Flow Sensors

PVC Tee Type Flow Sensors

Models: FS-228-15, FS-228-20, FS-228-30, FS-228-40

USER MANUAL

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⚠ CAUTION

- The K-Rain® style flow sensor described in this manual is not intended for use in safety critical applications. Use of the device in this manner is done at the sole discretion of the customer and/or end user of the device.
- The K-Rain® style flow sensor described in this manual is not intended for use in systems with flammable liquids or gases. Additionally, the device is not intended for systems containing hazardous fluids or fluids other than water.
- The K-Rain® style flow sensor described in this manual must be installed in accordance with all local/federal codes or end-use standards, as applicable.
- If the devices described in this manual are used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

⚠ ATTENTION

- Le capteur de débit de type turbine décrit dans le présent manuel n'est pas destiné à être utilisé dans des applications de sécurité critiques. L'utilisation du dispositif de cette manière se fait à la seule discrétion du client et/ou de l'utilisateur final du dispositif.
- Le capteur de débit de type turbine décrit dans le présent manuel n'est pas destiné à être utilisé dans des systèmes comportant des liquides ou gaz inflammables. En outre, le dispositif est pas destiné à des systèmes contenant des liquides dangereux ou autres que l'eau.
- Le capteur de débit de type turbine décrit dans le présent manuel doit être installé en conformité avec tous les codes locaux et fédéraux ou toutes les normes d'utilisation finale, selon le cas.
- Si les dispositifs décrits dans le présent manuel sont utilisés d'une manière non spécifiée par le fabricant, la protection fournie par l'équipement peut être altérée

MECHANICAL INSTALLATION

Depressurize and vent the piping system prior to any installation or maintenance of the flow sensor.

General Information

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, or other obstructions 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. K-Rain® flow sensors are designed to operate reliably under adverse conditions, but the following recommendations should be followed to ensure maximum system accuracy:

- Choose a location along the pipe 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.
- The preferred location for the sensor around the circumference of a horizontal pipe is at the 12 o'clock position. The sensor should never be located at the bottom of the pipe, as sediment may collect there. Locations off top dead center cause the impeller friction to increase, which may affect performance at low flow rates and increase wear. Any circumferential location is correct for installation in vertical pipes, with rising flow preferred to reduce the effects of any trapped air.

Mechanical Installation Procedure

NOTE: *The intended direction of flow is 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.*

1. Remove the clevis pin and remove the sensor from the tee.
2. Properly clean the pipe ends and tee sockets.
3. Use solvent cement to attach the pipe to the tee.
4. Reinstall the sensor in the tee as follows:
    a. Align the flow arrow on top of sensor housing in the direction of flow.
    b. Carefully press the sensor straight into the tee.
    c. Install the clevis pin through the tee, the sensor, and the conduit cap, and install the cotter ring.

ELECTRICAL INSTALLATION

IMPORTANT: *Disconnect the power from the flow sensor source and/or receiving device prior to any installation or maintenance of the system.*

Flow sensor source and/or receiving device must provide basic isolation from mains for safe operation of the system.

NOTE: *If the sensor has white and black wires instead of red and black,connect the white wire wherever red is indicated.*

Standard Sensors

1. Route the cable from the sensor to a K-Rain® flow monitor/endpoint. The cable may be extended up to 2000 feet (610 m), using 2-conductor shielded 20 AWG (or larger) stranded copper wire. Be sure to leave enough flexibility in the cable or conduit to allow for future service of the sensor, if necessary.
2. When connecting to a K-Rain® flow monitor/endpoint, locate the section of terminal strip on the monitor labeled **SENSOR INPUT** or **SENSOR**. Connect the red (or white) wire to **IN, SIGNAL(+)** or **SIGNAL** terminal, connect the black wire to **GND, SIGNAL(–)** or **COM** terminal, and connect the shield drain wire (if applicable) to **SLD**.
3. When interfacing with other equipment, consult the manufacturer for input designations. The signal wave forms and power requirements are as shown in “Specifications” on page 9.

ELECTRICAL INSTALLATION

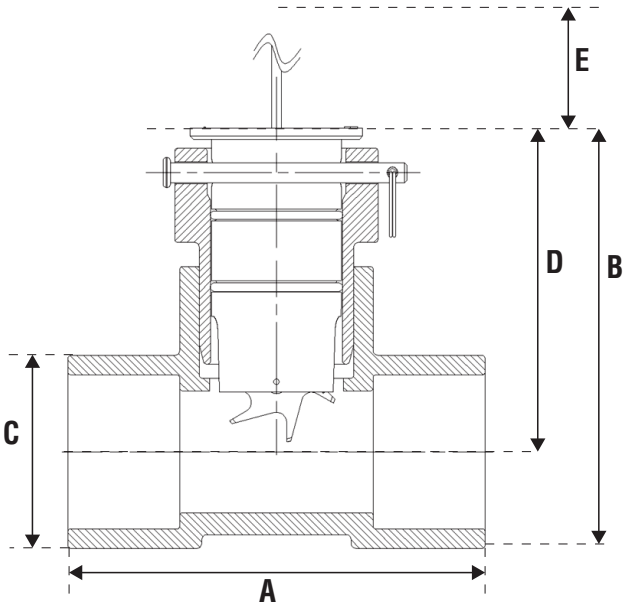
Intrinsically Safe Electrical Installation

Entity approval implies that only the sensor is approved as intrinsically safe. Unless power supplies, equipment, and instruments connected to the sensor are each rated either explosion-proof or intrinsically safe, these devices cannot be installed in a hazardous area. The installation directions here indicate that the apparatus is located in a non-hazardous location. Proper interfacing between the hazardous and non-hazardous areas must be provided. This interface must be constructed and all wiring must be performed by qualified contractors. To make sure the installation is intrinsically safe, the connection of the intrinsically safe sensor to instruments and or power supplies must take place using an approved intrinsically safe barrier located in a nonhazardous area. These barriers, listed below, are readily available from various suppliers.

Manufacturer	Barrier
Crouse-Hinds Spec 504	Cat No. SB19140M0715
Measurement Technology Ltd.	MTL 715+ 15 V
R Stahl Intrinspak	9001/01-158-150-101

DIMENSIONS

Model	FS-228-15	FS-228-20	FS-228-30	FS-228-40
A	5.0 in. (127 mm)	5.63 in. (143 mm)	6.50 in. (165 mm)	7.38 in. (187 mm)
B	5.16 in. (131 mm)	5.64 in. (143 mm)	6.83 in. (173 mm)	6.83 in. (199 mm)
C	2.38 in. (60 mm)	2.88 in. (73 mm)	4.23 in. (107 mm)	5.38 in. (137 mm)
D	3.97 in. (101 mm)	4.20 in. (107 mm)	4.68 in. (119 mm)	5.10 in. (130 mm)
E	5.0 in. (127 mm)	5.0 in. (127 mm)	5.0 in. (127 mm)	5.0 in. (127 mm)



No Fittings

CALIBRATION

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

Column Descriptions

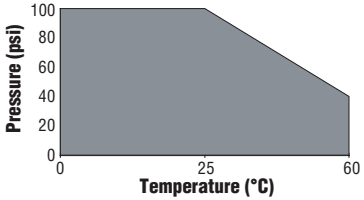
Column	Description
Column 1	Sensor model number
Columns 2 & 3	The K and offset values to use in the frequency equation: $\text{Freq} = \frac{\text{Gpm}}{\text{K}} - \text{offset}$ This equation describes the frequency of the output signal of all K-Rain® flow sensors. By substituting the appropriate K 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 K-Rain® product.
Column 4	This column indicates the suggested flow range of each tee sensor. K-Rain® flow sensors 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. If a lesser flow rate is chosen, an insufficient span exists for the proper operation of these circuits. This can result in excessive ripple and fluctuations in signal, which can adversely affect system performance.

Calibration Table

The table below provides calibration and operation data for K-Rain® plastic tee sensors 1-1/2–4 inches (38–102 mm). See the column descriptions above for additional information.

Column 1 Model for	**Column 2** K	**Column 3** Offset	**Column 4** Suggested Operating Range (GPM)
FS-228-15	1.697	-0.316	5–100
FS-228-20	2.8429	0.1435	10–200
FS-228-30	8.309	13.74283	20–300
FS-228-40	0.227	0.23707	40–500

SPECIFICATIONS

Wetted Materials (except tees)	See Ordering Matrix in the FS-200 Series Product Data Sheet for material specifics.
Tee for FS-200	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 (DO NOT EXCEED)	Depends on hardware configurations. 
Rated Temperature (DO NOT EXCEED)	Operating: 35°–110° F (2°–43° C) Storage 14–110° F (-10°–43° C)
Recommended Design Flow Range	0.5–30 ft/sec
Accuracy	± 1.0% of full scale over rec. design flow range
Repeatability	± 0.3% of full scale over rec. design flow range
Linearity	± 0.2% of full scale over rec. design flow range
Transducer Excitation	Supply voltage = 8V DC min. 35V DC max.
	Quiescent current = 600 µA (typical)
	OFF State (V_{High}) = Supply voltage – (600 µA * Supply impedance)
	ON State (V_{Low}) = 1.2V DC @ 40 mA (15 Ω + 0.7V DC)
Output Frequency	3.2–200 Hz
Output Pulse Width	5 msec ±25%
Environmental	• IP 68 / NEMA 4X • Suitable for pollution degree 4 environments • Suitable for outdoor use above grade, IR version below grade • Suitable for use in 100% humidity
Electrical Cable for Standard Sensor Electronics	20' (6 m) of 2-conductor AWG 20 with AWG 22 drain wire shielded UL type PTLC wire provided for connection to display or endpoint unit. Rated to 221° F (105° C). May be extended to a maximum of 2000' (610 m) with similar cable and insulation appropriate for application.

TROUBLESHOOTING

The FS-200 Series flow sensors are active devices that are most easily tested at the connection point of the controller to which they are connected.

The sensor is essentially a 15 Ohm switch with a 600 uA leakage current. With no flow running (the impeller not turning), the sensor will appear to the controller input as a small current load. When the impeller is turning, it appears a quick series of 5 ms short circuits.

- Before trying to troubleshoot, confirm that the flow rates are well above the minimum recommended flow rates. This will usually purge any air out of the line, and make sure that the impeller is actually spinning in the flow.
- If the controller is not recognizing a flow input from this sensor, test the controller itself by disconnecting the flow sensor, and very quickly and repeatedly short together the two terminals that the flow sensor was connected to. The controller should report some flow. If it does not, the problem is in the controller, and not the flow sensor or the wiring to it.
- If the controller appears to be working while the sensor is still disconnected, measure the open circuit voltage on the controller's sensor input terminals. This voltage must be between 8–24V DC for the sensor to operate. If the voltage is acceptable, reconnect flow sensor and re-measure. Depending on the age of the flow sensor, the voltage should drop slightly. Current production sensors will drop about a volt or so. Sensors manufactured prior to 2001 will drop to about 8V DC. If no drop is observed, the sensor is wired backwards, or there is a break in a wire or splice, or the sensor is open internally. If the voltage drops to near zero, there is either a short in the wiring or splice or the sensor is shorted internally. If the voltage drops below 7V, but not to levels indicating a short, there is most likely moisture penetration or corrosion in the wiring or in the sensor itself.
- If the electrical tests all look normal, you will have to drain the pipe, remove the sensing element, and spin the impeller by hand. It should spin freely and slide smoothly to a stop with no evidence of damage or wear on any of the surfaces. The controller should recognize the signal and report a flow. If it does't, the sensor electronics are no longer operational and must be replaced.
- If the impeller/bearing is simply worn or damaged and signal is observed when the impeller is forced to turn, an impeller repair kit can be installed.

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