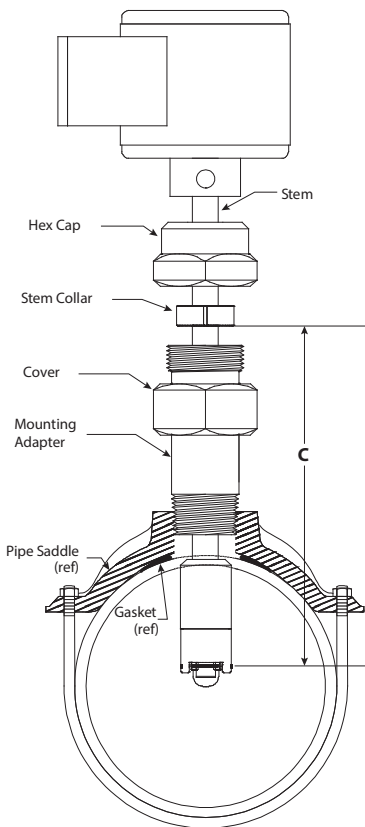


Figure 6: Dimension C

- b. Next, measure from the outside wall of the pipe to the top of the installed mounting adapter, this is dimension B in [Figure 5](#).
 - c. Add this number to the reference measurement. The resulting number is dimension C in [Figure 6](#)
 $\text{Dimension C} = \text{Customer Ref \#} + \text{Dimension B}$
 - d. Dimension C is the distance from the recess of the sensor tip to the bottom of the stem collar. Insert the metal tab of a tape measure into the recess of the flow sensor tip. Extend the tape up the stem and mark the shaft with a pencil.
 - e. Slide the collar along the shaft until its bottom surface is at the mark on the stem. Tighten the cap screw on the collar. When the sensor is reassembled, this will set the insertion depth of the sensor.
5. Attach the sensor to the mounting adapter by gently pushing the flow sensor into the mounting adapter until the cover touches the mounting adapter. Tighten the cover against the O-ring seal. This will seal the sensor assembly.
 6. Continue to insert the flow sensor stem until the stem collar meets the cover. Thread the hex cap onto the mounting adapter but do not tighten. Align the flow sensor with the pipe by using the flat cover on the electronics housing as a guide. Place a straightedge along the cover and rotate the sensor until the straightedge is parallel with the pipe as shown in [Figure 7](#). Tighten the hex cap over the collar approximately 10 ft-lb. The hex cap holds the sensor alignment but performs no sealing functions. **DO NOT OVER TIGHTEN**.
 7. Pressurize pipeline and check for leaks.

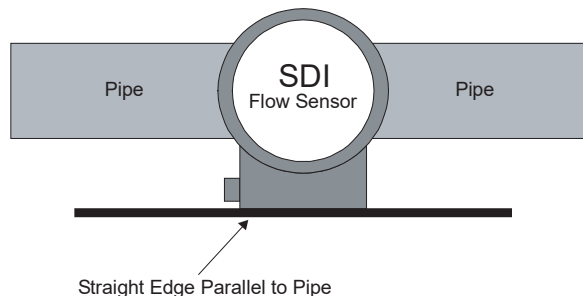


Figure 7: Align the flow sensor with the pipe

Installation for Hot Tap Models

The insertion depth and alignment of the sensor are critical to the accuracy of the flow measurement. The impeller must be at the same location in the pipe as it was during calibration. Badger Meter provides sensors with three different stem lengths. Longer stems are intended for use in larger diameter pipes and shorter stems for use in smaller pipelines. However stem length has no effect on the operation of the sensor provided that the impeller is positioned correctly in the center of the pipe.

Stem length H1 is intended for use in nominal pipe diameters from 1-1/2... 10 in., H2 is for nominal pipe diameters from 12...36 in. and stem length H3 is for nominal pipe diameters from 36 in. and up. However, pipe with extra thick walls, existing linings or unusual tapping hardware may require longer length sensors. For these, consult the factory.

The preferred method of installation is by means of a saddle with 1 in. NPT outlet. On steel pipelines a weld-on type fitting may be substituted.

1. Attach the saddle to a section of pipe that has at least 10 diameters of straight pipe ahead and five diameters of straight pipe behind the saddle. Drill a minimum 1-1/8 in. diameter hole in the pipe.
2. Remove the sensor assembly from the mounting hardware by loosening the hex cap over the stem collar and the cover to the mounting adapter and detaching the assembly. Set aside taking care not to damage impeller/shaft assembly.
3. If pipe is drained, drill a 1-1/8 in. minimum hole into pipe and install a saddle or welded fitting onto the pipe. If pipe is under pressure a tapping machine will be needed. Install the saddle onto the pipe and thread the 1 in. NPT end of the valve into the saddle using pipe joint compound.

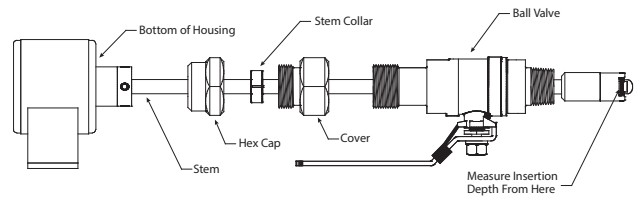
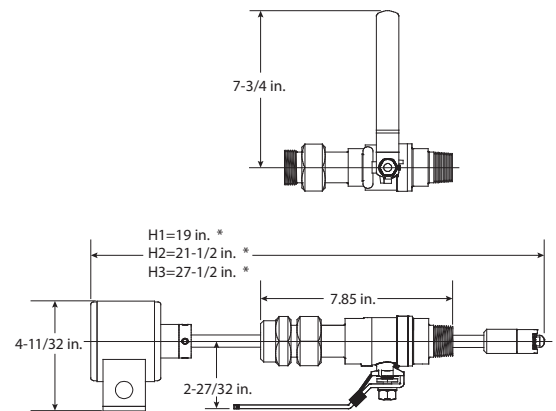


Figure 9: Installation for hot tap models



* Pipe Sizes for reference only. Depending on pipe material, tapping saddle or existing hardware longer sensor length may be required. Contact factory for more information.

Figure 10: Hot tap sensor dimensions

4. Attach the tapping adapter, (Badger Meter Part# A-1027) to the top of the valve (make sure O-ring is properly seated in the O-ring groove in the top of the ball valve assembly). It is recommended at this point that the valve be opened and the A-1027 be connected to a water or AIR Source to pressure test the saddle and valve threaded joint. Once the pipe is drilled, any leaks in this area would require that the pipe be drained to repair.
5. Use any tapping machine with a 1 in. MNPT pipe thread, with an arbor less than 1 in. O.D., capable of holding a 1.00 in. Hole Saw and with at least 7 in. of travel. The SDI ball valve is manufactured oversized with a 1.00 in. bore, and the SDI sensor is almost interference fit requiring that the hole being drilled also be 1.00 in. For this reason, the 7/8 in. drill bit normally recommended for drilling through a 1 in. ball valve cannot be used.
6. Attach the tapping machine to the tapping adapter. Make sure that all connections and seals are tight.
7. Slowly open the valve by rotating the handle 90° and lower the cutter past the valve ball to the pipe. Drill the 1 in. nominal hole according to the manufacturer's instructions.
8. Withdraw the cutter past the valve ball, close the valve and remove the tapping tool.
9. Remove the Badger Meter tapping adapter from the top of the valve.
10. The sensor rotor assembly is to be located a fixed distance from the center of the pipe. To position the impeller at this depth, a reference measurement for the pipe size and schedule is used.
 - a. Look up the pipe size and schedule number in the "Customer Reference Number Tables" on page 14 and note the Customer Reference Number (Customer Ref #).

NOTE: The Customer Reference Number has been calculated using the following formula:

$$\text{Ref \#} = \text{Insertion Depth} + \text{Wall Thickness} + \text{Cover Thickness}$$

- b. Next, measure from the outside wall of the pipe to the top of the installed mounting adapter, this is dimension B in Figure 5 on page 6.

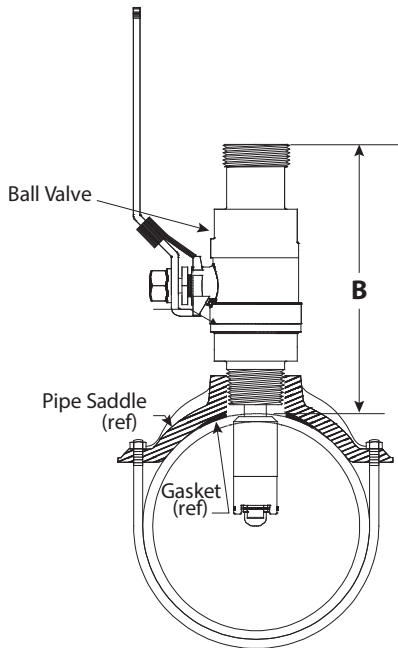


Figure 11: Ball valve and pipe saddle

- c. Add this number to the reference measurement. The resulting number is dimension C in [Figure 6](#)
 $\text{Dimension C} = \text{Customer Ref \#} + \text{Dimension B}$
- d. Dimension C is the distance from the recess of the sensor tip to the bottom of the stem collar. Insert the metal tab of a tape measure into the recess of the flow sensor tip. Extend the tape up the stem and mark the shaft with a pencil.
- e. Slide the collar along the shaft until its bottom surface is at the mark on the stem. Tighten the cap screw on the collar. When the sensor is reassembled, this will set the insertion depth of the sensor. Make sure to hold the sensor up tight against the cover when installing onto the valve, to prevent the possibility of damaging the impeller by striking the closed ball of the valve.

11. Slide the cover down the stem until it stops.
12. Attach the sensor to the valve by inserting the impeller end of the stem into the valve until the cover touches the top of the valve. The sensor tip and impeller will be in the section of the valve above the ball.
13. Tighten the cover against the O-ring in the top of the valve. This will seal the sensor assembly.
14. Open the ball valve again by slowly rotating the handle 90°. If the cover was not at the bottom of the sensor stem, water pressure from the pipe would now push it out until it stops. However, the sensor cannot be ejected from the pipe if the cover is secured to the valve. Check to make sure all joints are tight.

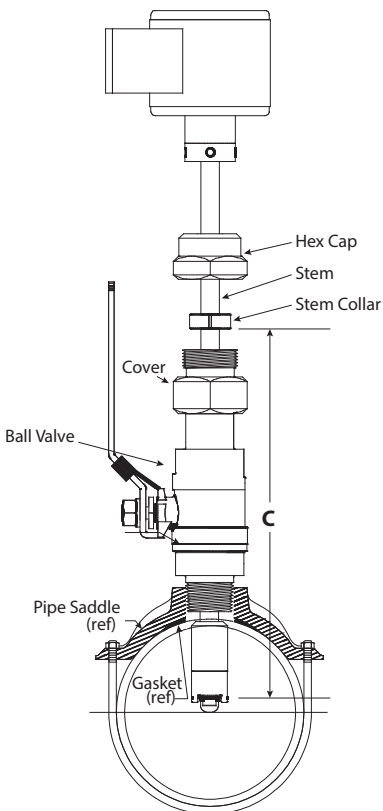


Figure 12: Sensor tip and stem collar

15. Insert the flow sensor stem into the pipe by pushing against the top of the electronics housing with a slight twisting motion until the stem collar meets the cover. The force required to push the sensor into the pipeline is approximately 20% of the line pressure. Be aware of the close spacing between the diameter of the flow sensor, the bore of the ball valve and the hole in the pipe. If the sensor stops or catches before the stem collar meets the cover, apply a gentle rocking/twisting motion to the sensor to continue its travel.
16. While holding the flow sensor collar against the cover, thread the hex cap onto the cover to hold the flow sensor in place, but do not tighten.
17. Align the flow sensor with the pipe using the flat side cover of the electronics housing as a guide. Place a straightedge along the cover and rotate the sensor until the straightedge is parallel to the pipe.
18. Tighten the hex cap to the cover to approximately 10 ft-lb. The hex cap holds the sensor alignment and depth but performs no sealing functions. **DO NOT OVER TIGHTEN**
19. Pressurize pipeline and check for leaks.

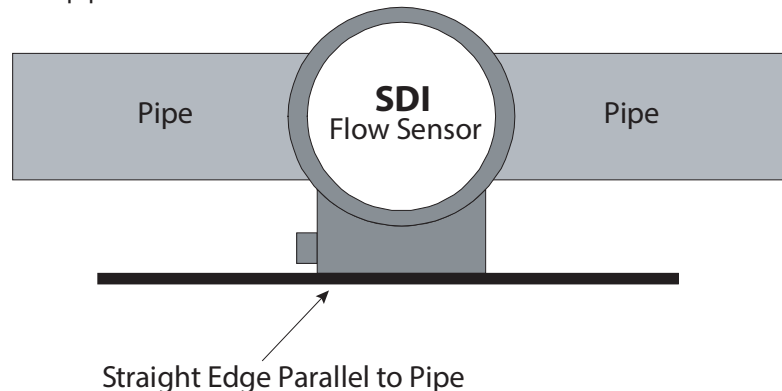


Figure 13: Level the sensor

ELECTRICAL INSTALLATION

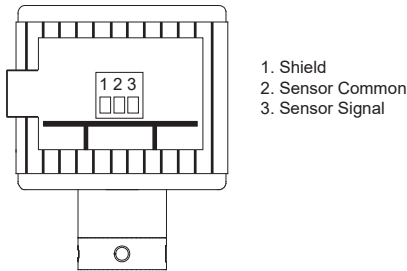
Access the wiring terminals by removing the side cover. A wiring diagram is on the side cover, under the gasket. Use care when replacing the side cover. Make sure that the gasket is in place.

DO NOT REMOVE THE CIRCULAR COVER from the top of the sensor. You may disturb the seal and label alignment.

A moisture absorbing silica pack has been placed inside the electronics housing during assembly. Leave it in place after making the wire connections.

Standard Frequency (Pulse) Output

(Option 0 in the ordering matrix)

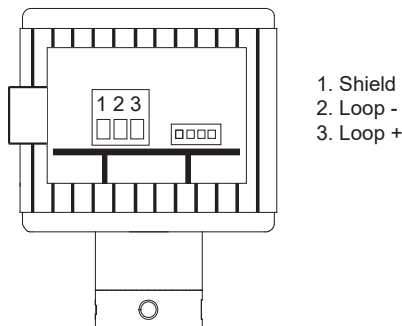


This two wire sensor is intended for connection to Badger Meter monitors and transmitters or other devices that supply 10...24V DC excitation voltage and accept frequencies from 0...1000 Hz.

1. Attach the sensor shield terminal 1 to the shield terminal on the transmitter (used for maximum protection from interference).
2. Attach the sensor common terminal 2 to the common (-) terminal on the transmitter.
3. Attach the sensor signal terminal 3 to the signal (+) terminal on the transmitter.

Analog 4...20 mA Output

(Option 1 in the ordering matrix)



This option provides a programmable 4...20 mA signal proportional to flow rate. All programming is accomplished as previously mentioned. You can program the unit for pipe size and flow scale. This is a two-wire option.

1. Attach SDI #1 (Shield) to Earth Ground or Power Supply Common. (This provides maximum power and signal EMI protection).

Analog output – wired as current sinking

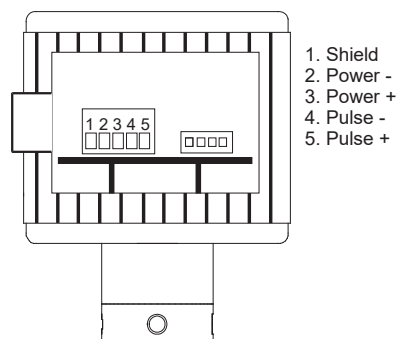
1. Attach SDI#2 (Loop -) to the Analog input terminal of device receiving this 4...20 mA signal.
2. Attach SDI#3 (Loop +) to +24V DC terminal of device receiving the 4...20 mA signal.

Analog output – wired as current sourcing (with separate 24V DC power supply)

1. Attach SDI #2 (Loop -) to Analog input terminal of device receiving this 4...20 mA signal (Sometimes labeled Loop +).
2. Attach SDI #3 (Loop +) to +24V DC Supply terminal.
3. Attach -24V DC Supply terminal to the Analog Input Common (Sometimes labeled Loop -).

Scaled Pulse output

(Option 2 in the ordering matrix)

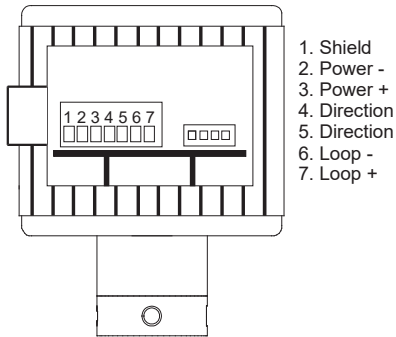


This option provides a programmable opto-isolated solid state switch closure with internal solid state fuse protection. All programming is accomplished as previously mentioned. The user can program the unit for pipe size, flow scale and the direction of flow. This is a six-wire option.

1. Attach SDI #1 (Shield) to Earth Ground or Power Supply Common. (This provides maximum power and signal EMI protection).
2. Attach SDI #2 (Power -) to the negative terminal of a nominal 12...24V AC/DC Power Supply. (See data sheet for current draw and voltage limits).
3. Attach SDI #3 (Power +) to positive terminal of power supply.
4. Attach SDI #4 (Pulse -) to the Input pulse (-) of the receiving device.
5. Attach SDI #5 (Pulse +) to the Input pulse (+) of the receiving device.

Bidirectional Analog Output

(Option 5 in the ordering matrix)



This option provides a programmable 4...20 mA signal proportional to flow rate and a contact closure to indicate the direction of flow. All programming is accomplished as previously mentioned. You can program the unit for pipe size, flow scale and the direction of flow. This is a six-wire option.

1. Attach SDI #1 (Shield) to Earth Ground or Power Supply Common (this provides maximum power and signal EMI protection).
2. Attach SDI #2 (Power -) to the negative terminal of a nominal 12...24V AC/DC Power Supply (See *"Specifications" on page 19* for current draw and voltage limits).
3. Attach SDI #3 (Power +) to positive terminal of power supply.
4. Attach SDI #4 and SDI#5 (Direction \pm) to the device receiving the directional signal (this connection is not polarity sensitive, and, when active, provides a solid-state switch closure for a maximum load of 100 mA @ 30V AC or \pm 40V DC).

Analog output – wired as current sinking

1. Attach SDI #6 (Loop -) to the Analog input terminal of device receiving this 4...20 mA signal.
2. Attach SDI #7 (Loop +) to +24V DC terminal of device receiving the 4...20 mA Signal.

Analog output – wired as current sourcing sharing SDI's 24V DC power supply

1. Attach SDI #6 (Loop -) to Analog input terminal of device receiving this 4...20 mA signal.
2. Attach SDI #7 (Loop +) to SDI#3 (Sharing terminal with +24V DC Supply).
3. Attach SDI #2 (Loop -) to Analog Input Common (sometimes labeled Loop -).

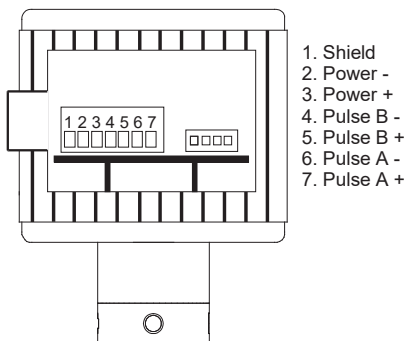
Analog output – wired as current sourcing (with separate 24V DC power supply)

1. Attach SDI #6 (Loop -) to Analog input terminal of device receiving this 4...20 mA signal (sometimes labeled Loop +).
2. Attach SDI #7 (Loop +) to +24V DC Supply terminal.
3. Attach -24V DC Supply terminal to the Analog Input Common (sometimes labeled Loop -).

Bidirectional Scaled Pulse Output

(Option 6 in the ordering matrix)

This option provides a programmable scaled pulse output signal proportional to flow rate and a contact closure to indicate the direction of flow. All programming is accomplished as previously mentioned. The user can program the unit for pipe size, flow scale and the direction of flow. This is a six-wire option.

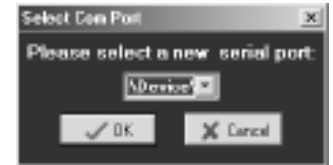


1. Attach SDI #1 (Shield) to Earth Ground or Power Supply Common (this provides maximum power and signal EMI protection).
2. Attach SDI #2 (Power -) to the negative terminal of a nominal 12...24V AC/DC Power Supply (see *"Specifications" on page 19* for current draw and voltage limits).
3. Attach SDI #3 (Power +) to positive terminal of power supply.
4. Attach SDI #4 (Pulse B -) to the Input pulse (-) of the receiving device.
5. Attach SDI #5 (Pulse B +) to the Input pulse (+) of the receiving device.
6. Attach SDI #6 (Pulse A -) to the Input pulse (-) of the receiving device.
7. Attach SDI #7 (Pulse A +) to the Input pulse (+) of the receiving device.

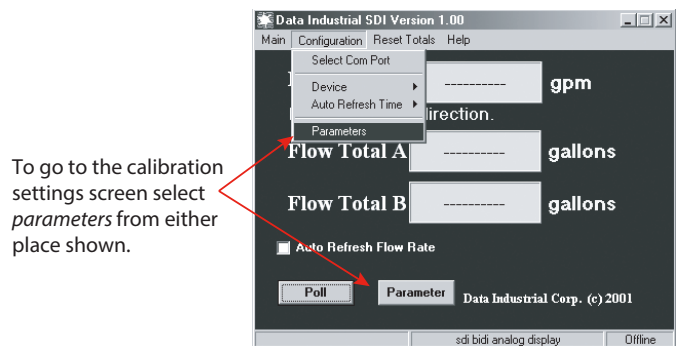
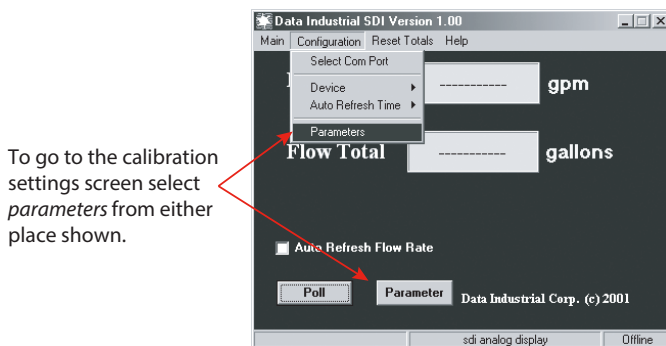
PROGRAMMING

Programming the Series SDI is accomplished by installing the Badger Meter programming software on a computer and entering data on templates of the Windows® based program.

1. Load the interface software into the computer.
2. Connect the computer to the SDI with the Badger Meter A-301 communications cable to the socket labeled *D.I.C. Comm Port*, taking care to properly align the tab on the plug and socket to maintain polarity. Connect the DB9 connector of the Badger Meter A-301 communications cable to the PC COM port of a PC that has the SDI software installed.
3. Connect the Series SDI flow sensor to a power supply.
4. Open the interface software and select the appropriate COM PORT as shown in the dialog box.



5. Open the *Parameters Screen* using one of the methods shown below.



6. Program using the following screens as reference.

Single Direction Analog Output Models

Step #1

Select rate units from the drop-down values.

Step #3

Select the pipe size from the drop-down menu, if the pipe size is not present then custom must be selected, or check for an updated pipe.dat table on the Badger Meter web site.

Step #5

Enter 4 mA flow rate. This is normally zero.

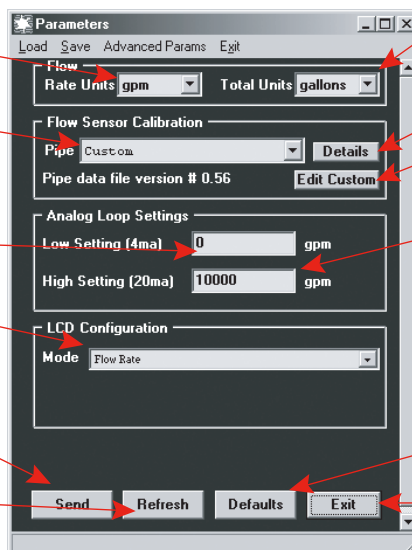
Step #7

For models with LCD Display Option select the desired LCD Configuration from the drop-down menu. If Model has no display then skip to **Step #8**.

Step #8

Press **Send** to transmit calibration data to the SDI Sensor.

Press **Refresh** to retrieve calibration data from SDI.



Step #2

Select total units from the drop-down values.

See Note #1

Step #4

If custom was selected in step 3 then click the custom button and see **Note #2**.

Step #6

Enter 20 mA flow rate.

Press **Defaults** to reset all parameters back to factory defaults. **Send** must be pressed to send this data to the SDI.

Step #9

Press **Exit** to exit parameters screen and to go back to the main screen.

NOTE #1 Press **Details** to see *K* and *offset* numbers for the selected pipe. The *K* and *offset* are factors used to convert the sensor frequency to flow rate. They are unique to each pipe size/material.

NOTE #2 Press **Custom** to enter *K* and *offset* numbers for pipe material not listed in drop-down menu. The numbers may be obtained by contacting Badger Meter.

Single Direction Scaled Pulse Output Models

Step #1

Select rate units from the drop-down values.

Step #3

Select the pipe size from the pull down menu, if the pipe size is not present then select custom or check for an updated pipe.dat table on the Badger Meter web site.

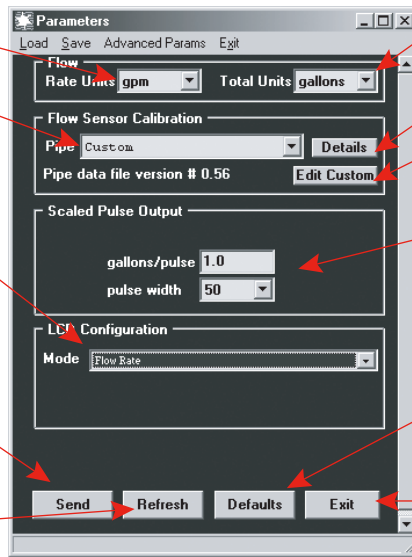
Step #6

For models with LCD Display Option select the desired LCD Configuration from the drop-down menu. If Model has no display then skip to **Step #7**.

Step #7

Press **Send** to transmit calibration data to the SDI Sensor.

Press **Refresh** to retrieve calibration data from SDI.



Step #2

Select total units from the drop-down values.

See Note #1.

Step #4

If custom was selected in **Step #3** then click the custom button and see **Note #2**.

Step #5

Enter the number of units per pulse and select the pulse width required.

Press **Defaults** to reset all parameters back to factory defaults. **Send** must be pressed to send this data to the SDI.

Step #8

Press **Exit** to exit parameters screen and to go back to the main screen.

NOTE #1 Press **Details** to see *K* and *offset* numbers for the selected pipe. The *K* and *offset* are factors used to convert the sensor frequency to flow rate. They are unique to each pipe size/material.

NOTE #2 Press **Custom** to enter *K* and *offset* numbers for pipe material not listed in drop-down menu. The numbers may be obtained by contacting Badger Meter.

Bidirectional Analog Output Models

Step #1

Select rate units from the drop-down values.

Step #3

Select the pipe size from the drop-down menu, if the pipe size is not present then select custom or check for an updated pipe.dat table on the Badger Meter web site.

Step #5

Enter 4 mA flow rate. This is normally zero.

Step #7

For models with LCD Display Option select the desired LCD Configuration from the pull down menu. If Model has no display then skip to **Step #10**.

Step #9

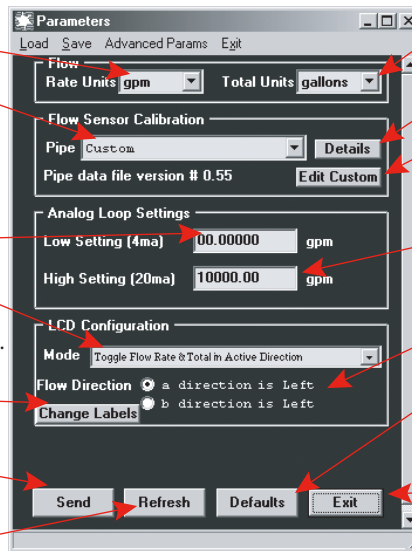
If the Flow direction label requires changing see

Note #3.

Step #10

Press **Send** to transmit calibration data to the SDI Sensor.

Press **Refresh** to retrieve calibration data from SDI.



Step #2

Select total units from the drop-down values.

See Note #1.

Step #4

If custom was selected in step 3 then press **Edit Custom** and see **Note #2**.

Step #6

Enter 20 mA flow rate.

Step #8

Select Active Direction.

Press **Defaults** to reset all parameters back to factory defaults. **Send** must be pressed to send this data to the SDI.

Step #11

Press **Exit** to exit parameters screen and to go back to the main screen.

NOTE #1 Press **Details** to see *K* and *offset* numbers for the selected pipe. The *K* and *offset* are factors used to convert the sensor frequency to flow rate. They are unique to each pipe size/material.

NOTE #2 Press **Custom** to enter *K* and *offset* numbers for pipe material not listed in drop-down menu. The numbers may be obtained by contacting Badger Meter.

NOTE #3 Press **Change Label** to change flow direction label. Enter up to 20 characters such as "From Pump."

Bidirectional Scaled Pulse Output Models

Step #1

Select rate units from the drop-down values.

Step #3

Select the pipe size from the drop-down menu, if the pipe size is not present then select custom or check for an updated pipe.dat table on the Badger Meter web site.

Step #5

Select the pulse output type that is required. If raw pulse is selected skip Step #6.

Step #7

For models with LCD Display Option select the desired LCD Configuration from the pull down menu. If Model has no display then skip to Step #10.

Step #9

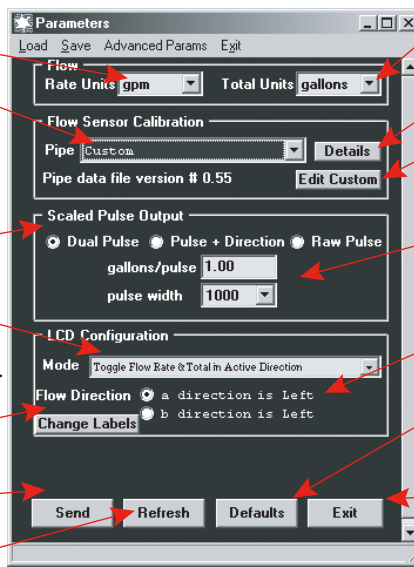
If the Flow direction label requires changing see

Note #3.

Step #10

Press **Send** to transmit calibration data to the SDI Sensor.

Press **Refresh** to retrieve calibration data from SDI.



Step #2

Select total units from the drop-down values.

See Note #1.

Step #4

If custom was selected in step 3 then press **Edit Custom** and see **Note #2**.

Step #6

Enter the number of units per pulse and select the pulse width required.

Step #8

Select Active Direction.

Press **Defaults** to reset all parameters back to factory defaults. **Send** must be pressed to send this data to the SDI.

Step #11

Press **Exit** to exit parameters screen and to go back to the main screen.

NOTE #1 Press **Details** to see *K* and *offset* numbers for the selected pipe. The *K* and *offset* are factors used to convert the sensor frequency to flow rate. They are unique to each pipe size/material.

NOTE #2 Press **Custom** to enter *K* and *offset* numbers for pipe material not listed in drop-down menu. The numbers may be obtained by contacting Badger Meter.

NOTE #3 Press **Change Label** to change flow direction label. Enter up to 20 characters such as "From Pump."

Battery Powered SDI Programming

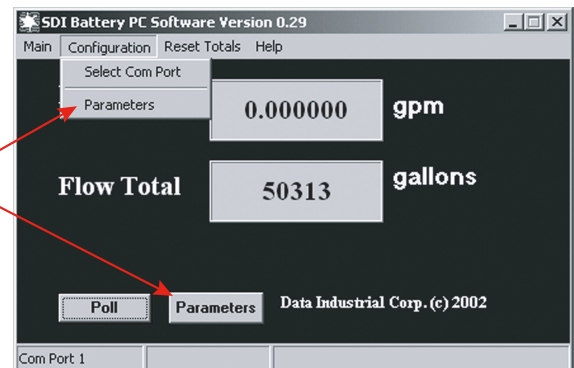
Programming the Series SDI is accomplished by installing the Badger Meter programming software on a computer and entering data on templates of the Windows based program.

1. Load the interface software into the computer.
2. Connect the PC to the SDI with the Badger Meter A-303 communications cable. Plug in the RJ11 plug on the A-303 cable to the RJ11 socket on Battery Powered SDI. Connect the DB9 connector of the A-303 cable to the PC COM port to a PC that has the SDI software installed. Open the interface software and select the appropriate COM PORT as shown in the dialog box.



3. Open the *Parameters Screen* as shown here.

To calibrate, select **Parameters** from either place shown.



4. Program parameters using this diagram as a reference.

Step #1

Enter in a K number found in Table B.

Step #2

Enter in an offset number found in Table B.

Step #3

Enter in a Reference number found in Table A.

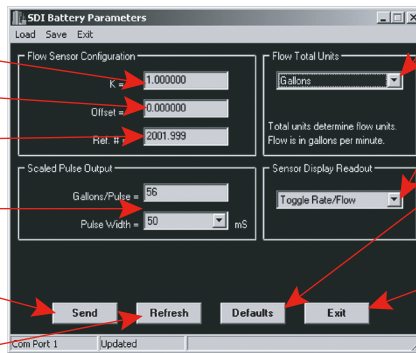
Step #6

Optional setting, Enter in the gallons/pulse and select pulse width. Skip this step if not using the Scaled pulse output.

Step #7

Press **Send** to transmit calibration data to the SDI Sensor. See **Note #1**

Press **Refresh** to retrieve calibration data from SDI.



Step #4

Select the desired flow rate and total units.

Step #5

Select the desired display readout mode.

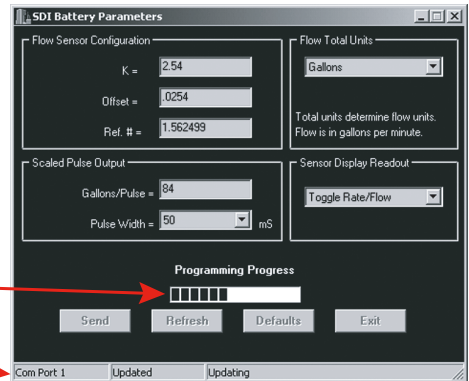
Press **Defaults** to reset all parameters back to factory defaults. **Send** must be pressed to send this data to the SDI.

Step #8

Press **Exit** to exit parameters screen and to go back to the main screen. See Note #2.

NOTE #1 After the **Send** button is pressed, the unit could take up to 1-1/2 minutes to program the Battery Powered SDI. This illustration shows the programming process bar. When the programming process bar disappears and the status bar says *updated*, the Battery Powered SDI is programmed.

NOTE #2 After the **Exit** button is pressed, it takes about 10 seconds to go back to the operating display and refresh flow rate and flow total.



Programming Process Bar

Status Bar

CUSTOMER REFERENCE NUMBER TABLES

Table A1 – Customer Reference Number								
Pipe			Pipe Schedules					
Size	O.D.	Description	10	10s	40	40s/Std	80	SDR21
1-1/2 in.	1.900	Wall	0.109	0.109	0.145	0.145	0.200	
		Insertion Depth	0.58	0.58	0.54	0.54	0.49	—
		Customer Ref #	1-9/16	1-9/16	1-9/16	1-9/16	1-9/16	
2 in.	2.375	Wall	0.109	0.109	0.154	0.154	0.218	0.113
		Insertion Depth	0.81	0.81	0.77	0.77	0.71	0.81
		Customer Ref #	1-13/16	1-13/16	1-13/16	1-13/16	1-13/16	1-13/16
2-1/2 in.	2.875	Wall	0.120	0.120	0.203	0.203	0.276	0.137
		Insertion Depth	1.05	1.05	0.97	0.97	0.90	1.04
		Customer Ref #	2-1/16	2-1/16	2-1/16	2-1/16	2-1/16	2-1/16
3 in.	3.500	Wall	0.120	0.120	0.216	0.216	0.300	0.167
		Insertion Depth	1.37	1.37	1.27	1.27	1.19	1.32
		Customer Ref #	2-3/8	2-3/8	2-3/8	2-3/8	2-3/8	2-3/8
4 in.	4.500	Wall	0.120	0.120	0.237	0.237	0.337	0.214
		Insertion Depth	1.70	1.70	1.61	1.61	1.53	1.63
		Customer Ref #	2-11/16	2-11/16	2-23/32	2-23/32	2-3/4	3-1/8
5 in.	5.563	Wall	0.134	0.134	0.258	0.258	0.375	
		Insertion Depth	1.59	1.59	1.63	1.63	1.44	—
		Customer Ref #	2-5/8	2-5/8	2-21/32	2-21/32	2-11/16	
6 in.	6.625	Wall	0.134	0.134	0.280	0.280	0.432	0.316
		Insertion Depth	1.91	1.91	1.82	1.82	1.73	1.83
		Customer Ref #	2-29/32	2-29/32	2-31/32	2-31/32	3-1/32	3-1/32

For sizes above 30 in., consult factory. Pipe O.D. and Schedule, or pipe O.D. and I.D., or pipe O.D. and wall thickness is required. A blank cell (—) = No data at time of printing.

Table A1 – Customer Reference Number								
Pipe			Pipe Schedules					
Size	O.D.	Description	10	10s	40	40s/Std	80	SDR21
8 in.	8.625	Wall	0.148	0.148	0.322	0.322	0.500	0.410
		Insertion Depth	2.50	2.50	2.39	2.39	2.29	2.40
		Customer Ref #	3-17/32	3-17/32	3-19/32	3-19/32	3-21/32	3-11/16
10 in.	10.750	Wall	0.165	0.165	0.365	0.365	0.594	0.511
		Insertion Depth	3.13	3.13	3.01	3.01	2.87	2.98
		Customer Ref #	4-5/32	4-5/32	4-1/4	4-1/4	4-11/32	4-3/8
12 in.	12.750	Wall	0.180	0.180	0.406	0.375	0.688	0.606
		Insertion Depth	3.72	3.72	3.58	3.60	3.41	3.52
		Customer Ref #	4-25/32	4-25/32	4-7/8	4-27/32	5	5
14 in.	14.000	Wall	0.250	0.188	0.438	0.375	0.750	—
		Insertion Depth	2.03	2.04	1.97	1.99	1.88	—
		Customer Ref #	3-5/32	3-3/32	3-9/32	3-1/4	3-1/2	—
16 in.	16.000	Wall	0.250	0.188	0.500	0.375	0.844	—
		Insertion Depth	2.33	2.34	2.25	2.29	2.15	—
		Customer Ref #	3-7/16	3-13/32	3-5/8	3-17/32	3-7/8	—
18 in.	18.000	Wall	0.250	0.188	0.562	0.375	0.938	—
		Insertion Depth	2.63	2.64	2.53	2.59	2.42	—
		Customer Ref #	3-3/4	3-23/32	3-31/32	3-27/32	4-1/4	—
20 in.	20.000	Wall	0.250	0.218	0.594	0.375	1.031	—
		Insertion Depth	2.93	2.94	2.82	2.89	2.69	—
		Customer Ref #	4-1/16	4-1/32	4-9/32	4-1/8	4-19/32	—
22 in.	22.000	Wall	0.250	—	—	0.375	1.125	—
		Insertion Depth	3.23	—	—	3.19	2.96	—
		Customer Ref #	4-11/32	—	—	4-7/16	4-31/32	—
24 in.	24.000	Wall	0.250	0.250	0.688	0.375	1.219	—
		Insertion Depth	3.53	3.53	3.39	3.49	3.23	—
		Customer Ref #	4-21/32	4-21/32	4-31/32	4-3/4	5-5/16	—
26 in.	26.000	Wall	—	0.312	—	0.375	—	—
		Insertion Depth	—	3.81	—	3.79	—	—
		Customer Ref #	—	5	—	5-1/32	—	—
28 in.	28.000	Wall	—	0.312	—	0.375	—	—
		Insertion Depth	—	4.11	—	4.09	—	—
		Customer Ref #	—	5-9/32	—	5-11/32	—	—
30 in.	30.000	Wall	0.312	0.312	—	0.375	—	—
		Insertion Depth	4.41	4.41	—	4.39	—	—
		Customer Ref #	5-19/32	5-19/32	—	5-5/8	—	—

For sizes above 30 in., consult factory. Pipe O.D. and Schedule, or pipe O.D. and I.D., or pipe O.D. and wall thickness is required.
A blank cell (—) = No data at time of printing.

Table A2 – Customer Reference Number						
Copper Tube			Type			
Size	O.D.	Description	K	L	M	DWV
1-1/2 in.	1.625	Wall	0.072	0.060	0.049	0.042
		Insertion Depth	0.48	0.49	0.50	0.51
		Customer Ref #	1-7/16	1-7/16	1-7/16	1-7/16
2 in.	2.125	Wall	0.083	0.070	0.058	0.042
		Insertion Depth	0.72	0.73	0.74	0.76
		Customer Ref #	1-11/16	1-11/16	1-11/16	1-11/16
2-1/2 in.	2.625	Wall	0.095	0.080	0.065	—
		Insertion Depth	0.95	0.97	0.98	—
		Customer Ref #	1-29/32	1-29/32	1-29/32	—
3 in.	3.125	Wall	0.109	0.090	0.072	0.045
		Insertion Depth	1.19	1.21	1.23	1.25
		Customer Ref #	2-3/16	2-3/16	2-3/16	2-3/16
4 in.	4.125	Wall	0.134	0.110	0.095	0.058
		Insertion Depth	1.54	1.56	1.57	1.60
		Customer Ref #	2-9/16	2-9/16	2-17/32	2-17/32
6 in.	6.125	Wall	0.192	0.140	0.122	0.083
		Insertion Depth	1.72	1.75	1.76	1.79
		Customer Ref #	2-25/32	2-3/4	2-3/4	2-3/4

A blank cell (—) = No data at time of printing

Table A3 – Customer Reference Number	
Ductile Iron	Because of the variety of iron pipe classes, sizes, and wall thicknesses, consult the factory for customer reference number. Pipe O.D. and Schedule, or pipe O.D. and I.D., or Pipe O.D. and wall thickness is required.

Table A4 – Customer Reference Number							
PVC AWWA C900				PVC AWWA C900			
Size	O.D.	Description	CL100	Size	O.D.	Description	CL100
1-1/2 in.	1.625	Wall	0.192	3 in.	3.125	Wall	0.444
		Insertion Depth	1.77			Insertion Depth	3.06
		Customer Ref #	2-27/32			Customer Ref #	4-3/8
2 in.	2.125	Wall	0.276	4 in.	4.125	Wall	0.528
		Insertion Depth	1.90			Insertion Depth	3.64
		Customer Ref #	3-1/16			Customer Ref #	5-1/16
2-1/2 in.	2.625	Wall	0.362				
		Insertion Depth	2.50				
		Customer Ref #	3-23/32				

For other types of pipe not listed above, consult the factory. Pipe O.D. and Schedule, or pipe O.D. and I.D., or Pipe O.D. and wall thickness is required.

K AND OFFSET TABLES

Table B1 – Estimated* K and Offset										
Pipe			Pipe Schedules							
Size	O.D.		CS 5	SS 5	CS 10	SS 10	CS 40	SS 40	CS 80	SS 80
1-1/2 in.	1.900	K	0.427271	0.427271	0.380552	0.380552	0.341075	0.341075	0.277850	0.277850
		Offset	-0.080605	-0.080605	0.002211	0.002211	0.081460	0.081460	0.226312	0.226312
2 in.	2.375	K	0.673452	0.673452	0.626407	0.626407	0.579615	0.579615	0.514211	0.514211
		Offset	-0.380524	-0.380524	-0.332296	-0.332296	-0.282874	-0.282874	-0.206396	-0.206396
2-1/2 in.	2.875	K	0.965024	0.965024	0.911744	0.911744	0.802796	0.802796	0.716671	0.716671
		Offset	-0.749072	-0.749072	-0.667702	-0.667702	-0.522645	-0.522645	-0.425526	-0.425526
3 in.	3.500	K	1.582350	1.582350	1.490176	1.490176	1.277418	1.277418	1.118942	1.118942
		Offset	-2.113500	-2.113500	-1.870796	-1.870796	-1.355648	-1.355648	-1.022076	-1.022076
3-1/2 in.	3.500	K	2.091068	2.091068	2.024960	2.024960	1.856175	1.856175	1.621456	1.621456
		Offset	-1.399853	-1.399853	-2.010633	-2.010633	-4.014395	-4.014395	-2.219542	-2.219542
4 in.	4.500	K	2.635261	2.635261	2.544009	2.544009	2.279943	2.279943	2.083741	2.083741
		Offset	1.524904	1.524904	1.224082	1.224082	-0.029050	-0.029050	-1.463673	-1.463673
5 in.	5.563	K	4.254704	4.254704	4.158287	4.158287	3.705163	3.705163	3.315944	3.315944
		Offset	1.040171	1.040171	1.265404	1.265404	2.073017	2.073017	2.362615	2.362615
6 in.	6.625	K	6.703921	6.703921	6.571415	6.571415	5.831518	5.831518	5.122780	5.122780
		Offset	-8.690330	-8.690330	-8.020263	-8.020263	-4.525378	-4.525378	-1.645774	-1.645774
8 in.	8.625	K	9.810699	9.810699	9.631116	9.631116	8.862069	8.862069	8.129755	8.129755
		Offset	4.373516	4.373516	4.521076	4.521076	5.253952	5.253952	6.129664	6.129664
10 in.	10.750	K	15.558041	15.558041	15.359217	15.359217	14.116608	14.116608	12.779132	12.779132
		Offset	2.693802	2.693802	2.681251	2.681251	2.693176	2.693176	2.904373	2.904373
12 in.	12.750	K	22.687525	22.687525	22.492687	22.492687	20.707010	20.946699	18.603270	19.990417
		Offset	5.074024	5.074024	4.969576	4.969576	4.099617	4.206793	3.302154	3.798262
14 in.	14.000	K	28.113718	28.113718	27.254274	27.819418	25.581423	25.581423	22.940674	25.043200
		Offset	8.609697	8.609697	7.977566	8.390513	6.819905	6.819905	5.212368	6.469292
16 in.	16.000	K	38.108196	38.108196	37.184074	37.856899	34.538799	35.847870	31.076347	34.538799
		Offset	17.436071	17.436071	16.524164	17.186449	14.010489	15.235909	10.962554	14.010489
18 in.	18.000	K	49.922424	49.922424	48.850674	49.631184	45.024284	47.297367	40.637650	45.771198
		Offset	30.346106	30.346106	29.092361	30.003992	24.739450	27.301405	20.013815	25.573288
20 in.	20.000	K	59.821514	59.821514	59.821514	59.459480	54.939907	57.568302	51.637486	56.066704
		Offset	3.372809	3.372809	3.372809	3.378817	3.459857	3.411363	32.381599	3.438600
22 in.	22.000	K	72.009399	72.009399	71.246956	71.640358	(69.712502)	—	60.582455	—
		Offset	3.211272	3.211272	3.219100	3.215024	(3.235763)	—	3.360413	—
24 in.	24.000	K	84.054832	84.054832	83.653954	83.653954	78.190941	82.090302	71.628067	80.530304
		Offset	3.126430	3.126430	3.128100	3.128100	3.158703	3.135363	3.215150	3.143800
26 in.	26.000	K	—	—	95.504044	—	(94.701706)	—	—	—
		Offset	—	—	3.111093	—	(3.110163)	—	—	—
28 in.	28.000	K	—	—	108.363754	—	(107.546707)	—	—	—
		Offset	—	—	3.165831	—	(3.160163)	—	—	—
30 in.	30.000	K	122.276558	122.276558	121.457077	121.457077	(120.625305)	—	—	—
		Offset	3.306300	3.306300	3.295768	3.295768	(3.285363)	—	—	—

For sizes above 30 in., consult factory. Pipe O.D. and Schedule, or pipe O.D. and I.D., or pipe O.D. and wall thickness is required.

CS = Carbon Steel

SS = Stainless Steel

* = Estimations are based on nominal I.D. from standard ASME B36.10 and B36.19

() = Standard Schedule

A blank cell (—) = No data at time of printing.

Table B2 – Estimated* K and Offset													
Copper Tube			Type				Copper Tube			Type			
Size	O.D.		K	L	M	DMW	Size	O.D.		K	L	M	DMW
1-1/2 in.	1.625	K	—	0.277993	—	—	4 in.	4.125	K	—	1.750507	—	—
		Offset	—	0.063685	—	—			Offset	—	4.142096	—	—
2 in.	2.125	K	—	0.509285	—	—	5 in.	5.125	K	—	3.587835	—	—
		Offset	—	-0.043054	—	—			Offset	—	0.198965	—	—
2-1/2 in.	2.625	K	—	0.784450	—	—	6 in.	6.125	K	5.041780	4.298570	—	—
		Offset	—	-0.126200	—	—			Offset	0.198965	3.295640	—	—
3 in.	3.125	K	—	1.177171	—	—							
		Offset	—	0.198965	—	—							

A blank cell (—) = No data at time of printing.

Table B3 – Estimated* K and Offset	
Ductile Iron	Because of the variety of iron pipe classes, sizes, and wall thicknesses, consult the factory for customer reference number. Pipe O.D. and Schedule, or pipe O.D. and I.D., or Pipe O.D. and wall thickness is required.

Table B4 – Estimated* K and Offset							
PVC Municipal C900			Schedules	PVC Municipal C900			Schedules
Size	O.D.		100	Size	O.D.		100
4 in.	4.800	K Offset	—	10 in.	11.100	K Offset	—
6 in.	6.900	K Offset	—	12 in.	13.200	K Offset	—
8 in.	9.050	K Offset	—				

For other types of pipe not listed above, consult the factory. Pipe O.D. and Schedule, or pipe O.D. and I.D., or Pipe O.D. and wall thickness is required.
 A blank cell (—) = No data at time of printing.

SPECIFICATIONS

Wetted Materials	Sensor stem, mounting adapter, isolation valve, and nipple	316 Stainless steel
	Sensor Tip	Polyphenylene sulfide (PPS)
	O-rings, Bearings, Shaft	See ordering matrix
Maximum Temperature Ratings	Fluid Measured	300° F (135° C) continuous service
	Operating Temperature: Electronics	150° F (65° C)
	Operating Temperature: LCD	150° F (65° C)
Maximum Pressure Rating	1000 psi @ 100° F, 900 psi @ 200° F, 750 psi @ 300° F	
Recommended Design Flow Range	0.33...20 ft/s	
	Initial flow detection below 0.25 ft/s	
Pressure Drop	0.5 psi or less @ 10 ft/s for all pipe sizes 1.5 in. diameter and up	
Accuracy	Standard calibration NIST traceable to $\pm 1\%$ of rate Custom wet calibration NIST traceable to $\pm 0.5\%$ of rate	
Straight Pipe Requirement	Install sensor in straight pipe section with a minimum distance of 10 diameters upstream and 5 diameters downstream to any bend, transition, or obstruction	
Repeatability	$\pm 0.5\%$	
Enclosure	Polypropylene with Viton® sealed acrylic cover. Meets NEMA 4X specifications	
Wire Connections	All wire connections are made to removable headers with screw-type terminals within the electronics housing, 1/2 in. conduit thread provided	
Programming	All programmable models use an A-301 connector cable and SDI Series software	
Display (optional)	8-character, 3/8 in. LCD	
	STN (Super Twisted Nematic) display	
	Annunciators for rate, total, input, output flow direction for bidirectional models	
Accessories	ASDI Programming Kit	
	A1027 Hot Tap Adapter Nipple	

		Unidirectional			Bidirectional	
		Raw Pulse Option 0	Analog Loop Option 1	Scaled Pulse Option 2	Analog Loop Option 5	Scaled Pulse Option 6
Number of Wire Connections		2	2	4	6	6
Pulse Units	Operating Voltage	8...35V DC	n/a	12...30V AC 12...35V DC	12...30V AC 12...35V DC	12...30V AC 12...35V DC
	Oversoltage Protection	30V AC $\pm 40V$ DC	$\pm 40V$ DC	30V AC $\pm 40V$ DC	30V AC $\pm 40V$ DC	30V AC $\pm 40V$ DC
	Quiescent Current Draw @ 12V DC or 24V AC	330 μ A typical	Software-controlled current of 3.5...20.5 mA	< 2.0 mA	< 5.0 mA	< 5.0 mA
	Short Circuit Current	50 mA typical	n/a	> 100 mA	For direction > 100 mA	> 100 mA
	Output Frequency	800 Hz max	n/a	Scaled by customer	n/a	Scaled by customer
	Output Pulse Width	5 mS below 100 Hz	n/a	Adjustable 50 mS to 5.0 seconds in 50 mS increments	n/a	Adjustable 50 mS to 5.0 seconds in 50 mS increments
	Output Isolation	n/a	n/a	Opto-isolated	Opto-isolated	Opto-isolated
Analog Units	Operating Voltage	n/a	8...25V DC	n/a	8...25V DC	n/a
	Output Response Time	n/a	Varies with programmable filter	n/a	Varies with programmable filter	n/a

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