Vertical Flow Sensors

FV4 Series

- Senses increasing or decreasing flow in gas systems
- Actuates an electrical switch at a predetermined flow range
- Welded 316L SS construction
- Working pressures up to 5000 psig (344 bar)
Features
- Models can be selected to sense either increasing flow or decreasing flow.
- Snap-action float provides positive actuation.
- All-welded construction ensures fluid containment.
- High-strength, permanent magnet and 316L SS materials enhance durability.
- Replaceable switch assembly outside flow path eases maintenance.

Operation
The Swagelok FV4 series flow sensor contains a float with a calibrated orifice that moves up or down in the float guide as flow increases or decreases. A magnet encased in the float above the orifice alternates electrical continuity between the black and the red leads of the adjacent reed switch.

Increasing Flow—Float Down
During normal flow, the float is down at the bottom of the sensor body and electrical continuity is through the red lead of the switch.

When flow increases to within the actuation range:
- differential pressure across the float orifice snaps the float up to the top of the float guide
- continuity switches to the black lead.

As flow returns to normal:
- the float drops down to the bottom of the sensor body
- the magnet draws the common reed to the red lead
- continuity switches to the red lead.

Decreasing Flow—Float Up
During normal flow, the float is up at the top of the float guide and electrical continuity is through the black lead of the switch.

When flow decreases below the actuation range:
- the float drops down to the bottom of the sensor body
- the magnet draws the common reed to the red lead
- continuity switches to the red lead.

As flow returns to normal:
- differential pressure across the float orifice snaps the float up to the top of the float guide
- continuity switches to the black lead.

Wetted components listed in italics.

<table>
<thead>
<tr>
<th>Component</th>
<th>Material Grade/ASTM Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Body</td>
<td>316L SS/A479</td>
</tr>
<tr>
<td>2 Float guide</td>
<td></td>
</tr>
<tr>
<td>3 Float</td>
<td></td>
</tr>
<tr>
<td>4 Magnet</td>
<td>Samarium cobalt</td>
</tr>
<tr>
<td>5 Retaining ring</td>
<td>300 stainless steel</td>
</tr>
<tr>
<td>6 Capsule</td>
<td>Plastic</td>
</tr>
<tr>
<td>7 Reed switch</td>
<td>Mixed, including epoxy sealant</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reed Switch</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Single-pole, double-throw, 3-wire/2-position</td>
</tr>
<tr>
<td>Contact Rating</td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>3 W max</td>
</tr>
<tr>
<td>Voltage</td>
<td>100 V (dc) max</td>
</tr>
<tr>
<td>Switching current</td>
<td>250 mA max</td>
</tr>
<tr>
<td>Initial contact resistance</td>
<td>0.200 Ω max</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cable Leads</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire</td>
<td>22 AWG, 7/30, 80°C, 300 V PVC</td>
</tr>
<tr>
<td>Jacket</td>
<td>36 in. (91.4 cm) Common</td>
</tr>
<tr>
<td>Length</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>Normally closed</td>
</tr>
<tr>
<td>Black</td>
<td>Normally open</td>
</tr>
</tbody>
</table>
**Flow, Sizing, and Selection**

**Sizing to Sense Increasing Flow**
Size the float to actuate the switch after flow **exceeds** the maximum rate.

**Increasing Flow**

- **System Pressure, bar**
- **Nitrogen Flow, std L/min**
- **Actuation Range**

Example:
- **Nitrogen** process gas
- **8 std L/min** maximum system flow rate
- **100 psig (6.8 bar)** system pressure
  1. Using the **Increasing Flow** graph, find the intersection of the system pressure (100 psig [6.8 bar]) and the maximum system flow rate (8 std L/min). ▲
  2. Locate the range directly **above** the intersection point (Range C).
  3. Insert C into the sensor ordering number.
  Example: 6L-FV4C-S4

**Cleaning and Packaging**
All FV4 series flow sensors are processed in accordance with Swagelok Special Cleaning and Packaging (SC-11), MS-06-63, to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C.

**Testing**
Every FV4 series flow sensor is tested for proper operation and is helium leak tested at the envelope to a maximum leak rate of 4 x 10^-9 std cm^3/s.

**Installation**
- △ The FV4 series flow sensor must be installed in a vertical orientation with the arrow pointing up.

**Sizing to Sense Decreasing Flow**
Size the float to actuate the switch before flow **drops below** the minimum rate.

**Decreasing Flow**

- **System Pressure, psig**
- **Nitrogen Flow, std L/min**
- **Actuation Range**

Example:
- **Nitrogen** process gas
- **10 std L/min** normal system flow rate
- **4 std L/min** minimum system flow rate
- **20 psig (1.3 bar)** system pressure
  1. Using the **Decreasing Flow** graph, find the intersection of the system pressure (20 psig [1.3 bar]) and the minimum system flow rate (4 std L/min). ◆
  2. Locate the range directly **above** the intersection point (Range C).
  3. Using the **Increasing Flow** graph, find the intersection of the system pressure (20 psig [1.3 bar]) and the normal system flow rate (10 std L/min).
    - Verify that the range identified in Step 2 (Range C) is below the intersection point.
  4. Insert C into the sensor ordering number.
  Example: 6L-FV4C-T4A

**Sizing for Other Gases**
To size the float for gases other than **nitrogen**, multiply the process gas flow rate by the density correction factor \( F_d \) to obtain equivalent nitrogen flow rates.

\[
F_d = \sqrt{\frac{MW_{\text{process}}}{28}}
\]

Proceed with sizing as described above.

\( MW_{\text{process}} \) = molecular weight of process gas.
**Safe Product Selection**
When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

**Caution:** Do not mix or interchange parts with those of other manufacturers.

**Ordering Information and Dimensions**
Dimensions, in inches and (millimeters), are for reference only and are subject to change.

For a complete ordering number, insert the actuation range designator A, B, C, or D (see graphs on page 3) into the basic ordering number.

Example: 6L-FV4A-S4

<table>
<thead>
<tr>
<th>End Connections</th>
<th>Basic Ordering Number</th>
<th>Dimensions in. (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Size</td>
<td>H</td>
</tr>
<tr>
<td>Swagelok tube fittings</td>
<td>1/4 in.</td>
<td>6L-FV4__-S4</td>
</tr>
<tr>
<td></td>
<td>6 mm</td>
<td>6L-FV4__-S6M</td>
</tr>
<tr>
<td>Male VCR® fittings</td>
<td>1/4 in.</td>
<td>6L-FV4__-VR4</td>
</tr>
<tr>
<td>Female to male VCR fitting</td>
<td>1/4 in.</td>
<td>6L-FV4__-FR4-VR4</td>
</tr>
<tr>
<td>Tube extensions</td>
<td>1/4 × 0.035 in.</td>
<td>6L-FV4__-T4A</td>
</tr>
<tr>
<td></td>
<td>6 × 1 mm</td>
<td>6L-FV4__-T6MA</td>
</tr>
</tbody>
</table>

Dimensions shown with Swagelok tube fitting nuts finger-tight.

**Accessories**

**Reed Switch Kit**
Replacement switch kit includes switch assembly, retaining ring, assembly tool, and assembly instructions.

Ordering number: MS-SRK-FV4

**Oxygen Service Hazards**
For more information about hazards and risks of oxygen-enriched systems, see the Swagelok Oxygen System Safety technical report, MS-06-13.

**Warranty Information**
Swagelok products are backed by The Swagelok Limited Lifetime Warranty. For a copy, visit swagelok.com or contact your authorized Swagelok representative.