Impeller
Data Industrial®

Flow Sensors

Insert Style Flow Sensors

SDI Series, Battery Powered

Badger Meter

SEN-UM-00217-EN-11 (June 2019)

User Manual

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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 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 1.0 fps to over 20 fps, regardless of the conductivity or turbidity of the liquid.

The battery powered versions are a complete flow measuring system providing a programmable display of rate, total or both powered by a "C" sized lithium battery. Options include a scalable pulse output and a data logger.

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. (25 mm) size shell 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

Scaled Pulse Output

The scaled pulse is produced by an onboard micro-controller for precise, accurate outputs. This option may be programmed to produce a solid state contact closure scaled to any number of engineering units of measure. Sensors may be preprogrammed at the factory or field programmed using the ASDIB-20 SDI programming kit and Windows®-based software program. All information is stored in the flow sensor non-volatile memory.

BATTERY POWERED FLOW SENSORS ORDERING MATRIX

	SDI	0	D1	B	N	1	-	0	2	0	0
MATERIAL											
Stainless Steel / PPS Tip		0									
Brass / PPS Tip **(not available with hot tap)**		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								
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											
Battery Powered/NEMA 6				B							
OUTPUT											
No Output					N						
Scaled Pulse					2						
2 Pulse Output					9						
DISPLAY											
LCD Option						1					
Remote Display/NEMA 4X						2					
O-RING											
Viton®								0			
EPDM								1			
AFLAS								2			
SHAFT											
Tungsten Carbide [Standard]									2		
Hastelloy® C-276 [optional - consult factory]									1		
IMPELLER											
Stainless Steel										0	
BEARING											
Torlon®											0

* Pipe size for reference only. Depending on pipe size, tapping saddle or existing hardware, longer sensor length may be required. Consult the factory. For material details, consult the factory.

Figure 1: Battery operated ordering matrix

Display Options

The eight character 3/8 in. LCD is mounted on the sensor, visible through a lens at the top of the electronics housing.

An optional remote display is available where the LCD is located in a wall mount NEMA 4X enclosure. The remote may be connected to the flow sensor up to a maximum of 50 feet (15 m) away using extension cables.

Cable Length	Part Number
5 ft extension cable	07101
10 ft extension cable	07108
20 ft extension cable	07102
50 ft extension cable	07109

Table 1: SDI remote cable part numbers

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

1. Choose a location along the pipe where there is straight pipe for a distance of ten pipe diameters upstream and five 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.

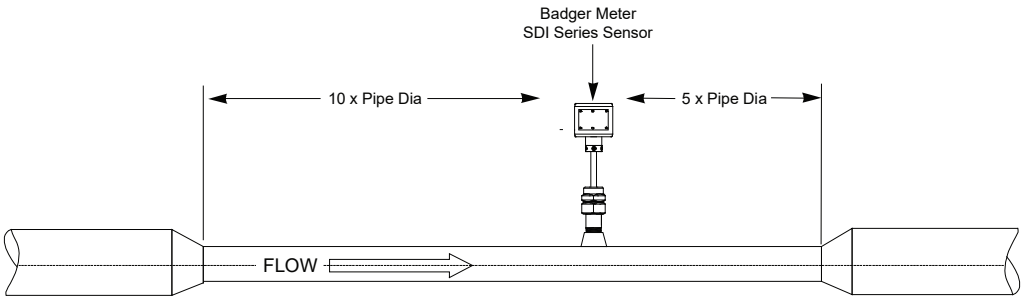
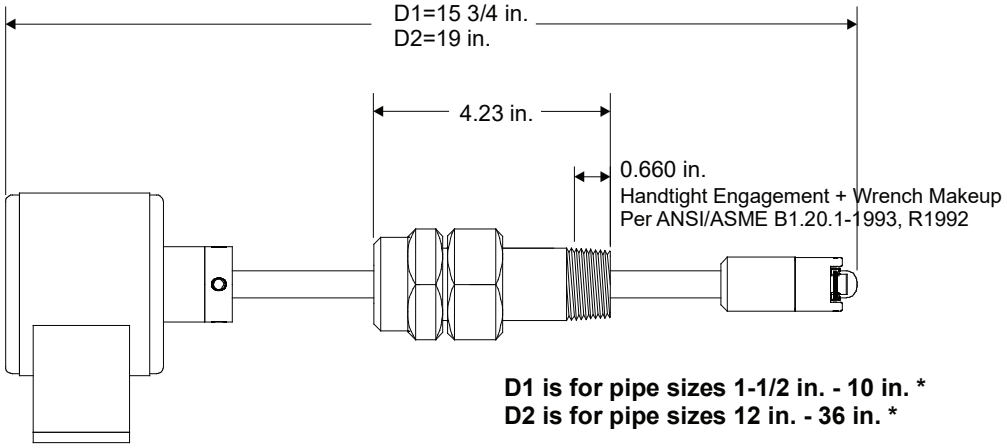


Figure 2: Minimum recommended straight run distance

2. 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.
3. 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 ensuring correct insertion depth.
4. 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.



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

Figure 3: Direct insertion sensor dimensions

Installation for Direct Insert Models

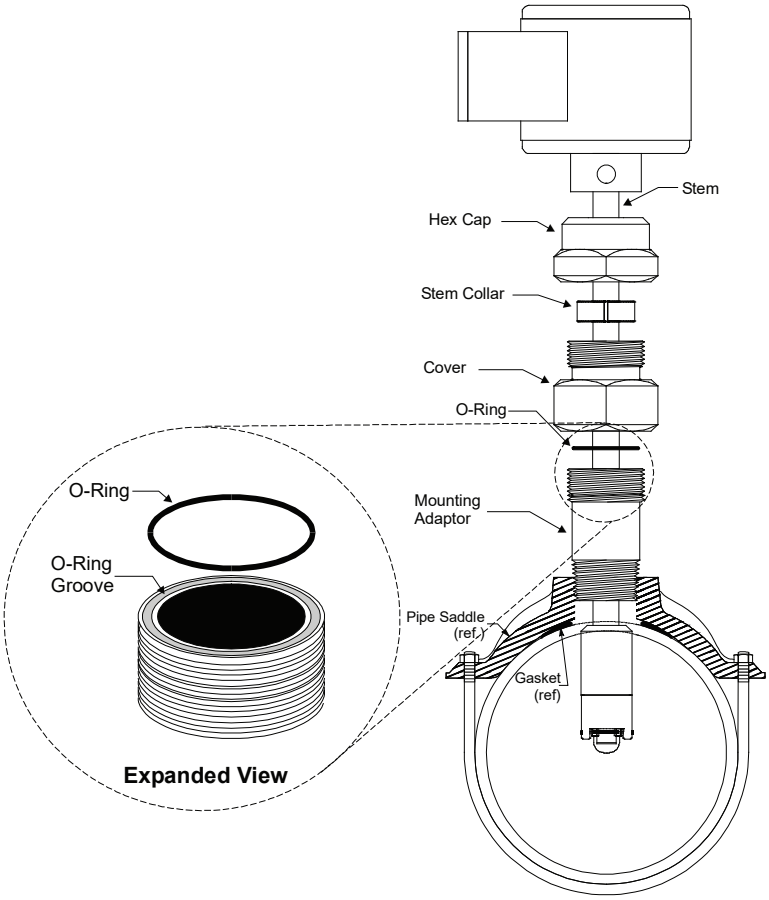


Figure 4: Direct insert model parts

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 effect on the operation of the sensor provided that the impeller is positioned correctly in the pipe.

Direct insert models are available in stem lengths designated D1, D2 and D3. The D1 is intended for nominal pipe diameters from 1-1/2…10 in. (38…254 mm), the D2 for pipe diameters from 12…36 in. (30…91 cm), and the D3 for pipe diameters 36 in. (91 cm) and up. However, pipe with extra thick walls, existing linings or unusual tapping hardware may require longer length sensors. For these pipes, consult the 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 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. (29 mm) 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. Locate the sensor rotor assembly 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 12* and note the Customer Reference Number (Customer Ref #).

NOTE: The Customer Reference Number is calculated using the following formula:
Ref # = Insertion Depth + Wall Thickness + Cover Thickness (0.875 in. (22 mm))

   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 5*.
   Dimension "C" = Customer Ref # + 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.

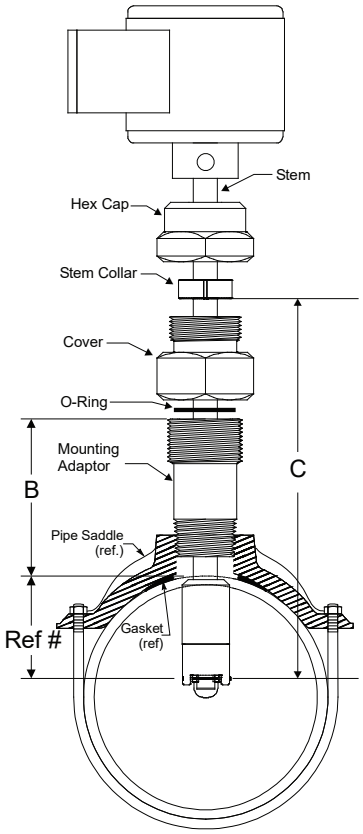


Figure 5: Dimensions "B" and "C"

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.
7. 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 6*.
8. 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*
9. Pressurize the pipeline and check for leaks.

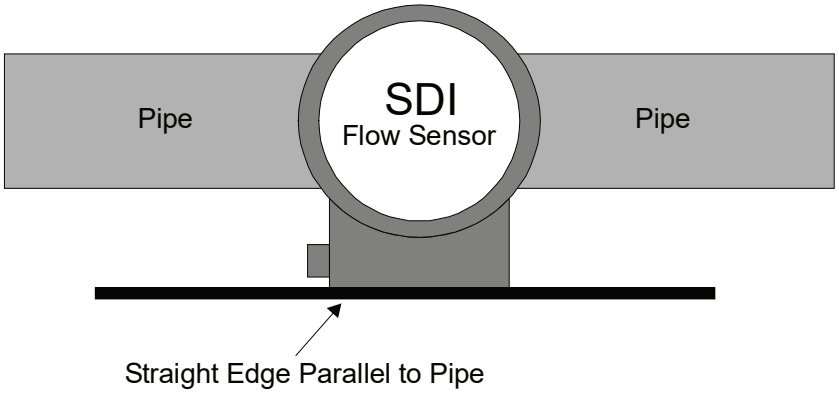


Figure 6: Level the sensor

Installation for Hot Tap Models

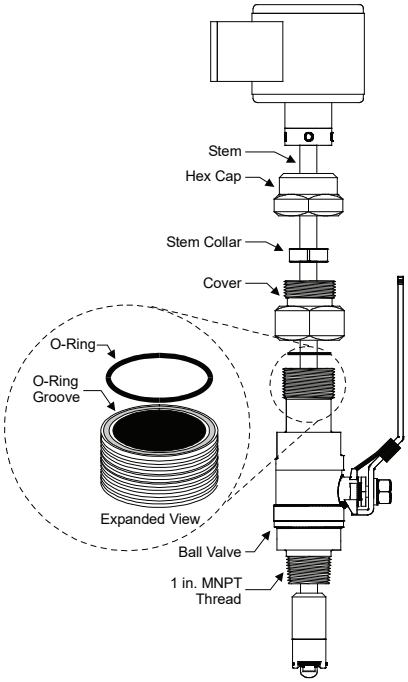


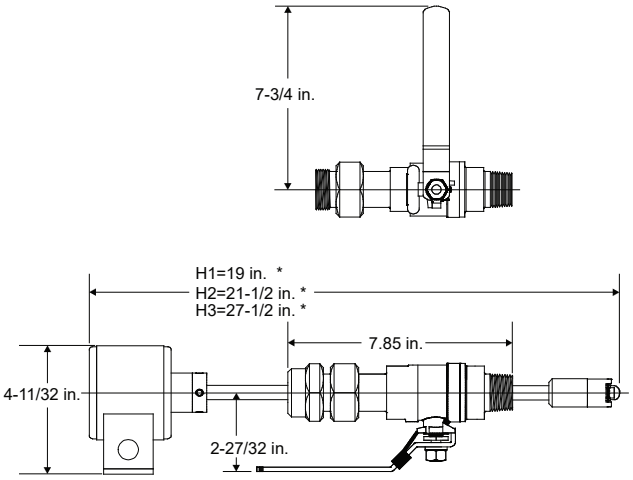
Figure 7: Installation for hot tap models

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.

In *Figure 8,* stem length H1 is intended for use in nominal pipe diameters from 1-1/2…10 in. (38…254 mm), H2 is for nominal pipe diameters from 12…36 in. (30…91 cm), 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 pipe types, 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 5 diameters of straight pipe behind the saddle. Drill a minimum 1-1/8 in. (29 mm)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 the impeller/shaft assembly.



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

Figure 8: Hot tap sensor dimensions

3. If the pipe is drained, drill a 1-1/8 in. (29 mm) minimum hole into the pipe and install a saddle or welded fitting onto the pipe. If the 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.
4. Attach the tapping adapter, (Badger Meter Part# A-1027) to the top of the valve (make sure the 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 you open the valve and connect the A-1027 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.

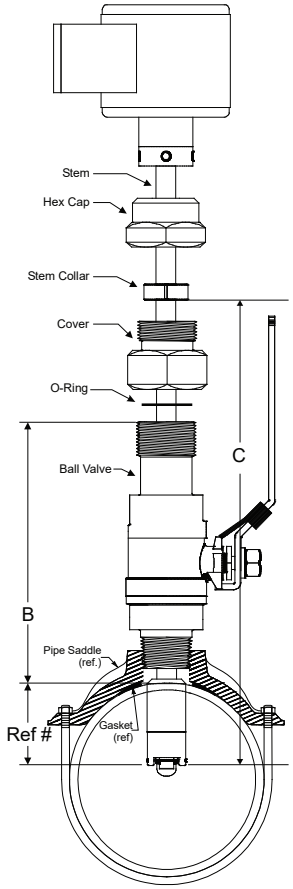


Figure 9: Dimensions "B" and "'C"

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 12* and note the Customer Reference Number (Customer Ref #).

    NOTE: The Customer Reference Number is calculated using the following formula:
    Ref # = Insertion Depth + Wall Thickness + Cover Thickness (0.875 in. (22 mm))

    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 7*.
    c. Add this number to the reference measurement. The resulting number is dimension "C" in *Figure 5 on page 7*
    Dimension "C" = Customer Ref # + 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 it 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.

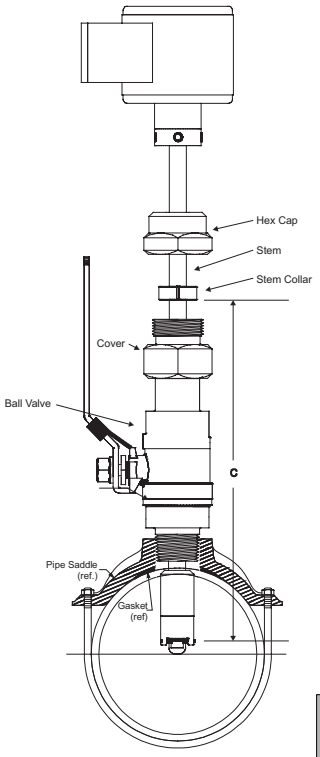


Figure 10: Sensor tip and stem collar

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.
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 by 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 as shown in *Figure 11*.
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 the pipeline and check for leaks.

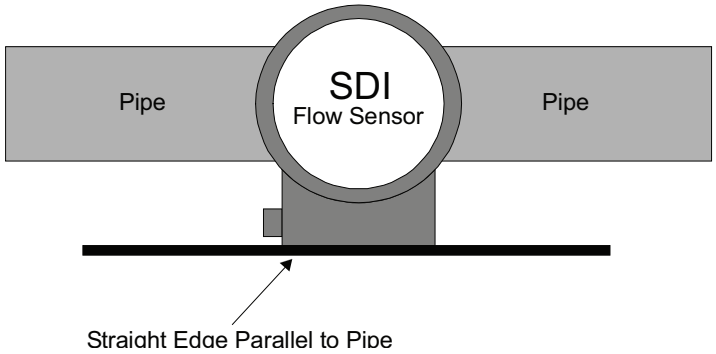


Figure 11: Level the sensor

Removing the Side Cover

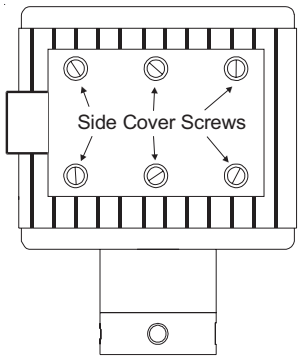


Figure 12: Remove the side cover

There are 6 screws to remove from the side cover / battery holder. To remove the side cover, use a screwdriver to unscrew each cover screw counterclockwise. These screws are captive so they will not fall out of the cover. Use care when replacing the side cover to make sure the O-ring is in place.

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

Battery Replacement

Although the Battery Powered SDI has up to a 5 year battery life, there will be a time when the battery needs to be replaced.

Local Display Option

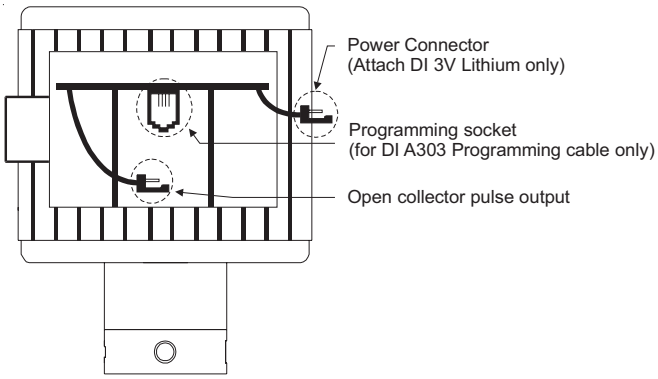


Figure 13: Battery replacement, local display

The battery is inside the blue housing on the end of the flow sensor, accessible by removing the side cover / battery holder. The battery is held in a spring clip attached to the cover. The required battery is a 3V lithium "C" size that can be purchased through Badger Meter.

The battery supplied by Badger Meter has the connector required to plug it into the power header. See *Figure 13* for the power header location.

Remote Display Option

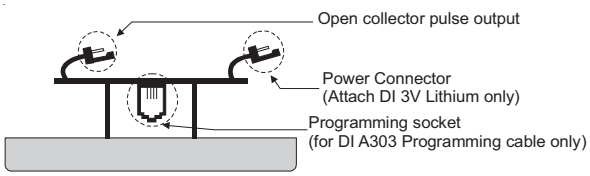


Figure 14: Battery replacement, remote display

The battery is located inside the remote display housing. Loosen the 1/4 turn fasteners at the corners of the cover. Open the enclosure to locate the "C" size lithium battery held by a spring clip. Disconnect the battery from the header and remove battery from the clip. Reverse this procedure to install a new battery. See *Figure 14* for the power header location.

Wiring Pulse Output

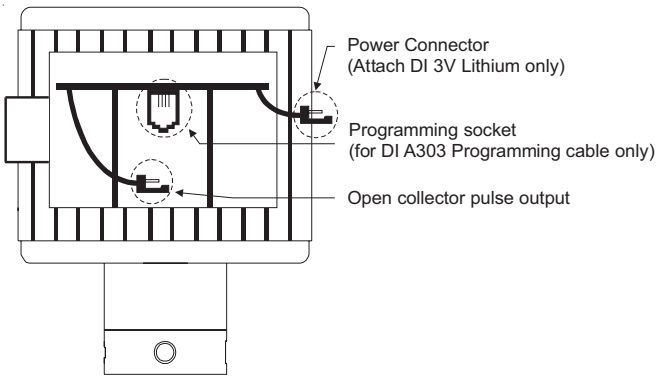


Figure 15: Pulse output

The optional pulse output of the Battery Powered SDI is a scaled pulse output that is set in the programming software. The output type is an open collector transistor closure with a maximum sinking current of 100 mA.

The cable that plugs into the existing pigtail from the PC board is PN 807021.

PROGRAMMING

To program Badger Meter SDI Series sensors, install the Badger Meter programming software on a computer and enter data in the templates of the Windows® based program following these steps.

1. Load the interface software onto the computer.
2. Connect the PC to the SDI with the ASDIB-20 SDI programming kit. Plug in the RJ11 plug from the ASDIB-20 kit to the RJ11 socket on Battery Powered SDI. Connect the DB9 connector of the ASDIB-20 kit to the PC COMM port of a PC that has the SDI software installed.
3. Open the interface software.

Figure 16: Comm port settings

4. Select **Configuration** in the menu and select the appropriate COMM PORT.

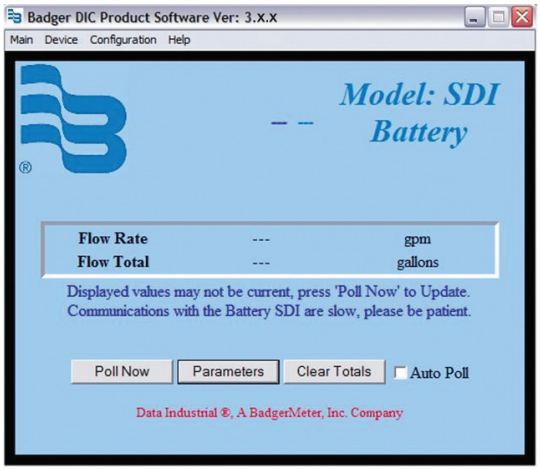


Figure 17: Select parameters

5. Select **Parameters** to open the *Parameters* screen.

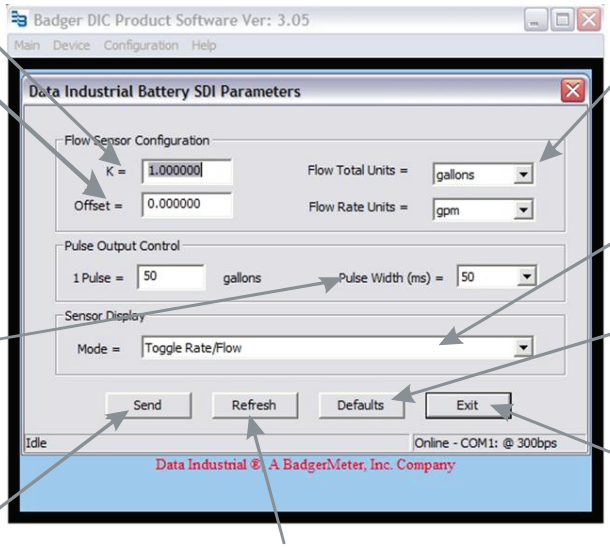
6. Program the parameters using the following screens as reference.

Step #1
Enter in a "K" number found in **Table B.**

Step #2
Enter in an "offset" number found in **Table B.**

Step #5
Optional setting, Enter in the gallons/pulse and select pulse width. Skip this step if not using the Scaled pulse output

Step #6
Press Send to transmit calibration data to the SDI Sensor. **See Note #1**



Press to retrieve calibration data from SDI.

Step #3
Select the desired flow rate and total units.

Step #4
Select the desired display readout mode.

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

Step #7
Press to exit parameters screen and to go back to the main screen. **See Note #2**

NOTE #1 After you press **Send**, the status bar shows programming progress. It may take up to 1-1/2 minutes to program the Battery Powered SDI. When the status bar says "updated", the Battery Powered SDI is programmed.

NOTE #2 After you press **Exit**, it takes about 10 seconds to go back to the operating display and refresh the *Flow Rate* and *Flow Total*.

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 Insertion Depth Customer Ref #	0.109 0.58 1-9/16	0.109 0.58 1-9/16	0.145 0.54 1-9/16	0.145 0.54 1-9/16	0.200 0.49 1-9/16	—
2 in.	2.375	Wall Insertion Depth Customer Ref #	0.109 0.81 1-13/16	0.109 0.81 1-13/16	0.154 0.77 1-13/16	0.154 0.77 1-13/16	0.218 0.71 1-13/16	0.113 0.81 1-13/16
2-1/2 in.	2.875	Wall Insertion Depth Customer Ref #	0.120 1.05 2-1/16	0.120 1.05 2-1/16	0.203 0.97 2-1/16	0.203 0.97 2-1/16	0.276 0.90 2-1/16	0.137 1.04 2-1/16
3 in.	3.500	Wall Insertion Depth Customer Ref #	0.120 1.37 2-3/8	0.120 1.37 2-3/8	0.216 1.27 2-3/8	0.216 1.27 2-3/8	0.300 1.19 2-3/8	0.167 1.32 2-3/8
4 in.	4.500	Wall Insertion Depth Customer Ref #	0.120 1.70 2-11/16	0.120 1.70 2-11/16	0.237 1.61 2-23/32	0.237 1.61 2-23/32	0.337 1.53 2-3/4	0.214 1.63 3-1/8
5 in.	5.563	Wall Insertion Depth Customer Ref #	0.134 1.59 2-5/8	0.134 1.59 2-5/8	0.258 1.51 2-21/32	0.258 1.51 2-21/32	0.375 1.44 2-11/16	—
6 in.	6.625	Wall Insertion Depth Customer Ref #	0.134 1.91 2-29/32	0.134 1.91 2-29/32	0.280 1.82 2-31/32	0.280 1.82 2-31/32	0.432 1.73 3-1/32	0.316 1.83 3-1/32
8 in.	8.625	Wall Insertion Depth Customer Ref #	0.148 2.50 3-17/32	0.148 2.50 3-17/32	0.322 2.39 3-19/32	0.322 2.39 3-19/32	0.500 2.29 3-21/32	0.410 2.40 3-11/16
10 in.	10.750	Wall Insertion Depth Customer Ref #	0.165 3.13 4-5/32	0.165 3.13 4-5/32	0.365 3.01 4-1/4	0.365 3.01 4-1/4	0.594 2.87 4-11/32	0.511 2.98 4-3/8
12 in.	12.750	Wall Insertion Depth Customer Ref #	0.180 3.72 4-25/32	0.180 3.72 4-25/32	0.406 3.58 4-7/8	0.375 3.60 4-27/32	0.688 3.41 5	0.606 3.52 5
14 in.	14.000	Wall Insertion Depth Customer Ref #	0.250 2.03 3-5/32	0.188 2.04 3-3/32	0.438 1.97 3-9/32	0.375 1.99 3-1/4	0.750 1.88 3-1/2	—
16"	16.000	Wall Insertion Depth Customer Ref #	0.250 2.33 3-7/16	0.188 2.34 3-13/32	0.500 2.25 3-5/8	0.375 2.29 3-17/32	0.844 2.15 3-7/8	—
18 in.	18.000	Wall Insertion Depth Customer Ref #	0.250 2.63 3-3/4	0.188 2.64 3-23/32	0.562 2.53 3-31/32	0.375 2.59 3-27/32	0.938 2.42 4-1/4	—
20 in.	20.000	Wall Insertion Depth Customer Ref #	0.250 2.93 4-1/16	0.218 2.94 4-1/32	0.594 2.82 4-9/32	0.375 2.89 4-1/8	1.031 2.69 4-19/32	—
22 in.	22.000	Wall Insertion Depth Customer Ref #	0.250 3.23 4-11/32	—	—	0.375 3.19 4-7/16	1.125 2.96 4-31/32	—
24 in.	24.000	Wall Insertion Depth Customer Ref #	0.250 3.53 4-21/32	0.250 3.53 4-21/32	0.688 3.39 4-31/32	0.375 3.49 4-3/4	1.219 3.23 5-5/16	—
26 in.	26.000	Wall Insertion Depth Customer Ref #	—	0.312 3.81 5	—	0.375 3.79 5-1/32	—	—
28 in.	28.000	Wall Insertion Depth Customer Ref #	—	0.312 4.11 5-9/32	—	0.375 4.09 5-11/32	—	—
30 in.	30.000	Wall Insertion Depth Customer Ref #	0.312 4.41 5-19/32	0.312 4.41 5-19/32	—	0.375 4.39 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 Insertion Depth Customer Ref #	0.072 0.48 1-7/16	0.060 0.49 1-7/16	0.049 0.50 1-7/16	0.042 0.51 1-7/16
2 in.	2.125	Wall Insertion Depth Customer Ref #	0.083 0.72 1-11/16	0.070 0.73 1-11/16	0.058 0.74 1-11/16	0.042 0.76 1-11/16
2-1/2 in.	2.625	Wall Insertion Depth Customer Ref #	0.095 0.95 1-29/32	0.080 0.97 1-29/32	0.065 0.98 1-29/32	—
3 in.	3.125	Wall Insertion Depth Customer Ref #	0.109 1.19 2-3/16	0.090 1.21 2-3/16	0.072 1.23 2-3/16	0.045 1.25 2-3/16
4 in.	4.125	Wall Insertion Depth Customer Ref #	0.134 1.54 2-9/16	0.110 1.56 2-9/16	0.095 1.57 2-17/32	0.058 1.60 2-17/32
6 in.	6.125	Wall Insertion Depth Customer Ref #	0.192 1.72 2-25/32	0.140 1.75 2-3/4	0.122 1.76 2-3/4	0.083 1.79 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			
Size	**O.D**	**Description**	**CL100**
4 in.	4.800	Wall Insertion Depth Customer Ref #	0.192 1.77 2-27/32
6 in.	6.900	Wall Insertion Depth Customer Ref #	0.276 1.90 3-1/16
8 in.	9.050	Wall Insertion Depth Customer Ref #	0.362 2.50 3-23/32
10 in.	11.100	Wall Insertion Depth Customer Ref #	0.444 3.06 4-3/8
12 in.	13.200	Wall Insertion Depth Customer Ref #	0.528 3.64 5-1/16

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 Offset	0.427271 -0.080605	0.427271 -0.080605	0.380552 0.002211	0.380552 0.002211	0.341075 0.081460	0.341075 0.081460	0.277850 0.226312	0.277850 0.226312
2 in.	2.375	K Offset	0.673452 -0.380524	0.673452 -0.380524	0.626407 -0.332296	0.626407 -0.332296	0.579615 -0.282874	0.579615 -0.282874	0.514211 -0.206396	0.514211 -0.206396
2-1/2 in.	2.875	K Offset	0.965024 -0.749072	0.965024 -0.749072	0.911744 -0.667702	0.911744 -0.667702	0.802796 -0.522645	0.802796 -0.52264	0.716671 -0.425526	0.716671 -0.425526
3	3.500	K Offset	1.582350 -2.113500	1.582350 -2.113500	1.490176 -1.870796	1.490176 -1.870796	1.277418 -1.355648	1.277418 -1.355648	1.118942 -1.022076	1.118942 -1.022076
3-1/2 in.	3.500	K Offset	2.091068 -1.399853	2.091068 -1.399853	2.024960 -2.010633	2.024960 -2.010633	1.856175 -4.014395	1.856175 -4.014395	1.621456 -2.219542	1.621456 -2.219542
4 in.	4.500	K Offset	2.635261 1.524904	2.635261 1.524904	2.544009 1.224082	2.544009 1.224082	2.279943 -0.029050	2.279943- 0.029050	2.083741 -1.463673	2.083741 -1.463673
5 in.	5.563	K Offset	4.254704 1.040171	4.254704 1.04017	4.158287 1.265404	4.158287 1.265404	3.705163 2.073017	3.705163 2.073017	3.315944 2.362615	3.315944 2.362615
6 in.	6.625	K Offset	6.703921 -8.690330	6.703921 -8.690330	6.571415 -8.020263	6.571415 -8.020263	5.831518 -4.525378	5.831518- 4.525378	5.122780 -1.645774	5.122780 -1.645774
8 in.	8.625	K Offset	9.810699 4.373516	9.810699 4.373516	9.631116 4.521076	9.631116 4.521076	8.862069 5.253952	8.862069 5.253952	8.129755 6.129664	8.129755 6.129664
10 in.	10.750	K Offset	15.558041 2.693802	15.558041 2.693802	15.359217 2.681251	15.359217 2.681251	14.116608 2.693176	14.116608 2.693176	12.779132 2.904373	12.779132 2.904373
12 in.	12.750	K Offset	22.687525 5.074024	22.687525 5.074024	22.492687 4.969576	22.492687 4.969576	20.707010 4.099617	20.946699 4.206793	18.603270 3.302154	19.990417 3.798262
14 in.	14.000	K Offset	28.113718 8.609697	28.113718 8.609697	27.254274 7.977566	27.819418 8.390513	25.581423 6.819905	25.581423 6.819905	22.940674 5.212368	25.043200 6.469292
16 in.	16.000	K Offset	38.108196 17.436071	38.108196 17.436071	37.184074 16.524164	37.856899 17.186449	34.538799 14.010489	35.847870 15.235909	31.076347 10.962554	34.538799 14.010489
18 in.	18.000	K Offset	49.922424 30.346106	49.922424 30.346106	48.850674 29.092361	49.631184 30.003992	45.024284 24.739450	47.297367 27.301405	40.637650 20.013815	45.771198 25.573288
20 in.	20.000	K Offset	59.821514 3.372809	59.821514 3.372809	59.821514 3.372809	59.459480 3.378817	54.939907 3.459857	57.568302 3.411363	51.637486 32.381599	56.066704 3.438600
22 in.	22.000	K Offset	72.009399 3.211272	72.009399 3.211272	71.246956 3.219100	71.640358 3.215024	(69.712502) (3.235763)	—	60.582455 3.360413	—
24 in.	24.000	K Offset	84.054832 3.126430	84.054832 3.126430	83.653954 3.128100	83.653954 3.128100	78.190941 3.158703	82.090302 3.135363	71.628067 3.215150	80.530304 3.143800
26 in.	26.000	K Offset	—	—	95.504044 3.111093	—	(94.701706) (3.110163)	—	—	—
28 in.	28.000	K Offset	—	—	108.363754 3.165831	—	(107.546707) (3.160163)	—	—	—
30 in.	30.000	K Offset	122.276558 3.306300	122.276558 3.306300	121.457077 3.295768	121.457077 3.295768	(120.625305) (3.285363)	—	—	—

For sizes above 30", 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**			
Size	**O.D.**		**K**	**L**	**M**	**DMW**
1-1/2 in.	1.625	K Offset	—	0.277993 0.063685	—	—
2 in.	2.125	K Offset	—	0.509285 -0.043054	—	—
2-1/2 in.	2.625	K Offset	—	0.784450 -0.126200	—	—
3 in.	3.125	K Offset	—	1.177171 0.198965	—	—
4 in.	4.125	K Offset	—	1.750507 4.142096	—	—
5 in.	5.125	K Offset	—	3.587835 0.198965	—	—
6 in.	6.125	K Offset	5.041780 0.198965	4.298570 3.295640	—	—

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**
Size	**O.D.**		**100**
4 in.	4.800	K Offset	—
6 in.	6.900	K Offset	—
8 in.	9.050	K Offset	—
10 in.	11.100	K Offset	—
12 in.	13.200	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.

POWER SPECIFICATIONS

		Unidirectional			**Bidirectional**		**Battery Operated**
		Raw Pulse Option 0	**Analog Loop Option 1**	**Scaled Pulse Option 2**	**Analog Loop Option 5**	**Scaled Pulse Option 6**	**Scaled Pulse Option 2**
Number of Wire Connections		**2**	**2**	**4**	**6**	**6**	**2**
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	n/a
	Overvoltage Protection	30V AC ± 40V DC	± 40V DC	30V AC ± 40V DC	30V AC ± 40V DC	30V AC ± 40V DC	n/a
	Quiescent Current Draw @ 12V DC or 24V AC	330 µA typical	Software-controlled current of 3.5…20.5 mA	< 2.0 mA	< 5.0 mA	< 5.0 mA	n/a
	Short Circuit Current	50 mA typical	n/a	> 100 mA	For direction > 100 mA	> 100 mA	> 100 mA
	Output Frequency	800 Hz max	n/a	Scaled by customer	n/a	Scaled by customer	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	Selectable 50 mS 100 mS 250 mS
	Output Isolation	n/a	n/a	Opto-isolated	Opto-isolated	Opto-isolated	Opto-isolated
Analog Units	Operating Voltage	n/a	8…25V DC	n/a	8…25V DC	n/a	n/a
	Output Response Time	n/a	Varies with programmable filter	n/a	Varies with programmable filter	n/a	n/a

The battery powered version is powered by a "C" size lithium battery with a five year life span

SPECIFICATIONS

Wetted Materials	Sensor stem, mounting adapter, isolation valve, and nipple:	316 Stainless steel
		Brass, B16, UNS C36000
Sensor Tip	Polyphenylene sulfide (PPS)	
	Polyetheretherketone (PEEK)	
O-rings, Bearings, Shaft	See ordering matrix	
Operating Temperature	Electronics	14…150° F (–10…65° C)
	LCD	–4…150° F (–20…65°C)
Maximum Pressure Rating Stainless Steel (Non Shock)	1000 psi (68.9 bar) @ 70° F (21° C)	
	900 psi (62 bar) @ 100° F (37.8° C)	
	670 psi (46.1 bar) @ 140° F (60° C)	
	225 psi (15.5 bar) @ 180° F (82° C)	
Maximum Pressure Rating Brass (Non Shock)	600 psi (41.3 bar) @ up to 140° F (60° C)	
	225 psi (15.5 bar) @ 180° F (82° C)	
Optimum Design Flow Range	1…20 ft/sec. (0.30…6 m/sec.)	
	Extended flow range < 0.5…20 fps	
Pressure Drop	0.5 psi or less at 10 ft/sec (3 m/sec.) for all pipe sizes 1.5 in. (38 mm) diameter and up	
Accuracy	Standard: to ±1% of rate over optimum flow range	
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	±0.5%	
Enclosure	Sensor- battery	Polypropylene with Viton® sealed acrylic cover. Meets NEMA 6P specifications
	Remote	Polycarbonate w/ Neoprene® sealed cover. Meets NEMA 4X specifications.
Programming	A-303 connector cable and SDI Series software	
Display (Optional)	8 character, 3/8 in. (10 mm) LCD	
	STN (Super Twisted Nematic) display	
	Annunciators for rate, total, totalizer multipliers, low battery, flow direction	
Accessories	ASDIB-20 Programming kit- battery powered A-301 connector cable or USB	
	07101 5 ft (1.5 m) extension cable 07108 10 ft (3 m) extension cable 07102 20 ft (6 m) extension cable 07109 50 ft (15 m) extension cable	

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Legacy Document Number: 872042