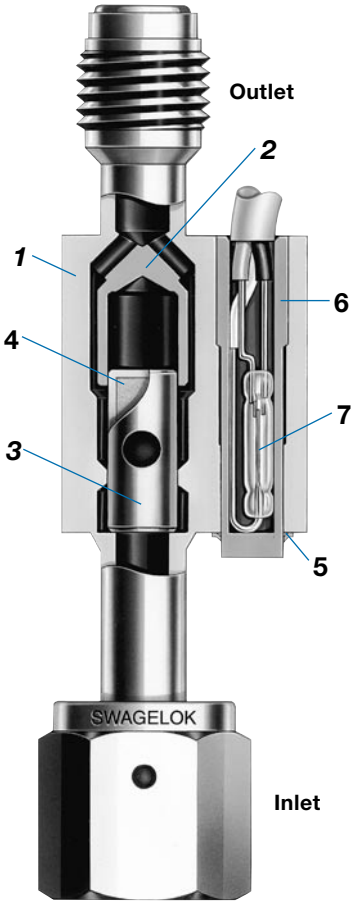
# Vertical Flow Sensors


## 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)

Swagelok

## Materials of Construction




| Component | Material Grade/ ASTM Specification |
|---|---|
| **1** *Body* | *316L SS/A479* |
| **2** *Float guide* | |
| **3** *Float* | |
| **4** Magnet | Samarium cobalt |
| **5** Retaining ring | 300 stainless steel |
| **6** Capsule | Plastic |
| **7** Reed switch | Mixed, including epoxy sealant |

Wetted components listed in *italics*.

| Reed Switch | |
|---|---|
| **Type** | |
| Single-pole, double-throw, 3-wire/2-position | |
| **Contact Rating** | |
| Power<br>Voltage<br>Switching current<br>Initial contact resistance | 3 W max<br>100 V (dc) max<br>250 mA max<br>0.200 Ω max |
| **Cable Leads** | |
| Wire<br>Jacket<br>Length<br>White<br>Red<br>Black | 22 AWG, 7/30, 80°C, 300 V<br>PVC<br>36 in. (91.4 cm)<br>Common<br>Normally closed<br>Normally open |

## 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.

## Technical Data

### Pressure-Temperature Ratings

| Material | 316L SS |
|---|---|
| **Temperature** °F (°C) | **Working Pressure** psig (bar) |
| –40 (–40) to 100 (37)<br>175 (79) | 5000 (344)<br>4415 (304) |

### Flow Coefficient—0.5

## 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*

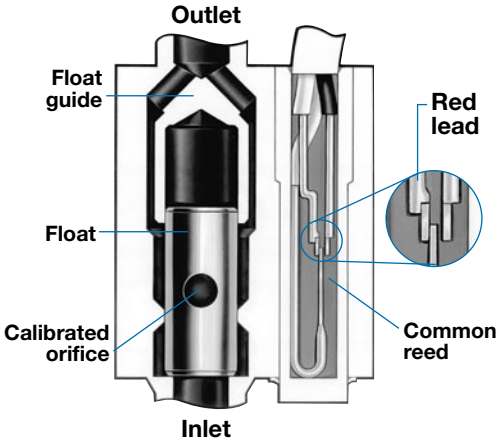
During normal flow, the float is *down* at the bottom of the sensor body and electrical continuity is through the **red** lead of the switch.

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*

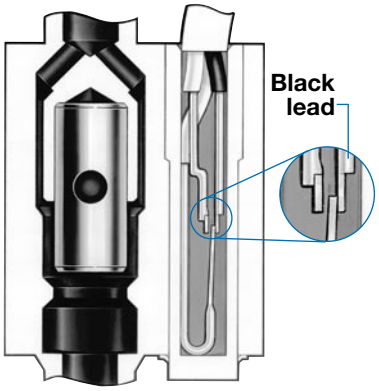
During normal flow, the float is *up* at the top of the float guide and electrical continuity is through the **black** lead of the switch.

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.

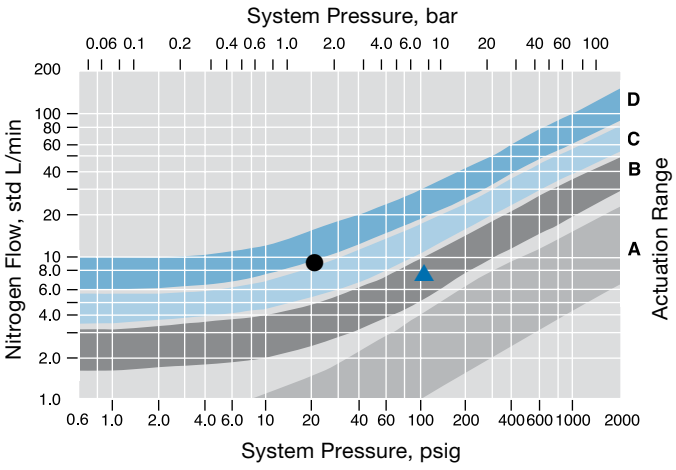


# Flow, Sizing, and Selection

## Sizing to Sense Increasing Flow

Size the float to actuate the switch after flow **exceeds** the maximum rate.

### *Increasing Flow*




Example:

**Nitrogen** process gas

**8 std L/min** maximum system flow rate

**100 psig (6.8 bar)** system pressure

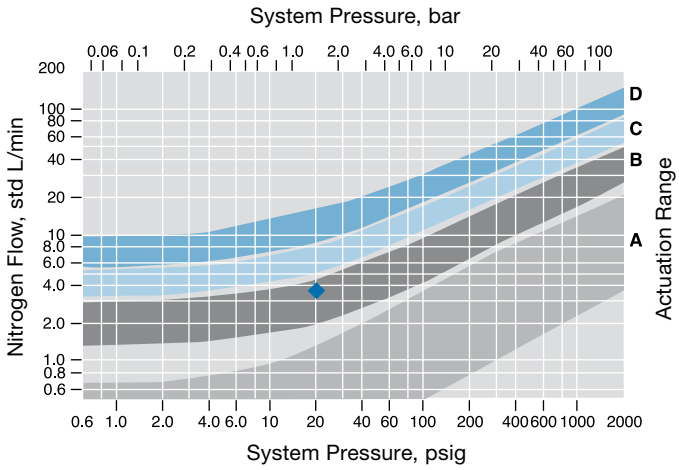
1. Using the **Increasing Flow** graph, find the intersection of the system pressure (100 psig [6.8 bar]) and the maximum system flow rate (8 std L/min). ▲
2. Locate the range directly **above** the intersection point (Range **C**).
3. Insert **C** into the sensor ordering number.

Example: 6L-FV4**C**-S4

## Sizing to Sense Decreasing Flow

Size the float to actuate the switch before flow **drops below** the minimum rate.

### *Decreasing Flow*




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-FV4**C**-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.

$$F_d = \sqrt{\frac{MW_{process}}{28}}$$

Proceed with sizing as described above.

$MW_{process}$ = molecular weight of process gas.

# Cleaning and Packaging

All FV4 series flow sensors are 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 $4 \times 10^{-9}$ std $cm^3/s$.

# Installation

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

## Ordering Information and Dimensions

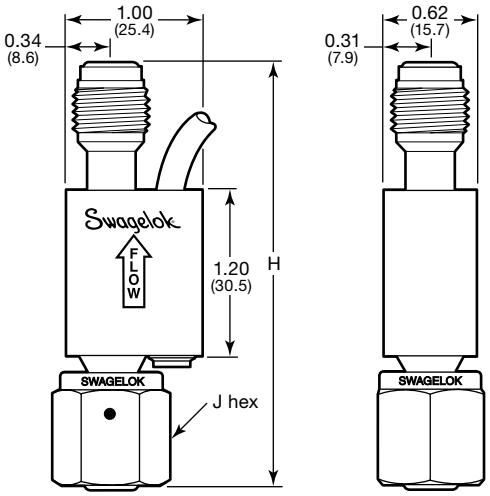
Dimensions, in inches and (millimeters), are for reference only and are subject to change.

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-FV4**A**-S4

| End Connections | | Basic Ordering Number | Dimensions in. (mm) | |
|---|---|---|---|---|
| **Type** | **Size** | | **H** | **J** |
| Swagelok tube fittings | 1/4 in. | 6L-FV4__-S4 | 3.68 (93.4) | 9/16 |
| | 6 mm | 6L-FV4__-S6M | | (14) |
| Male VCR® fittings | 1/4 in. | 6L-FV4__-VR4 | 3.10 (78.7) | — |
| Female to male VCR fitting | 1/4 in. | 6L-FV4__-FR4-VR4 | | 3/4 |
| Tube extensions | 1/4 × 0.035 in. | 6L-FV4__-T4A | 3.19 (81.0) | — |
| | 6 × 1 mm | 6L-FV4__-T6MA | | |

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.

**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.**

## Warranty Information

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