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FEATURES

Cover, or transmitter or indicator module
Powder coated aluminum housing
Cable strain relief
PVDF electrode cap
O-ring, EPDM (Fluoroelastomer optional)
Sensor body (Stainless, Brass or PVC)
Hastelloy® electrodes

SPECIFICATIONS*

Pipe Size

Materials Mechanical 316 SS/Brass/PVC
Electrodes Hastelloy®
Housing Cast powder-coated aluminum
Electrode Cap PVDF
O-ring EPDM standard (Fluoroelastomer optional)
Power

Full Power

12 to 25 VDC, 250 mA

Low Power

12 to 25 VDC, 40 mA average with 250 mA peaks

Flow Rate

0.28 to 20 ft/sec (0.08 - 6.09 m/sec)

Temperature

Ambient Temp 0 to 180 °F (-17 to 72 °C)
Fluid Temp: Brass/SS 32 to 200 °F (0 to 93 °C)
Fluid Temp: PVC 32 to 130 °F (0 to 55 °C) @ 0 psi

Pressure

Brass/SS 200 psi (13.8 bar)
PVC 150 psi (10 bar) @ 75 °F

Minimum Conductivity

20 microSiemens/cm

Calibration Accuracy +/- 1% of full-scale

Output

Square wave pulse, opto isolated, 550 Hz @ 20 ft/sec

Empty Pipe Detection

Software, defaults to zero flow

*Specifications subject to change

Hastelloy® is a registered trademark of Haynes International, Inc.
Fitting Installation. EFS2 Series meters require special fittings that ensure that the flow sensor is installed to the correct depth. The fitting must be installed in the pipeline before the meter can be installed. For best results, install with at least ten diameters of straight pipe upstream of the meter and five diameters downstream (or more under specific adverse circumstances). See diagrams, on page 3.

If there is not enough straight run to smooth out the turbulence caused by valves, fittings, and changes in direction, some decrease in accuracy may result. This does not mean that the flow meter’s reading is meaningless, however. In some applications (control systems, valve operation, chemical addition), a repeatable reading may be more important than a highly accurate one.

Although EFS2 Series PVC meter tees are supplied with some straight pipe, additional straight pipe should be added to meet straight pipe recommendations. It is not advisable to connect a flow-disturbing device (e.g., valve or elbow) directly to the end of these fittings.

A PVC fitting is usually installed by solvent welding. The stainless steel and brass meter fittings have female pipe threads, requiring the appropriate male threaded fittings. Saddle or weld fittings (3” and above) require a hole to be cut in the pipe. Recommended hole size is 1-3/4”.

Chemical Injection or Fertigation. When any magmeter, by any manufacturer, is used in a chemical injection application (including fertigation), the chemical injection point must be placed downstream of the magmeter OR far enough upstream for complete mixing to occur before the fluid reaches the meter. When unmixed chemical or fertilizer alternates with water passing through the meter, the rapid changes in conductivity may cause sudden spikes and drops in the meter’s reading, resulting in inaccurate measurement. The magmeter will restabilize, however, with a steady flow of fluid of uniform conductivity.

Caution: Never remove the U-clip retainer when the pipe is under pressure. Always remove pressure from the pipe before you attempt to remove the meter. Removal under pressure may result in damage or serious injury.

Caution: When any magmeter, by any manufacturer, is used in a chemical injection application (including fertigation), the chemical injection point must be placed downstream of the magmeter OR far enough upstream for complete mixing to occur before the fluid reaches the meter. When unmixed chemical or fertilizer alternates with water passing through the meter, the rapid changes in conductivity may cause sudden spikes and drops in the meter’s reading, resulting in inaccurate measurement. The magmeter will restabilize, however, with a steady flow of fluid of uniform conductivity.

Caution: These flow sensors are not recommended for installation downstream of a boiler feedwater pump where installation fault may expose the flow sensor to boiler pressure and temperature. Maximum recommended temperature is 130°F (Plastic), 200°F (Metal).

Caution: In chemical injection or fertigation applications, install chemical injection point downstream of magmeter, or far enough upstream to allow complete mixing of fluids before the meter.

**Meter Installation.** After the meter fitting is installed in the pipeline, the meter can be installed in the fitting. After noting the direction of the flow arrow, press the meter into the fitting as far as it will go. Retain the meter in place by inserting the U-clip. The pin can be installed from either side. It may be necessary to rotate the probe back and forth slightly to start the pin into the slots on the probe. Slide the pin in as far as it will go.

**BEST POSITIONS**

Okay position if there is no air in the pipe

**Caution: In chemical injection or fertigation applications, install chemical injection point downstream of magmeter, or far enough upstream to allow complete mixing of fluids before the meter.**

**Positioning the Meter**

Okay position if there is no air in the pipe

**Caution: These flow sensors are not recommended for installation downstream of a boiler feedwater pump where installation fault may expose the flow sensor to boiler pressure and temperature. Maximum recommended temperature is 130°F (Plastic), 200°F (Metal).**

**Caution: Never remove the U-clip retainer when the pipe is under pressure. Always remove pressure from the pipe before you attempt to remove the meter. Removal under pressure may result in damage or serious injury.**
**FULL PIPE RECOMMENDATIONS**

**Possible Problem:**
- Allows air pockets to form at sensor
- Post-valve cavitation can create air pocket
- Air can be trapped

**Better Installation:**
- Ensures full pipe
- Keeps pipe full at sensor
- Allows air to bleed off

**GROUNDING DIAGRAM**

**General Electrical Guidelines:**

- Whenever possible avoid running control cables in the same conduit with or bundled with AC power.
- Using shielded cable, be sure to connect shield to ground at power supply end of the cable.
- Avoid routing flow sensor cables in close proximity to a variable frequency drive.
- Recommended power and output wiring is shielded twisted pair 18 to 22 AWG control cable.
- Recommended voltage is 12 to 24 Vdc. Note that unregulated power supplies can vary from nameplate voltage by a considerable amount, especially with AC line voltage fluctuation. Therefore 24V power supplies must be regulated.

See the Connections diagrams on pages 6 & 7 for the appropriate terminals.

**Power:**
A 12 to 24 Vdc power supply capable of at least 250 mA current output is needed.

**Forward Flow Output:**
This open-collector isolated output does not supply power. This pulse is generated in the forward flow direction on the standard unit. (Reverse flow output is available as an option).

**Reverse Flow Output:**
Reverse flow output is available as an option. This open-collector isolated output does not supply power. It functions like a polarity-sensitive switch closure. Note: This output is limited to 6 mA at 30 Vdc maximum.

**Grounding Guidelines:**
For best results, use a good quality earth ground, such as metallic water piping or a driven ground, to ensure a good connection to earth ground and good noise suppression.

For Metallic Pipe:
- For optimum connection, clamp wire to the piping a short distance to one side of the flow sensor using an electrical grounding clamp. Connect the wire to the earth ground and to one of the housing screws.

For Non-Metallic Pipe:
- Connect a wire from the housing screws to a good earth ground, such as metallic water piping or a rod driven into the ground, as shown in the “Grounding Diagram” below.

**Series EFS2 & IEFS meters are usually unaffected by moderate levels of electrical noise. In some applications performance may be improved by taking the following steps:**

- Use shielded twisted pair cable (Belden 8723 or equivalent above ground or Alpha 35482 or equivalent burial).
- Clamp a ferrite bead (Steward 28A2029-OAO or equivalent) on meter signal/power wire within 3/4” of the meter strain relief (tape or tie wrap in place if necessary). See diagram below.
- **IMPORTANT** - Connect the cable shield ground wire to ground, ONLY at power supply end of cable.
CONNECTIONS DIAGRAMS

COUNTER OR PLC

<table>
<thead>
<tr>
<th>Power</th>
<th>12 to 24 Vdc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Output</td>
<td>Max. 6 mA, 30 VDC</td>
</tr>
<tr>
<td>Reverse Output</td>
<td>Max. 6 mA 30 VDC</td>
</tr>
</tbody>
</table>

*See Dual RTI Diagram for an example of bidirectional connections.

SERIES BAT 4 to 20 mA OUTPUT

<table>
<thead>
<tr>
<th>Power</th>
<th>24 VDC Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Output</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>Reverse Output</td>
<td>4 to 20 mA</td>
</tr>
</tbody>
</table>

*See Dual RTI Diagram for an example of bidirectional connections.

RTI DISPLAY AND 4 to 20 mA OUTPUT

<table>
<thead>
<tr>
<th>Power</th>
<th>24 VDC Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Output</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>Reverse Output</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>Series EFS2</td>
<td>4 to 20 mA</td>
</tr>
</tbody>
</table>

*See Dual RTI Diagram for an example of bidirectional connections.

RTI DISPLAY AND PROPORTIONAL FEED

<table>
<thead>
<tr>
<th>Power</th>
<th>24 VDC Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Output</td>
<td>To Proportional Feed</td>
</tr>
<tr>
<td>Reverse Output</td>
<td>Metering Pump</td>
</tr>
<tr>
<td>Series RTI</td>
<td>Pulse Scaled</td>
</tr>
</tbody>
</table>

*Requires 12 to 24 Vdc power source.

SERIES RTI DISPLAYS

DUAL SERIES RTI DISPLAYS

(Example of Bidirectional Connection)

SERIES RTI | Power 4 to 20mA |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse Scaled</td>
<td>Forward Output</td>
</tr>
<tr>
<td>Sensor Input</td>
<td>Reverse Output</td>
</tr>
<tr>
<td>Series EFS2</td>
<td>Power 4 to 20mA</td>
</tr>
</tbody>
</table>

*Requires 12 to 24 Vdc power source.
Zero Adjustment. When the EFS2 Series is powered up and there is no flow, there should be no output pulses (or, if connected to the RTI, flow rate should read “0”). If there are pulses it may be necessary to adjust the flow meter under no-flow conditions after it has been installed. This should only be done if the indicated flow is low, near the lower cutoff.

To perform the adjustment, after determining that there is a full pipe with no flow, create a short between the two pins marked “Zero Adjust”. Once the red LED light comes on for approximately 50 seconds and then goes out, the zero adjustment is completed.

Minimum Flow. As with any other flow sensor, there is a rate below which the EFS2 Series sensor cannot read. Check the flow rate table below for the minimum flow rate detectable by the sensor for a given pipe size.

<table>
<thead>
<tr>
<th>Normal Pipe Size</th>
<th>3”</th>
<th>4”</th>
<th>6”</th>
<th>8”</th>
<th>10”</th>
<th>12”</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC/Steel (Sch. 40)</td>
<td>70.397</td>
<td>40.985</td>
<td>18.110</td>
<td>10.497</td>
<td>6.674</td>
<td>4.709</td>
</tr>
<tr>
<td>PVC/Steel (Sch. 80)</td>
<td>76.748</td>
<td>45.360</td>
<td>20.944</td>
<td>11.495</td>
<td>7.322</td>
<td>5.184</td>
</tr>
<tr>
<td>Stainless Steel (10S)</td>
<td>62.381</td>
<td>36.626</td>
<td>16.570</td>
<td>9.642</td>
<td>6.175</td>
<td>4.573</td>
</tr>
<tr>
<td>Stainless Steel (40S)</td>
<td>70.397</td>
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<td>18.110</td>
<td>10.497</td>
<td>6.674</td>
<td>4.709</td>
</tr>
<tr>
<td>Copper Tubing (Type L)</td>
<td>76.371</td>
<td>45.519</td>
<td>19.513</td>
<td>11.201</td>
<td>7.230</td>
<td>5.016</td>
</tr>
<tr>
<td>Copper Tubing (Type K)</td>
<td>78.371</td>
<td>46.638</td>
<td>20.223</td>
<td>11.622</td>
<td>7.500</td>
<td>5.239</td>
</tr>
<tr>
<td>Brass Pipe</td>
<td>70.672</td>
<td>41.517</td>
<td>17.778</td>
<td>10.445</td>
<td>6.674</td>
<td>4.661</td>
</tr>
</tbody>
</table>

Presence of Flow Indication. To assist in troubleshooting, the “Status LED” has two blinking modes in normal operation. When there is no flow detectable by the meter (below minimum threshold) the LED blinks every 8.0 seconds. When there is detectable flow, the same indicator blinks every 3.0 seconds.

Filtering. The software of the EFS2 Series sensor filters out electrical noise and averages sudden variations in the flow to smooth the output. It takes a matter of seconds for the flow sensor to get up to full output when it is powered up or when flow begins.

Calibration ("K-factor"). The K-factor represents the actual number of pulses per gallon the meter produces during a flow test. This number can be entered into your electronic control to make it read properly. If the EFS2 Series meter is ordered with a saddle fitting, it is factory-calibrated in the fitting and the K-factor is indicated on the side of the fitting (see diagram).

To assist in troubleshooting, find your K-factor in the chart below.

<table>
<thead>
<tr>
<th>K-Factors Saddles &amp; Weldolets</th>
<th>3”</th>
<th>4”</th>
<th>6”</th>
<th>8”</th>
<th>10”</th>
<th>12”</th>
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NOTE: K-factors are in Pulses/gallon. For Pulses/Liter, divide by 3.785.

Electrode Coating. Grease or other adhering, non-conductive materials can stop flow detection if the electrodes become heavily coated. To clean the electrodes, remove the sensor from the pipe and gently scrub the electrodes (three silver bumps) on the reading face of the flow sensor. A mild soap (dishwashing liquid for example) can be used to aid the cleaning process.

Problem Probable Cause Try...

| Troubleshooting |  |
|-----------------|-----------------|-----------------|
| Output pulses incorrect | Missing or incorrect ground wire | Check for proper ground |
| | Excessive electrical noise | Check for proper electrical wiring |
| | Fluid conductivity <20 microSiemens/cm | Select another flow meter |
| | Empty pipe | Check for full pipe or install meter in the vertical position |
| | Not enough straight pipe | Check for ten diameters upstream AND five diameters downstream |
| Jumpy reading | Rapidly changing conductivity (in chemical injection or fertigation applications) | Install chemical injection line downstream of magmeter (or far enough upstream to allow complete mixing of fluids before meter) |

NOTE: The electronics of the EFS2 Series meters are not field-repairable. Warranty is void if unauthorized repair is attempted.
WARRANTY/RETURN

Refer to "Terms and Conditions of Sale" in our catalog or on our website. Contact customer service to receive a Returns Goods Authorization number before shipping your product back for repair. Be sure to include a brief description of the problem plus any relevant application notes.