Variable Area Flowmeters
Installation Instructions
G Series and M Series

Glass-tube models, G series

Metal-tube models, M series

Contents

Safety Definitions

Potential danger to life or of serious injuries.

Potential for personal injury from electrical shock.

Safety Information

Swagelok variable area flowmeters must be installed, operated, and serviced according to NEC, applicable local regulations, and these instructions. Otherwise, serious personal injuries, damage, or both can occur.

The electrical connections provided on any electronic relays should be used as originally supplied and not bypassed or modifed (other than wire length). Only qualified personnel should work on these products.

Safe Product Use

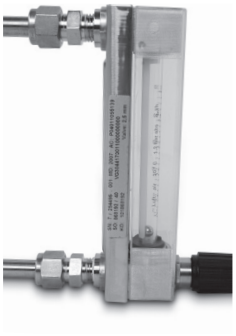
Follow any enclosed instructions and refer to the product catalog for detailed product information. When using a variable area flowmeter, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user. **Improper selection or misuse of the product may result in serious personal injury or property damage**.

Installation

For optimal performance, prior to installation:

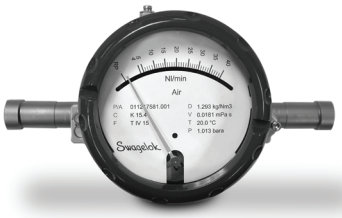
- flush out the pipe or tube leading to the flowmeter.
- For gas flow applications, dry the pipe or tube leading to the flowmeter.

The variable area flowmeter must be installed as vertically as possible to ensure the most accurate flow reading, with the exception of the Swagelok MH horizontal model.



G Series
Vertical Mount

Direction of flow is from bottom to top in vertical models and can be either right to left or left to right in horizontal models, as specified when ordering.



Left-to-right
Horizontal
Mount

Align the pipe or tube leading to and from the flowmeter axially with the connections on the flowmeter to keep them free of stress.
If necessary, support the pipe or tube leading to and from the flowmeter to prevent vibration being transmitted to the flowmeter.

Startup

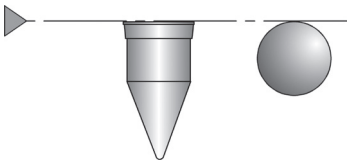
1. For accurate flow measurement, the system media, pressure, and temperature should be consistent with the calibration of the flowmeter.
2. Close the integral metering valve on the flowmeter before the system is pressurized.
   Note: M4 and M4H models do not contain an integral metering valve.
3. Open the shutoff valves upstream and downstream of the flowmeter.
4. Add system pressure slowly.

   NOTICE
   Open the metering valve slowly when starting the flow to prevent damage to the float.
5. Adjust the metering valve until the flowmeter shows the desired flow rate.

Reading the Flowmeter

Glass-Tube Models

Glass-Tube flowmeters are read by the position of the float or ball within the flowmeter tube. The flow rate is read at the upper, top edge of the float or ball.



Metal-Tube Models

The flow rate is read with the pointer on the scale or the LED display.

Reading the Flowmeter using a Conversion Factor

Flowmeters calibrated for one fluid at a specific pressure and temperature can be used to measure other fluids and different pressures and temperatures by using a conversion factor.
Use the following equation to calculate the conversion factor. Multiply the conversion factor by the flowmeter reading for flowmeters in gas service to determine the flow rate for the new conditions.

$$F = \sqrt{\frac{\rho_{cal}}{\rho_{new}}} \times \sqrt{\frac{P_{new}}{P_{cal}}} \times \sqrt{\frac{273 + T_{cal}}{273 + T_{new}}}$$

where

F = conversion factor
ρ_{cal} = fluid density of calibrated scale
ρ_{new} = new fluid density
P_{cal} = pressure (in standard condition) of calibrated scale
P_{new} = new pressure (in standard condition)
T_{cal} = temperature of calibrated scale, in °C
T_{new} = new temperature, in °C
Note: For temperatures in °F, replace 273 in equation with 460.

Example

Calibrated scale:	*New fluid or conditions:*
ρ = 1.5 kg/m^3	ρ = 1.5 kg/m^3
P = 7 bar (abs)	P = 10 bar (abs)
T = 30°C	T = 60°C

$$F = \sqrt{\frac{1.5}{1.5}} \times \sqrt{\frac{10}{7}} \times \sqrt{\frac{273 + 30}{273 + 60}} = 1.14$$

Multiply 1.14 by the calibrated scale to determine the flow rate.

Example:

The flowmeter reading is 100 NL/h or 3.8 SCFH.

100 NL/h $\times$ 1.14 = 114 NL/h

3.8 SCFH $\times$ 1.14 = 4.3 SCFH

Use the following equation to calculate the conversion factor for flowmeters in liquid service. Multiply the conversion factor by the flowmeter reading to determine the flow rate for the new conditions.

F = square root (ρ_{cal} / ρ_{new})

A conversion factor in case of viscosity change cannot be given in a simplified formula like for the density change. The conversion factor for viscosity change is based on arrays of characteristic measurement curves. Please contact the supplier.

Limit Switches

⚠ **Do not wire limit switches for initial installation while system is in operation.**

Up to two limit switches compliant with IEC 60947-5-6 (NAMUR EN 60947-5-6) may be connected to the flowmeter. Connect the limit switch(es) to the desired monitoring device.

Note: When using two limit switches, space the limit switches a mininum of 0.63 in. (16 mm) apart.

Note: Any flowmeter with a limit switch installed must be kept a minimum of 0.24 in. (6 mm) from any moving object containing nickel, iron or cobalt.

Wiring a Limit Switch Without a Junction Box

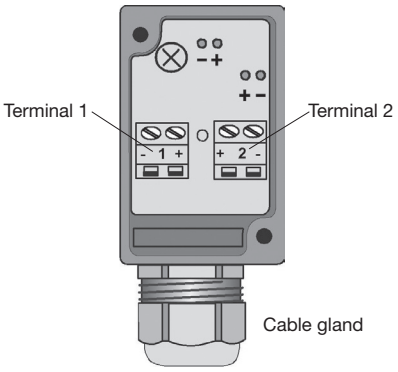
All Models

1. Connect the brown wire extending from the flowmeter/limit switch assembly to the positive (+) input of the monitoring device.
2. Connect the blue wire extending from the flowmeter/limit switch assembly to the negative (–) input of the monitoring device.

Wiring a Limit Switch With a Junction Box

Glass-Tube Models

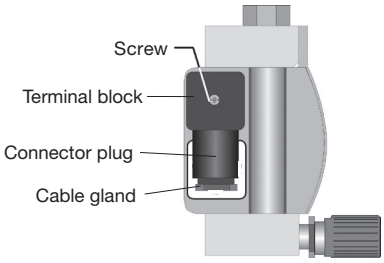
1. Loosen screws and remove the front cover of the junction box.
2. Feed the connecting cable (max 16 AWG or 1.31 mm^2) through the **cable gland** and screw down the cable gland.
3. Connect the positive and negative wires.
   Note: When using one limit switch only, wire to **Terminal 1**.
   When using two limits switches, wire the lower switch to **Terminal 1** and the upper switch to **Terminal 2**.



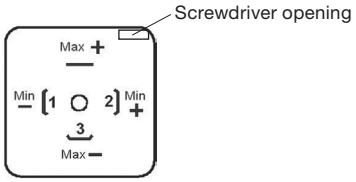
Metal-Tube Models

M1 Model

1. Loosen the **screw** on the **connector plug** and remove the plug from the junction box.

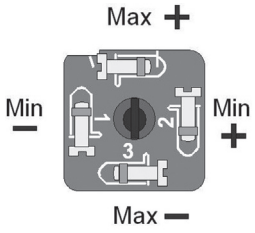


2. Remove the screw from the plug.
3. Place a screwdriver in the **opening**, lift and remove the **terminal block**.



4. Feed the connecting cable (max 16 AWG or 1.31 mm^2) through the **cable gland** of the plug and screw down the cable gland.

5. Connect the wires to the positive and negative locations on underside of the terminal block for the minimum, maximum, or both.

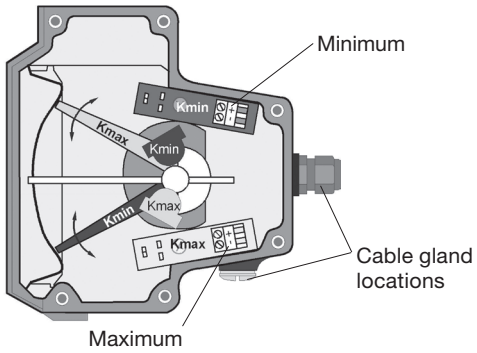


6. Reinstall the terminal block into the plug, snapping in place.
7. Reinstall plug onto junction box and replace the screw. Tighten screw.

M2 Model

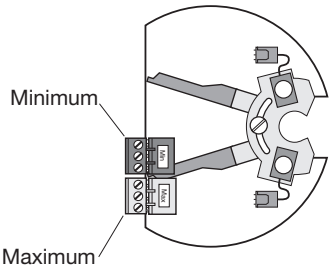
1. Remove the screws and cover from the flowmeter.
2. Feed the connecting wires through the **cable gland** (max 16 AWG) and screw down the cable gland.
3. Connect the wires to the positive and negative locations of the **minimum**, **maximum**, or both.
4. Replace the cover and tighten the screws.

M2 Model



M4 and M4H Models

1. Open the housing by turning the cover counterclockwise with the help of the enclosed plastic wrench.
2. Feed the connecting wires through the **cable gland** (max 16 AWG) and screw down the cable gland.
3. Connect the wires to the positive and negative locations of the **minimum**, **maximum**, or both.
4. Close the housing by turning the cover clockwise with the help of the enclosed plastic wrench.

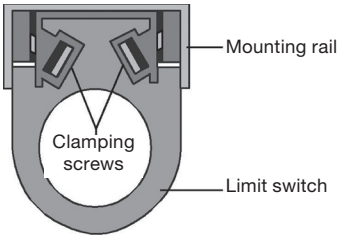


Adjusting a Limit Switch

Limit switches can be adjusted after installation or set during operation.

Glass-Tube Models

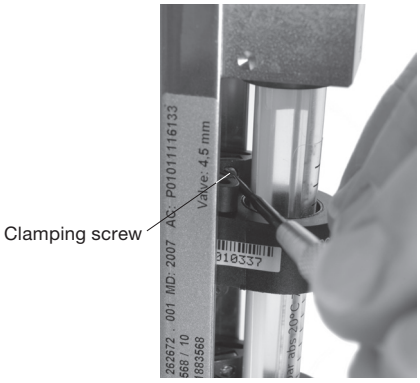
1. Remove the cover from the flowmeter.
2. Loosen the two **clamping screws** fastening the



limit switch to the **mounting rail** of the flowmeter.

3. Slide the limit switch along the mounting rail to set the top for a minimum switch, the bottom for a maximum switch, or both if two switches are installed.

   Note: When setting the limit switch, lay the wires so they won't get damaged during use.



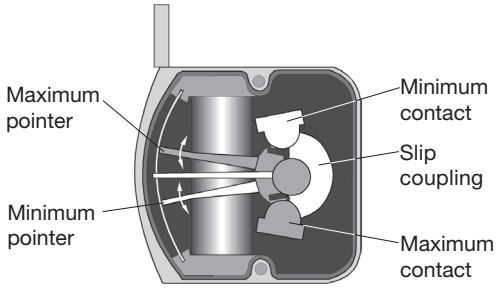
4. Tighten the **clamping screws**.
5. Replace the cover.

Metal-Tube Models

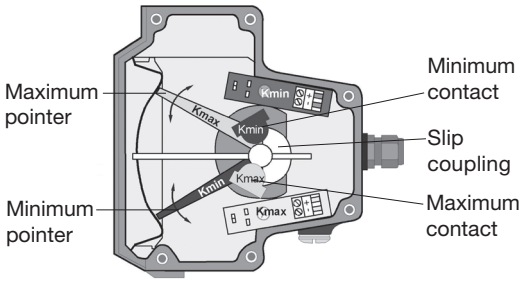
M1 and M2 Models

1. Remove the screws and cover from the flowmeter.
2. Slide the **minimum contact**, **maximum contact**, or both along the **slip coupling** to set the corresponding pointers to the desired limit on the scale.
3. Replace the cover and tighten the screws.

M1 Model



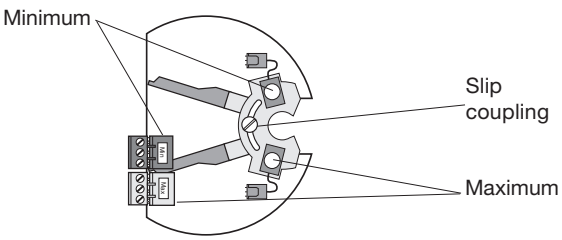
M2 Model



M4 and M4H Models

1. Open the housing by turning the cover counterclockwise with the help of the enclosed plastic wrench.
2. Slide the **minimum contact**, **maximum contact**, or both along the **slip coupling** to set the corresponding pointers to the desired limit on the scale.
3. Close the housing by turning the cover clockwise with the help of the enclosed plastic wrench.

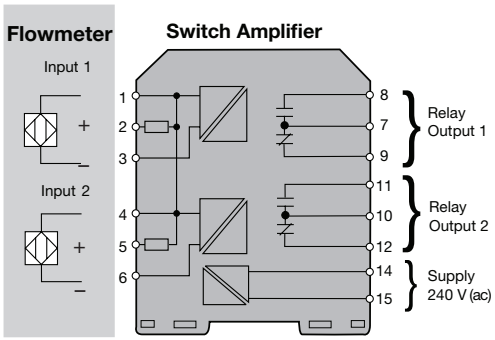
M4 and M4H Models



Wiring Limit Switch to a Switch Amplifier With Isolated Relay Output

⚠ **Do not wire limit switches for initial installation while system is in operation.**

Note: The limit switch wires are brown (+) and blue (–).
Note: Additional diagram information is provided for the switch amplifier by the manufacturer.

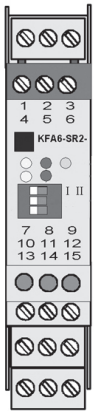


Connection to Customer Switch Amplifier

Connection to Swagelok-Offered Switch Amplifier

One Limit Switch

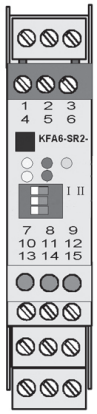
1. Connect the limit switch to slot 1 (+) and slot 3 (–) of the transistor relay.
2. Connect the outputs of the limit switch to slot 7 and slot 8 for a signal when flow is above the limit switch setting (normally open) or to slot 7 and slot 9 for a signal when flow is below the setting (normally closed).
3. Connect alternating current power to slot 14 (+) and



slot 15 (-).

Connection to Swagelok-Offered Switch Amplifier Two Limit Switches

1. Connect the minimum limit switch to slot 1 (+) and slot 3 (–) of the transistor relay.
2. Connect the maximum limit switch to slot 4 (+) and slot 6 (–).
3. Connect the outputs of the minimum limit switch to slot 7 and slot 8 for a signal when flow is above the limit switch setting (normally open) or to slot 7 and slot 9 for a signal when flow is below the setting (normally closed).
4. Connect the outputs for the maximum limit switch to slot 10 and slot 11 for a signal when flow is above the limit switch setting (normally open) or to slot 10 and slot 12 for a signal when below the setting



(normally closed).

5. Connect alternating current power to slot 14 (+) and slot 15 (–).

4 to 20 mA Output Signal

⚠ Do not wire output signal for initial installation while system is in operation.

This 2-wire system connects the power supply, flowmeter, and monitoring device in a series circuit. This creates a “current loop” with the flowmeter functioning as a measurement device.
The 4 to 20 mA interface requires an auxillary power of 14.8 to 30 V (dc). Swagelok suggests use of a 24 V (dc) power supply.

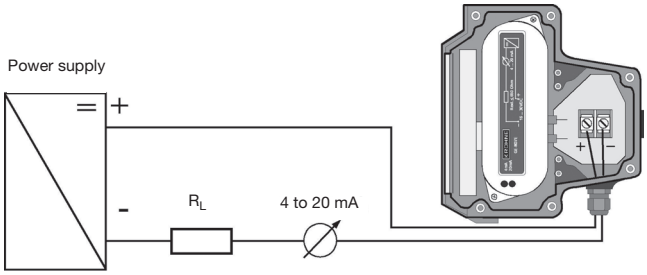
Maximum Load Equations

Milliampere Output Signal, 2-Wire

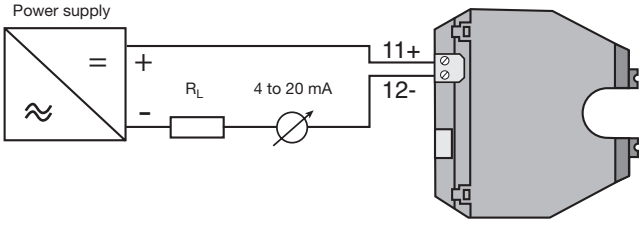
Output	4 to 20 mA
Supply	V = 14.8 to 30 V (dc)
Max load	R_L = (V [dc] – 14.8) / 0.02
Terminals	See drawings

The output will be proportional to the measured flow based on the scale on the flowmeter. Wire the loop according to the appropriate diagram below.

M2 Model



M4 and M4H Models



For product technical data, including materials of construction, see the *Swagelok Variable Area Flowmeters* catalog, MS-02-346.

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