

Owner's Manual for Flow Sensors by Data Industrial

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Introduction

Used in conjunction with flow monitors or transmitters, Rain Bird non-magnetic flow sensors manufactured by Data Industrial provide accurate readings of the rate of liquid flow as well as total accumulated flow. A number of sensor models are offered, which cover applications for a wide range of pipe sizes.

The flow sensors generate a frequency which is proportional to flow rate. An internal preamplifier allows the pulse signal to travel up to 3000 feet without further amplification. Power to operate the sensor is provided by the flow transmitter. The impeller, shaft, O-rings, and impeller bearings are replaceable in the field.

Data Industrial flow sensors feature a closed, six-bladed impeller design, using a proprietary, non- magnetic sensing technology. The forward-swept impeller shape provides higher, more constant torque than other impeller designs, and is less prone to fouling by water-borne debris. The forward-curved shape, coupled with the absence of magnetic drag, provides improved operation and repeatability, even at lower flow rates. As the liquid flow turns the impeller, a low impedance digital signal is transmitted with a frequency proportional to the flow rate.

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

Sensor Types and Size Selection

Rain Bird provides several basic sensor configurations using the same impeller element. This allows for a wide range of applications and pipe sizes. Sensors are supplied with two single conductor 18 AWG stranded copper wire leads 48 inches in length with U.L. Style 1056 direct burial insulation. These sensors may be used in below grade applications in meter pits of valve boxes. All sensor electrical components are self-contained. Pressure and temperature ratings for the various models are contained in the Specifications section of this manual. These models are further described one the following pages.

Rain Bird Flow Sensors

Brass Insert Sensor (FS350B)

This Insert style sensor has a 5 1/4" long sleeve length, and uses brass and bronze hardware. It is used in all pipe sizes from 3" to 40.0" in diameter. A bronze 2" NPT externally threaded hex adapter is provided. The adapter may be mounted to the pipe using a welded-on threaded fitting such as a Thredolet® or pipe saddle.

Stainless Steel Insert Sensor (FS350SS)

This is the same as a Brass Insert Sensor, except that the sensor, sleeve and hex adapter are made of 300 Series stainless steel.

PVC Tee Sensors

These models feature a modified PVC tee with solvent weld socket end connections, and a removable PPS sensor insert. They are available in the following sizes and thread types:

Model (thread)	Model (thread)	Size
FS400P (slip)	IFS400PFL (DIN flanged)	4" (110mm)
FS300P (slip)	IFS300BPS (BSP)	3" (75mm)
FS200P (slip)	IFS200BPS (BSP)	2" (50mm)
FS150P (slip)	IFS150BPS (BSP)	1 1/2" (40mm)
FS100P (slip)	IFS100BPS (BSP)	1" (25mm)
FS075P (slip)	IFS075BPS (BSP)	3/4" (20mm)
FS050P (slip)	IFS050BPS (BSP)	1/2" (12mm)

BSP = Female BPS straight threaded ends

Bronze Tee Sensor

These models combine a PPS electronics package inserted into a proprietary cast bronze pipe tee with threaded NPT (female iron pipe thread - FIPT) connections. They are available in the following sizes and thread types:

Model	Thread	Size
FS200B	NPT	2" (50mm)
FS150B	NPT	1 1/2" (40mm)
FS100B	NPT	1" (25mm)

Flanged Irrigation PPS Insert Assembly (Model FSTINSERT).

This is a flow sensor insert for use with tee style fittings for larger pipe diameters.

Suggested Operating Range for Tee Selection

Model	Description	Operating Range		
		GPM	LPM	m ³ /hr
Brass Tees				
FS200B	2" Brass Tee Flow sensor	10 to 100	38 to 380	2.3 to 23
FS150B	1 1/2" Brass Tee Flow sensor	4 to 80	15 to 300	1 to 18
FS100B	1" Brass Tee Flow sensor	2 to 40	7.6 to 150	0.5 to 9
Plastic Tees				
FS400P	4" PVC Tee Flow Sensor	40 to 500	150 to 1900	9 to 110
FS300P	3" PVC Tee Flow Sensor	20 to 300	75 to 1130	4.5 to 70
FS200P	2" PVC Tee Flow Sensor	10 to 200	40 to 750	2.3 to 45
FS150P	1 1/2" PVC Tee Flow Sensor	5 to 100	19 to 380	1.1 to 23
FS100P	1" PVC Tee Flow Sensor	5.4 to 54	20 to 200	1.2 to 12
FS075P	3/4" PVC Tee Flow Sensor	3.3 to 33	13 to 125	.75 to 7.5
FS050P	1/2" PVC Tee Flow Sensor	1.9 to 19	7 to 70	.43 to 4.3
Inserts				
FS350B	Brass Insert Flow Sensor	Depends on Pipe Type and Size. See pages 6 through 8.		
FS350SS	Stainless Steel Insert Flow Sensor			

Values for plastic tees apply for BSP and slip threads.

Mechanical Installation

General

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

- 1) Choose a location along the pipe where 10 pipe diameters upstream and 5 pipe diameters downstream of the sensor provide no flow disturbance. Pipe bends, valves, other fittings, pipe enlargements and reductions should not be present in this length of pipe.
- 2) The preferred location around the circumference of a horizontal pipe is on top. If trapped air or debris will interfere, then the sensor should be located further around the pipe from the top but not more than 45 degrees from top dead center. The sensor should never be located at the bottom of the pipe, as sediment may collect there. Locations off top dead center cause the impeller friction to increase, which may affect performance at low flow rates. Any circumferential location is correct for installation in vertical pipes.
- 3) Small pipe PVC and Bronze Tee Type sensors are Factory Set, but for insert sensors the Insertion depth should be set to 1 1/2" for accurate flow readings. The following pages show methods for ensuring correct insertion depth for various sensor mounting configurations.
- 4) Alignment of the sensor to ensure that impeller rotation is parallel to flow is important. Alignment instructions are also included on the following pages.

Mechanical Installation for PVC Tee Sensors

- 1) Note intended direction of flow as indicated by arrows on the tee. There must be free, unrestricted pipe for at least 10 diameters upstream and 5 diameters downstream of the tee.
- 2) Remove the clevis pin and remove the sensor from the tee.
- 3) Properly clean the pipe ends and tee sockets.
- 4) Solvent cement the pipe to the tee.
- 5) Reinstall sensor in tee as follows:
 - a) Align the flow arrow on the top of the sensor housing in the direction of flow.
 - b) Carefully press sensor straight into tee.
 - c) Lead the sensor cable through the conduit cap, if so equipped. The cap will fit standard 1/2" conduit fittings.
 - d) Install clevis pin through tee, sensor, and conduit cap, and install cotter ring.

Mechanical Installation for Bronze Tee Sensor

Install with flow label pointing in the direction of flow (downstream).

To install the sensor tee

- 1) Note intended direction of flow as indicated by arrows on the cast bronze tee. There must be free, unrestricted pipe for at least 10 diameters upstream and 5 diameters downstream of the tee.
- 2) Apply pipe compound over the first 3 or 4 threads of the mating pipe.
- 3) Thread the pipe into the sensor tee until hand tight.
- 4) Tighten the pipe, using a wrench, an additional 1 1/2 turns.

Rain Bird Flow Sensors

To install sensor in tee

- 1) Apply a small amount of silicone grease to O-rings on sensor insert and chamfer on inside lip of tee. Clean off any grease which could be deposited on the impeller.
- 2) Align flow arrow on sensor with direction of flow.
- 3) Carefully press sensor straight into tee. **Caution: Impeller may strike sides of venturi cavity in tee if misaligned, causing damage to impeller or shaft.**
- 4) Install clevis pin through the tee, sensor, and conduit cap, and install split ring.
- 5) Before pressurizing pipe, verify that:
 - All threaded connections are tight.
 - The flow direction arrows on the tee and sensor are aligned with the flow direction.
 - The clevis pin and cotter ring are installed.

Mechanical Installation for Insert Sensors

The insertion depth and alignment of the sensor assembly are critical to the accuracy of the flow measurement. The Flat End of the sensor tube assembly **MUST BE INSTALLED 1-1/2" from the inside wall of the pipe.** In order to allow for variations in wall thickness, lining or coatings, the depth adjustment is controlled by the position of the Hex Nuts on the three (3) threaded studs of the Hex Mounting Adapter. The Hex Mounting Adapter is provided with a 2" Male NPT connection.

There are two methods of mounting these Rain Bird sensors in a 3" or larger pipe. One for PVC pipe uses a 2" NPT threaded pipe saddle. The other, for steel pipe, uses a welded-on fitting such as a Thredolet®, also tapped for a 2" NPT connection. In either case, cut a 2" hole through a depressurized pipe and then secure the saddle or welded fitting to the pipe. **Note: Do not use a threaded outlet tee, the inside dimension of the tee is not the same as the pipe O.D.** Install the 2" NPT adapter provided, using a thread sealant to prevent leakage. Tighten as necessary. Rain Bird insert style sensors are calibrated with the sensor inserted 1 1/2" into the pipe flow.

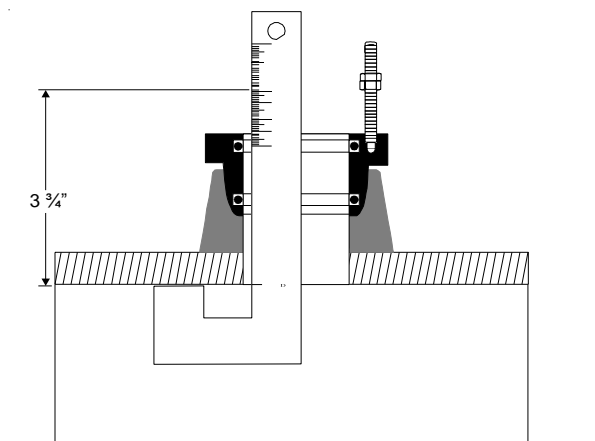
To determine the proper insertion depth, proceed as follows:

- 1) **Apply Anti-Seize thread lubricant, supplied with the sensor, to the threaded studs of the mounting adaptor.**
- 2) Determine the height to the upper adjusting nuts on the three 1/4" studs using the insertion depth gauge contained in the RBIK Installation Kit. Set them at 3 3/4" above the inside wall of the pipe.
- 3) Clean O-Rings and flow sensor sleeve, and lightly lubricate O-Rings with silicone grease from the packet provided or some other acceptable lubricant. Take care not to get grease on the impeller or bearing.
- 4) Insert the flow sensor into the 2" NPT adapter so that the mounting holes in the positioning collar fit over the studs on the adapter. Lower the sensor onto the previously adjusted nuts. Install the lock nuts on top of the positioning collar and tighten. Now tighten the lower jam nuts firmly against the upper adjusting nuts to secure them for future removal of the sensor for inspection or service.

Alignment of Flow Sensor

- 1) Loosen positioning collar set screws with a 3/32" Allen wrench. Place the alignment rod through the sight holes in the flow sensor. Refer to Figure 2. Using the alignment rod as a guide, align the flow sensor so that the flow label arrow matches pipe flow direction and so that the alignment rod is exactly parallel to the pipe. This procedure aligns the impeller directly into the fluid flow. As a backup to the flow arrow label, there is a small hole next to the larger sighting hole of the upstream side.

Figure 1
Installation of FS350B and FS350SS



- 2) With a 3/32" Allen wrench, tighten positioning collar set screws. Double check that the sighting holes in the sleeve are parallel down the pipe and that the flow arrow label matches pipe liquid flow direction.
- 3) Cable routing: The positioning collar is threaded for connection of a standard 1/2" electrical conduit (flex cable) or a wire strain relief. Route cable as required. Be sure to leave enough flex in cable or conduit to allow future removal of sensor for service or cleaning if necessary.

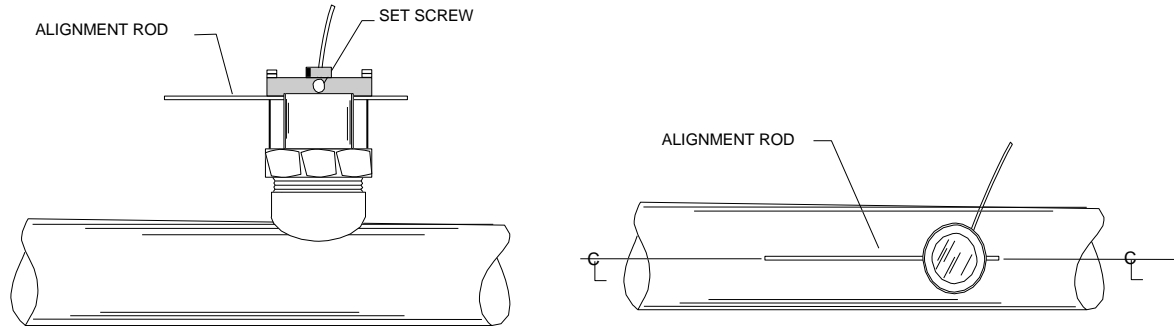


Figure 2 – Alignment of FS350B and FS350SS

Electrical Installation

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

- 1) **DO NOT** remove the plastic caps from the sensor leads until ready
- 2) Use PE-39 #19 AWG cable, which is suitable for direct burial and clean data transmission, to connect the sensor to the transmitter, monitor, or controller.
- 3) Make a water tight splice. Direct burial silicone grease splices are recommended (Rain Bird DBRY20 or 3M DBR/Y-6). Two part epoxy type waterproof kits are also acceptable (be sure the epoxy seals the ends of the cables).
- 4) For silicone grease splices, make sure the wire nut is installed as deep as possible into the grease tube. For epoxy type, make sure the epoxy is hardened before inverting the splice or dropping it in standing water.
- 5) **DO NOT** make an underground splice unless absolutely necessary.
- 6) Route the cable from the sensor to a Rain Bird flow monitor/transmitter. The cable may be extended up to 2000 feet by using PE-39 #19 AWG cable, which is shielded. Be sure to leave sufficient slack in the cable to allow for future service of sensor.
- 7) When connecting to a Rain Bird flow monitor/transmitter, locate the section of terminal strip on the monitor labeled "**SENSOR INPUT**" or "**SENSOR**". Connect the red wire to **RED(+)** terminal and the black wire to **BLACK(-)**.

Rain Bird Flow Sensors

Calibration

Rain Bird sensors use unique K and offset numbers for calibration. These numbers are derived from calibration runs using NIST traceable instruments. Using both a K and an offset number provides higher accuracy than using a K factor alone. K and offset numbers for each tee configuration are listed in the following tables.

Calibration Tables

The table on pages 7 and 8 provides calibration and operation data for most scheduled pipe sizes from 3” through 36”. For tee-mounted sensors, see the table below.

Calibration Table for Tee Mounted Sensors						
K Value, Offset and Suggested Operating Range						
Model	Description	K Value	Offset	Operating Range		
				GPM	LPM	m ³ /hr
Brass Tees						
FS200B	2" Brass Tee Flow sensor	2.7470	0.0000	10 to 100	38 to 380	2.3 to 23
FS150B	1 1/2" Brass Tee Flow sensor	1.0653	0.0892	4 to 80	15 to 300	1 to 18
FS100B	1" Brass Tee Flow sensor	0.3974	0.2618	2 to 40	7.6 to 150	0.5 to 9
Plastic Tees						
FS400P	4" PVC Tee Flow Sensor	13.7424	0.2307	40 to 500	150 to 1900	9 to 110
FS300P	3" PVC Tee Flow Sensor	8.3090	0.2270	20 to 300	75 to 1130	4.5 to 70
FS200P	2" PVC Tee Flow Sensor	2.8429	0.1435	10 to 200	40 to 750	2.3 to 45
FS150P	1 1/2" PVC Tee Flow Sensor	1.6970	-0.3160	5 to 100	19 to 380	1.1 to 23
FS100P	1" PVC Tee Flow Sensor	0.2611	1.2000	5.4 to 54	20 to 200	1.2 to 12
FS075P	3/4" PVC Tee Flow Sensor	0.1563	0.9000	3.3 to 33	13 to 125	.75 to 7.5
FS050P	1/2" PVC Tee Flow Sensor	0.0780	0.9000	1.9 to 19	7 to 70	.43 to 4.3

Description of Column Information for Pipe Sizes 3” through 36”

- Column 1 Nominal Pipe Size
- Column 2 Pipe O.D. as defined by ASA B36.10 and other standards
- Column 3 Pipe I.D. as defined by ASA B36.10 and other standards
- Columns 4 and 5 The K value and Offset that should be used in our frequency equation:

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

This equation describes the frequency of the output signal of all Rain Bird flow sensors. By substituting the appropriate K and Offset values from the table, the sensor’s output frequency can be calculated for each pipe size. This information is required when calibrating an output board or when using the raw sensor data as direct output to interface with a device that is not a Rain Bird product.

- Column 6 This column indicates the suggested flow range of sensors in each pipe size. Rain Bird sensors will operate both above and below the indicated flow rates. However, good design practice dictates the use of this range for best performance.

Sensors should be sized for flow rather than pipe size. To prevent disturbances to the flow profile always connect the sensor tee to pipe nipples measuring at least 10 pipe diameters in length on the upstream (supply) side and at least 5 pipe diameters in length on the downstream (delivery) side before making the transition in pipe size.

CALIBRATION TABLE FOR PIPE SIZES 3" THROUGH 36"

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Pipe Size	Pipe O.D.	Pipe I.D.	K Value	Offset	Suggested Operating Range (GPM)
3" Sch 10S	3.500"	3.260"	5.009	.090	12-400
Std. Wt., Sch 40	3.5"	3.068"	4.362	.063	12-400
Extra Strong, Sch 80	3.5"	2.900"	3.858	.043	12-400
PVC Class 125	3.5"	3.284"	5.094	.093	12-400
PVC Class 160	3.5"	3.230"	4.902	.085	12-400
PVC Class 200	3.5"	3.166"	4.682	.076	12-400
4" Sch 10S	4.5"	4.260"	9.597	.241	20-600
Std. Wt., Sch 40	4.5"	4.026"	8.34	.229	20-600
Extra Strong, Sch 80	4.5"	3.826"	7.354	.188	20-600
PVC Class 125	4.5"	4.224"	9.396	.240	20-600
PVC Class 160	4.5"	4.154"	9.013	.240	20-600
PVC Class 200	4.5"	4.072"	8.578	.239	20-600
5" Sch 10S	5.563"	5.295"	16.305	.250	30-900
Std. Wt., Sch 40	5.50"	5.047"	14.674	.248	30-900
Extra Strong, Sch 80	5.50"	4.813"	13.165	.246	30-900
6" Sch 10S	6.625"	6.357"	24.089	.260	50-1,500
Std. Wt., Sch 40	6.5"	6.065"	21.574	.257	50-1,500
Extra Strong, Sch 80	6.5"	5.761"	19.457	.254	50-1,500
PVC Class 125	6.625"	6.217"	22.853	.258	50-1,500
PVC Class 160	6.625"	6.115"	21.968	.257	50-1,500
PVC Class 200	6.625"	5.993"	21.068	.256	50-1,500
8" Sch 10S	8.625"	8.329"	43.914	0.286	80-2,500
Sch 20	8.625"	8.125"	41.653	0.283	80-2,500
Sch 30	8.625"	8.071"	41.063	0.283	80-2,500
Std. Wt., Sch 40	8.625"	7.981"	40.086	0.281	80-2,500
Sch 60	8.625"	7.813"	38.288	0.279	80-2,500
Extra Strong, Sch 80	8.625"	7.625"	36.315	0.276	80-2,500
PVC Class 125	8.625"	8.095"	41.324	0.283	80-2,500
PVC Class 160	8.625"	7.961"	39.869	0.281	80-2,500
PVC Class 200	8.625"	7.805"	38.203	0.279	80-2,500
10" Sch 10S	10.75"	10.420"	70.195	0.321	125-4,000
Sch 20	10.75"	10.250"	67.668	0.318	125-4,000
Sch 30	10.75"	10.136"	66.069	0.316	125-4,000
Sch 40, Std.Wt.	10.75"	10.020"	64.532	0.314	125-4,000
Extra Strong, Sch 60	10.75"	9.750"	61.016	0.309	125-4,000
Sch 80	10.75"	9.564"	58.644	0.306	125-4,000
PVC Class 125	10.75"	10.088"	65.431	0.315	125-4,000
PVC Class 160	10.75"	9.924"	63.272	0.312	125-4,000
PVC Class 200	10.75"	9.728"	60.733	0.309	125-4,000
12" Sch 10S	12.75"	12.390"	104.636	0.367	175-5,000
Sch 20	12.75"	12.250"	102.553	0.364	175-5,000
Sch 30	12.75"	12.090"	99.347	0.36	175-5,000
Std. Wt., Sch 40S	12.75"	12.000"	97.576	0.358	175-5,000
Sch 40	12.75"	11.938"	97.369	0.356	175-5,000
Sch 60	12.75"	11.625"	90.441	0.348	175-5,000
Extra Strong	12.75"	11.750"	92.775	0.351	175-5,000
Sch 80	12.74"	11.376"	85.922	0.342	175-5,000
PVC Class 125	12.75"	11.966"	96.912	0.357	175-5,000
PVC Class 160	12.75"	11.770"	93.152	0.352	175-5,000
PVC Class 200	12.75"	11.538"	88.842	0.346	175-5,000

Continued on Next Page

CALIBRATION TABLE FOR PIPE SIZES 3" THROUGH 36"

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Pipe Size	Pipe O.D.	Pipe I.D.	K Value	Offset	Suggested Operating Range (GPM)
14" Sch 10S	14.00"	13.500"	122.307	0.391	200-6,000
Sch 20	14.00"	13.375"	120.216	0.388	200-6,000
Std. Wt., Sch 30	14.00"	13.250"	118.151	0.385	200-6,000
Sch 40	14.00"	13.124"	116.096	0.382	200-6,000
Sch 60	14.00"	12.814"	111.148	0.376	200-6,000
Extra Strong	14.00"	13.00"	114.098	0.33	200-6,000
Sch 80	14.00"	12.50"	106.299	0.369	200-6,000
16" Sch 10S	16.00"	15.500"	159.243	0.44	300-9,000
Sch 20	16.00"	15.375"	156.742	0.436	300-9,000
Std. Wt., Sch 30	16.00"	15.250"	154.267	0.433	300-9,000
Sch 60	16.00"	14.688"	143.456	0.419	300-9,000
Extra Strong, Sch 40	16.00"	15.000"	149.394	0.427	300-9,000
Sch 80	16.00"	14.314"	136.548	0.41	300-9,000
18" Sch 10S	18.00"	17.500"	202.739	0.498	350-10,000
Sch 20	18.00"	17.375"	199.828	0.494	350-10,000
Sch 30	18.00"	17.124"	194.061	0.486	350-10,000
Std. Wt.	18.00"	17.250"	196.943	0.49	350-10,000
Sch 40	18.00"	16.876"	188.464	0.479	350-10,000
Sch 60	18.00"	16.500"	180.171	0.469	350-10,000
Extra Strong	18.00"	17.000"	191.25	0.482	350-10,000
Sch 80	18.00"	16.126"	172.152	0.457	350-10,000
20" Std. Wt., Sch 20	20.00"	19.25"	246.179	0.555	400-12,000
Sch 40	20.00"	18.812"	234.836	0.540	400-12,000
Extra Strong, Sch 30	20.00"	19.000"	239.666	0.547	400-12,000
Sch 80	20.00"	17.938"	213.14	0.511	400-12,000
22" Std. Wt., Sch 20	22.00"	21.25"	301.975	0.621	500-15,000
Extra Strong, Sch 30	22.00"	21.00"	294.642	0.616	500-15,000
Sch 80	22.00"	19.75"	259.513	0.573	500-15,000
24" Std. Wt., Sch 20	24.00"	23.25"	364.331	0.666	600-18,000
Extra Strong	24.00"	23.00"	356.178	0.660	600-18,000
Sch 40	24.00"	22.624"	344.109	0.652	600-18,000
Sch 80	24.00"	21.562"	311.271	0.628	600-18,000
26" Sch 10	26.00"	25.376"	437.809	0.719	700-21,000
Std. Wt.	26.00"	25.25"	433.247	0.716	700-21,000
Sch 20, Extra Strong	26.00"	25.00"	424.274	0.709	700-21,000
28" Sch 10	28.00"	27.376"	513.698	0.774	900-23,000
Std. Wt.	28.00"	27.25"	508.723	0.770	900-23,000
Extra Strong, Sch 20	28.00"	27.00"	498.930	0.763	900-23,000
30" Sch 10	30.00"	29.376"	596.147	0.833	1,000-30,000
Std. Wt.	30.00"	29.25"	590.759	0.829	1,000-30,000
Sch 20, Extra Strong	30.00"	29.00"	580.146	0.822	1,000-30,000
32" Sch 10	32.00"	31.376"	685.156	0.897	1,200-35,000
Std. Wt.	32.00"	31.25"	679.355	0.893	1,200-35,000
Sch 20, Extra Strong	32.00"	31.00"	667.922	0.885	1,200-35,000
Sch 40	32.00"	30.624"	650.919	0.873	1,200-35,000
34" Sch 10	34.00"	33.312"	777.566	0.964	1,300-40,000
Std. Wt.	34.00"	33.25"	774.511	0.962	1,300-40,000
Extra Strong, Sch 20	34.00"	33.00"	762.258	0.953	1,300-40,000
Sch 40	34.00"	32.624"	744.022	0.940	1,300-40,000
36" Sch 10	36.00"	35.376"	882.855	1.040	1,500-45,000
Std. Wt.	36.00"	35.25"	876.227	1.035	1,500-45,000
Sch 20, Extra Strong	36.00"	35.00"	863.154	1.025	1,500-45,000
Sch 40	36.00"	34.50"	837.315	1.007	1,500-45,000

Impeller Assembly and Shaft Replacement

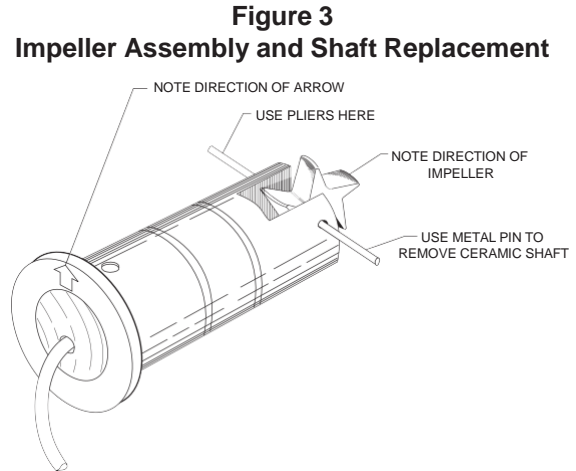
If you are replacing an existing Rain Bird sensor and have already calibrated your flow transmitter, no calibration changes are necessary. For installation of a new flow transmitter or for relocation of a sensor in a new pipe size, please refer to the calibration instructions in flow transmitter manual.

- 1) Depressurize pipe from which sensor is to be removed.
- 2) For Insert Style Sensors: Remove the three (3) lock nuts that secure the positioning collar to the threaded rods of metal sensor. For Tee Type Sensors: Remove clevis pin.

NOTE: Before removing lock nuts, record the dimension from top of 2" NPT adapter to the bottom of the positioning collar. This dimension will be required later to reinstall.

- 3) Remove the sensor from the hex adapter or the tee.
- 4) Note the impeller blade orientation relative to flow arrows and the alignment hole in metal sensors beside one of the sighting holes. In order to maintain proper calibration, the impeller will have to be reinstalled in the same manner with the impeller blades pointing toward the small alignment hole, and into the flow direction as indicated by the flow arrows.
- 5) To remove the old impeller blade assembly, push the old shaft out of the sleeve with the new shaft (or small diameter rod) just far enough to grab the end with a pair of pliers and pull the shaft completely out. The impeller assembly will now be free, and will drop out.
- 6) Inspect the shaft and bearings for wear, and replace as necessary.
- 7) Refer to Figure 3. To reinstall, position the impeller in the cavity oriented as in Step 4 so that the impeller blades point into the flow direction and toward the small alignment hole located beside one of the sighting holes on metal sensors. For Brass Tee Type the flow direction arrow on the top of the sensor housing should point downstream with the impeller blades pointing upstream.
- 8) Carefully push the shaft through the sleeve and impeller, taking care not to damage bearings. Make sure that the shaft is inserted far enough so that it clears the sleeve on each side of the impeller housing.

NOTE: If shaft is not carefully installed, the bearing can be deformed, preventing free rotation.
- 9) Inspect the O-rings for damage and replace as necessary. Clean the O-rings and the sleeve and lubricate with silicone grease from the packet provided or some other acceptable lubricant.
- 10) Install the sensor into the 2" NPT adapter or tee so that alignment hole is facing upstream and flow arrows point in the direction of the actual flow. Since the positioning collar was not loosened during this operation, the studs should all line up perfectly when the sighting holes are parallel to pipe. If this has been accidentally loosened, please refer to the installation instructions for the alignment of the flow sensor unit.
- 11) Install and tighten the nuts or replace the clevis pin.
- 12) For metal sensors, double check that the distance from the top of the 2" NPT adapter to the bottom of the positioning collar equals the dimension as measured in Step 2, and holes in sleeve sight exactly down the pipe, the arrows point in direction of flow and alignment holes located beside one sighting hole is pointing towards the source. If not, refer to *Installation* section in this manual.
- 13) This completes the replacement procedure. The system may now be repressurized and tested.



Troubleshooting

- 1) Using a voltmeter on the 0-20 VDC scale, connect the voltmeter across the sensor wires which are connected to the sensor input on the barrier strip. The voltage reading should be 8 VDC +/- 0.5 V with no flow in the pipe. If the reading is in range, go to step 2. If not, go to step 3.
- 2) With the sensor installed in the pipe and flow through the pipe, connect the volt meter across the sensor wires at the sensor input of the barrier strip. The voltage should fall between 4 VDC and 8 VDC. The higher the flow rate, the lower the DC voltage level should drop. It should not drop below 4 VDC as your meter averages the DC level of the square wave signal generated by the sensor.

If this is correct, the flow sensor should be operational, and the flow monitor should display a flow rate or the transmitter output should change with a change in flow at the sensor. The signal generated by the sensor is a square wave with 5 msec pulses up to 100 Hz (at which time the pulses narrow to a 50% duty cycle), the use of an oscilloscope on the 5 msec time base, 2 VDC/division would indicate that the sensor is operating properly.

- 3) If the voltage at the sensor input is less than 7 VDC in a No Flow situation or less than 3 VDC in a flow situation, disconnect the sensor from the barrier strip and measure the voltage at the sensor input terminals of the barrier strip again. It should be between 8 VDC and 12 VDC. If the voltage is between 8-12 VDC, the sensor is bad. If the voltage at the sensor input is still below 7 VDC or 3 VDC, the problem may be with the monitor.
- 4) If you suspect that the sensor is bad, you can test the monitor circuitry by connecting a piece of wire to one of the sensor input terminals and tap the other side of the wire to the other sensor input terminal. Shorting across the sensor input terminals ON and OFF repeatedly allows the display to respond by trying to calculate a flow rate for the frequency of your shorting action. If the display does not show a change from 0.00, it indicates a problem with the monitor.
- 5) If the flow sensor wiring is shorted or grounded the blue light on the module may blink continuously. Disconnect the flow sensor wire from the module in the controller. Remove and reinstall the module and the flow rate should return to zero. If secondary surge protection was installed remove it. Check sensor wiring for: 1) damaged insulation; 2) wire nuts must be direct burial type Rain Bird DBRY20 or 3M DBR/Y-6; and 3) sensor should be connected on dedicated PE-39 cable with no other signals in the cable. Fix the wiring and test the system.

Specifications

Sensor Sleeve and Hex Adapter for Brass Insert Sensor (FS350B)

- Sleeve: Admiralty Brass, UNS C44300; Hex Adapter: Valve Bronze, UNS C83600

Sensor Sleeve and Hex Adapter for Stainless Steel Insert Sensor (FS350SS)

- 300 Series Stainless Steel

Tee for FS100B

- Cast valve bronze, UNS C83600

Tee for PVC Tee Sensors (F###P and IFS###BPS)

- Schedule 80 PVC per ASTM D-2462 and D-2467. Virgin, unplasticized PVC resin, Type 1 cell classification 12454-B. Fittings and solvent carry approval for potable water by NSF and IAMPO.

Pressure, Temperature Ratings

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

Recommended Design Flow Range

- 0.5 to 30 ft/sec
- Initial detection below 0.3 ft/sec
- 0.3 to 15 ft/sec for FS100B

Accuracy

- $\pm 1.0\%$ of full scale over recommended design flow range

Repeatability

- $\pm 0.3\%$ of full scale over recommended design flow range
- $\pm 0.7\%$ of full scale over recommended design flow range for FS100B

Linearity

- $\pm 0.2\%$ of full scale over recommended design flow range
- $\pm 0.7\%$ of full scale over recommended design flow range for FS100B

Transducer Excitation

- Typically provided by Rain Bird flow transmitter. Any alternate supply must be of a resistance-limited type meeting the following constraints:
- Source current @ 8 Volts: 1 mA minimum, 20mA maximum
- Short Circuit Current: 200 mA maximum

Output Frequency

- 3.2 Hz to 200 Hz
- 0.8 Hz to 80 Hz for FS100B

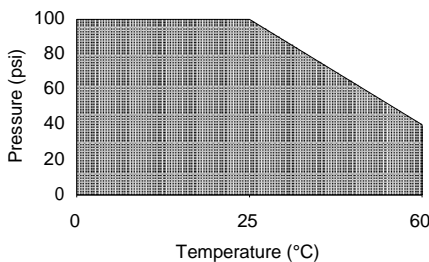
Output Pulse Width

- 5 msec $\pm 25\%$

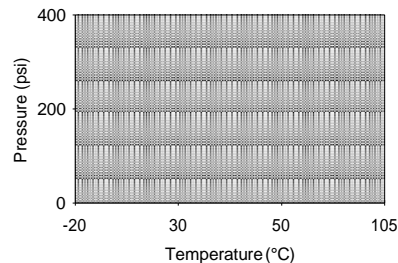
Electrical Cable

- 48 inches of U.L. Style 1056 copper solid AWG 18 wire w/direct burial insulation. Rated to 105°C.

PRESSURE/TEMPERATURE DIAGRAMS FOR RAIN BIRD FLOW SENSORS



FS150P
FS200P
FS300P
FS400P



FS100B
FS350B
FS350SS



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