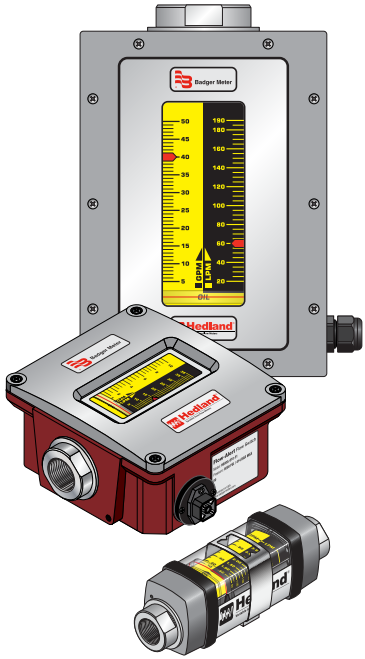
Hedland®
Variable Area Flow Meters

Flow-Alert

Flow Switch



Badger Meter®

VAM-UM-00646-EN-05 (July 2022)

User Manual

CONTENTS

INTRODUCTION

The Flow-Alert flow meter combines the rugged proven technology of a direct reading, piston-type variable area flow meter, coupled with electrical contacts used to signal operators or PLCs at customer-defined flow rates. This combination is sealed against industrial contamination by a NEMA 12 and 13 (IP52/54) rated enclosure (does not apply to strap versions).

This product provides a local flow indication and automatically signals the operator or PLC if flow is too high or too low.

Uses of the Flow-Alert flow meters include, but are not limited to: bearing lubrication, case drain verification, gun drill cooling and pump flow confirmation.

INSTALLATION

⚠CAUTION ***THIS PRODUCT SHOULD BE INSTALLED AND SERVICED BY TECHNICALLY QUALIFIED PERSONNEL TRAINED IN MAINTAINING INDUSTRIAL CLASS FLOW INSTRUMENTATION AND PROCESSING EQUIPMENT.***

⚠CAUTION ***READ INSTRUCTIONS THOROUGHLY BEFORE INSTALLING THE UNIT. IF YOU HAVE ANY QUESTIONS REGARDING PRODUCT INSTALLATION OR MAINTENANCE, CALL YOUR LOCAL SUPPLIER FOR MORE INFORMATION.***

⚠CAUTION ***THIS FLOW METER MAY CONTAIN RESIDUAL AMOUNTS OF TEST FLUID AT THE TIME OF SHIPMENT. THIS FLUID SHOULD BE REMOVED PRIOR TO INSTALLATION AS THE FLUID MAY BE INCOMPATIBLE OR HAZARDOUS WITH SOME LIQUIDS OR GASES. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DAMAGE TO THE EQUIPMENT.***

⚠CAUTION ***ALL FLOW ALERT FLOW METERS ARE UNIDIRECTIONAL AND HAVE NO BYPASS OPTION. ATTEMPTS TO FLOW FLUIDS IN THE OPPOSITE DIRECTION OF THE FLOW ARROW WILL RESULT IN THE FLOW METER ACTING AS A CHECK VALVE, CREATING A DEADHEADING SITUATION. IF THE DIFFERENTIAL PRESSURE MAGNITUDE IS GREAT ENOUGH, DAMAGE TO THE INTERNAL PARTS OF THE FLOW METER RESULTS.***

⚠WARNING ***DISCONNECT ELECTRICAL POWER BEFORE OPENING WIRING ENCLOSURE. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH AND/OR DAMAGE TO THE EQUIPMENT.***

⚠WARNING ***ALL WIRING SHOULD BE INSTALLED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND MUST CONFORM TO ANY APPLICABLE STATE AND LOCAL CODES. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH AND/OR DAMAGE TO THE EQUIPMENT.***

⚠CAUTION ***AIR/GAS FLOW METERS ARE NOT OXYGEN CLEANED. USE WITH OXYGEN MAY CAUSE HAZARDOUS OR EXPLOSIVE CONDITIONS THAT MAY CAUSE SERIOUS PERSONAL INJURY AND/OR DAMAGE TO THE EQUIPMENT.***

Installation Recommendations

Hedland flow meters are designed for easy installation. However, the following measures are recommended for reliable,
trouble-free operation:

- Piping should be accurately aligned and of correct length. The high pressure body of the flow meter can withstand shock and flow/pressure pulsation. Piping should be firmly supported by external mounting brackets, both upstream and downstream of the flow meter, to avoid any pipe flexing actions that could reduce flow meter life.
- If the flow meter inlet or outlet is rigidly mounted, and the opposing port is connected to flexible hose, the end connected with the flexible hose must be rigidly mounted.
- Install a union near the inlet or outlet of the flow meter to facilitate quick and easy flow meter removal and inspection during periodic maintenance procedures.
- Mount the flow meter either horizontally or vertically (flow arrow pointing to either side or straight up). If the flow meter must be mounted inverted, special inverted scales are available.
- Verify the fluid is traveling in the direction of the flow arrow, see *Figure 1 on page 5*.
- Systems that do not have filtration should be equipped with at least a 200 mesh (74 micron) filter. Most hydraulic system applications already have much finer filtration. The flow meter will allow particulates to pass that would jam most valves and flow controls. Dirt, ferrous metal or sealing agents may lodge and cause malfunction. If the flow meter is jammed at a fixed position, follow cleaning and maintenance instructions.
- Do not use thread locking compounds as thread sealant.
- Do not install the flow meter near turbulence producing fittings such as elbows, reducers and close coupled valves for maximum reliability. The inline flow meter does not require flow straighteners or special lengths of straight inlet/outlet piping to stabilize turbulent flow patterns.
- Do not install the flow meter near fast-acting valves. Fast-acting valves have the potential to create high magnitude hydraulic pressure spikes. These spikes can damage the internal components of the flow meter, resulting in inaccuracies or malfunction.
- Do not operate flow meter against the direction of the flow arrow. The flow meter is unidirectional. The piston acts as a check valve to block flow in the reverse direction. This causes an excessive pressure differential, which can result in damage to internal flow meter components.

Installation Instructions

1. See *Figure 1*. Mount the flow meter so fluid is traveling in the direction of the flow arrow.

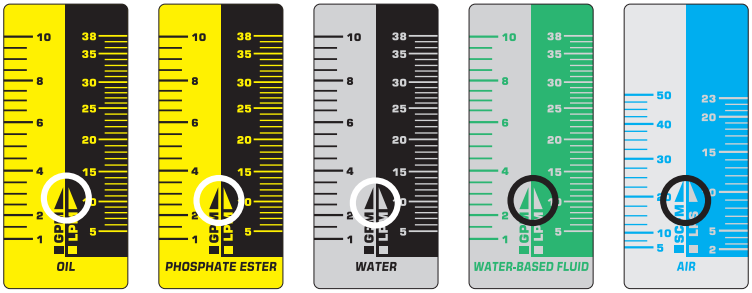
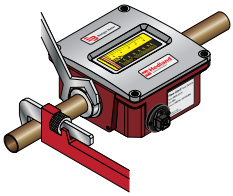
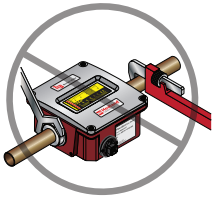


Figure 1: Flow direction arrows

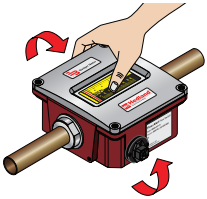
2. See *Figure 2*. Select a mounting location that is suitable for viewing and product service. To connect the flow meter into the piping system, place an open-ended wrench onto the flow meter wrench flats adjacent to the pipe connection being installed. DO NOT wrench on the opposite end of the flow meter or leakage may result.
3. After installation, rotate flow meter by hand to view flow scale.



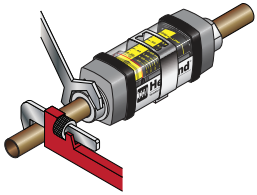
Place wrench on transmitter flats on the same side plumbing is being tightened.



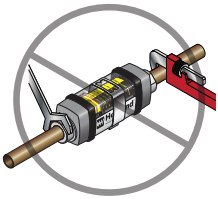
Never place wrench on transmitter flats opposite plumbing being tightened.



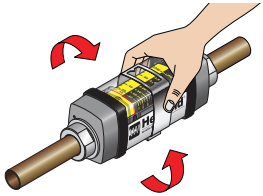
Rotate transmitter by hand only to view flow scale. Never use wrench on flats to rotate transmitter.



Place wrench on meter flats on the same side plumbing is being tightened.



Never place wrench on meter flats opposite plumbing being tightened.



Rotate meter by hand only to view flow scale. Never use wrench on flats to rotate meter.

Figure 2: Installing and rotating the flow meter

ELECTRICAL CONNECTIONS

All Flow-Alert flow meters are offered with either single or dual switches. Consult local wiring codes before applying power.

Wiring through Conduit

Some installations may require a rigid conduit for the wiring. To access a conduit connection:

- For microswitch equipped models only:
  Remove the black, watertight strain-relief/gland connection from the outside of the enclosure
- For all other models (excluding strap assembly models):
  Remove the Hirshmann connection from the outside of the enclosure

Microswitch Configurations

The strain-relief/gland connection outside of the microswitch enclosure is watertight.

Microswitch Cable Specifications

Single Switch: 4-Wire #18 AWG, SJO Jacket Cable					
Color	**Function**	**Cable Length: 1/4…1 in. Meters**		**Cable Length: 1-1/4…1-1/2 in. Meters**	
		Inside Enclosure	**Overall**	**Inside Enclosure**	**Overall**
Red	Normally Closed (N.C.)	4.00 in. (101.60 mm)	42.0 in. (106.68 cm)	6.00 in. (152.40 mm)	50.0 in. (127.00 cm)
Black	Normally Open (N.O.)				
White	Common				
Green	Ground	2.00 in. (50.80 mm)		5.00 in. (127.00 mm)	

Table 1: Microswitch single switch specifications

Dual Switch: 7-Wire #16 AWG, SJO Jacketed Cable						
Color	**Function**	**Switch ID**	**Cable Length for 1/4…1 in. Meters**		**Cable Length for 1-1/4… 1-1/2 in. Meters**	
			Inside Enclosure	**Overall**	**Inside Enclosure**	**Overall**
Red	Normally Closed (N.C.)	Switch 1 Decreasing Switch	4.00 in. (101.60 mm)	28.0 in. (711.20 mm)	10.0 in. (254.00 mm)	35.0 in. (889.00 mm)
Black	Normally Open (N.O.)					
White	Common					
Orange	Normally Closed (N.C.)	Switch 2 Increasing Switch	10.5 in. (266.70 mm)		15.0 in. (381.00 mm)	
Blue	Normally Open (N.O.)					
White/ Black	Common					
Green	Ground		2.00 in. (50.80 mm)		5.00 in. (127.00 mm)	

Table 2: Microswitch dual switch specifications

Reed Switch Configurations

Most units are equipped with an enclosure and a 15 ft (4.57 m) length of 4-wire #25 AWG type, PVC jacketed cable with a 4-pin Hirschmann connector.

Certain 1/4 in. or SAE 6 meters with lower flow ranges are equipped with a strap housing.

For safe operation of the reed switch, do not exceed the maximum wattage for that switch.

For example, the normally open (N.O.) reed switch has a maximum power rating of 10 Watts. If the switch is to operate at 24V DC, the maximum current is the wattage divided by the voltage.

$$I = \frac{W}{E} = \frac{10}{24} = 0.417A$$

Exceeding the maximum power rating for a particular switch will damage it.

Reed Switch Cable Specifications

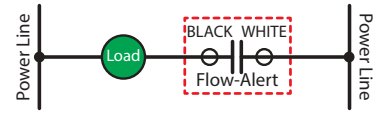
Single Switch (Strap Version): 2-Wire #24 AWG with Flying Leads		
Color	**Function**	**Wire Length**
Yellow	Normally Open (N.O.)	40.0 in. (101.60 cm)
Green and Blue	Normally Closed (N.C.)	18.0 in. (457.20 mm)

Table 3: Reed switch (strap version) single switch specifications

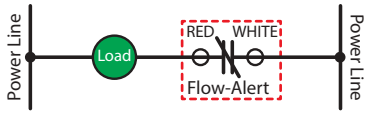
Single or Dual Switch: 4-Wire #25 AWG, PVC Jacketed Cable with Hirschmann Connector			
Color	**Wire Assignment**		**Cable Length**
	Single Switch	**Dual Switch**	
Red (Pin 1)	X	Switch 1 Decreasing Switch	15 ft (4.57 m)
Black (Pin 2)	X		
Green (Pin 3)	Not Used	Switch 2 Increasing Switch	
White (Pin 4)	Not Used		

Table 4: Configuration of reed switch with enclosure

Wiring Configurations

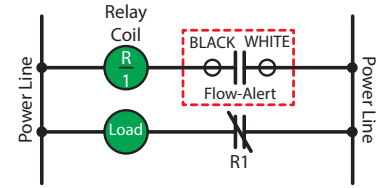


Load turns ON when flow exceeds setpoint.

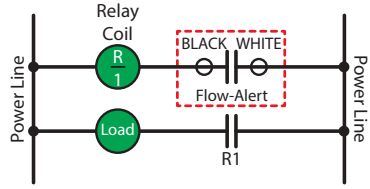


Load turns OFF when flow exceeds setpoint.

Figure 3: Loads within contact rating



Load turns OFF when flow exceeds setpoint.



Load turns ON when flow exceeds setpoint.

Figure 4: Loads outside contact rating

OPERATION

See *"Application Information" on page 12* for application information and fluid charts.

Microswitch Adjustment

1. Remove cover screws and front cover.

NOTE: On flow meters equipped with dual microswitches, the side closest to the connector is the *decreasing* flow switch and the side opposite the connector is the *increasing* flow switch.

NOTE: See *"Microswitch Cable Specifications" on page 6* for cable lengths and specifications.

2. Loosen the screws securing the switching roller and latching rollers to the guide bar. Turn each screw a maximum of one full turn.

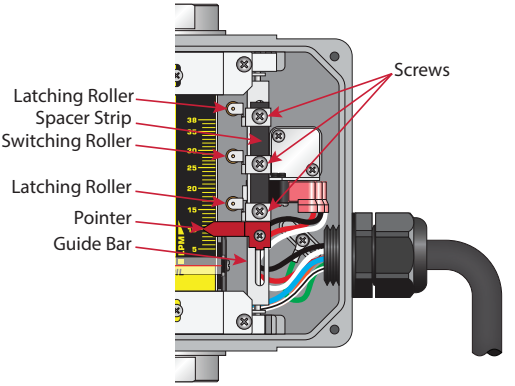


Figure 5: Microswitch adjustment

3. All rollers are secured as a set to the spacer strip. Slide the entire roller set until the pointer is at the desired setting.

NOTE: The spacer strip controls the maximum distance between rollers. This distance may be shortened when the switch setting is close to the end of the flow scale. Latching rollers may also be removed if the switch setting is close to the end of the flow scale.

4. Make sure the roller brackets are flush against the guide bar. Tighten the roller screws.
5. For dual switch models, repeat steps 1…4 for the *increasing* switch setting.
6. Install the cover gasket and front cover and secure with screws. To properly seat the cover gasket, tighten cover screws in a crisscross pattern (see *Figure 6*).

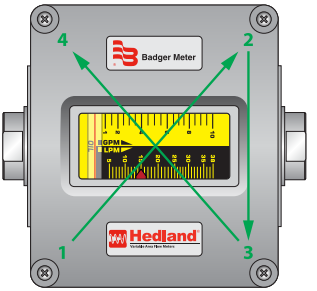


Figure 6: Cover screw tightening sequence

Reed Switch Adjustment

1/4 inch Models with Strap Assembly

1. Loosen the screw securing the switch assembly (see *Figure 7*).

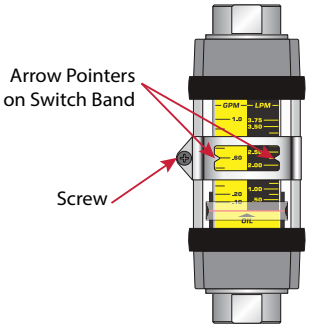


Figure 7: Reed switch adjustment (1/4 in. models)

2. Slide the switch assembly until the arrow pointers on the switch band are aligned with the desired flow rate indicated on the scale.
3. Tighten the screw.

1/4…1-1/2 inch Models with Enclosure

1. Remove cover screws and front cover.
2. Loosen the screw securing the switch assembly (see *Figure 8*).

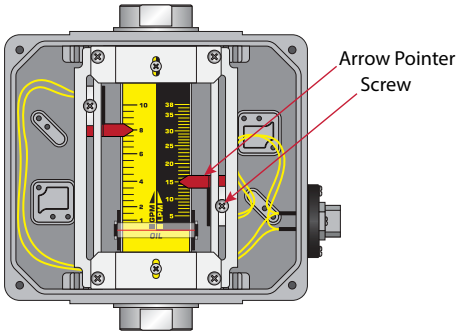


Figure 8: Reed switch adjustment (1/4…1-1/2 in. models)

NOTE: On flow meters equipped with dual reed switches, the side closest to the connector is the *decreasing* flow switch and the side opposite the connector is the *increasing* flow switch.

NOTE: See *"Reed Switch Cable Specifications" on page 7* for cable lengths and specifications.

3. Slide the switch assembly until the arrow pointer aligns with the desired flow rate indicated on the scale.
4. Tighten the screw.
5. For dual switch models, repeat steps 1…4 for the *increasing* switch setting.

6. Install the front cover and gasket. To properly seat the cover gasket, tighten the cover screws in a crisscross pattern.
   See *"Figure 6: Cover screw tightening sequence" on page 8*.

MAINTENANCE

Quick Recoupling

The piston type variable area flow meter is inherently less sensitive to shock and vibration than other variable area designs. The unique magnetic coupling also eliminates the need for mechanical linkages that can wear or loosen over the functional life of the flow meter.

However, a pressure spike or extreme flow surge can cause the piston to move at such rapid speed that it disconnects the piston magnet and the external indicator ring. If this occurs, use one of these procedures to recouple the magnet and the external indicator ring:

- If the system permits, simply change flow rate from "no flow" to "full flow" allowing the moving piston to magnetically recouple to the indicator ring.
- Remove the cover and manually reattach the external flow indicator to the internal magnet/piston assembly.
- For rigorous cyclical applications where decoupling may occur frequently, consult technical support.

⚠WARNING ***DISCONNECT ELECTRICAL POWER BEFORE REMOVING THE FLOW METER COVER. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH AND/OR DAMAGE TO THE EQUIPMENT.***

Cartridge Cleaning

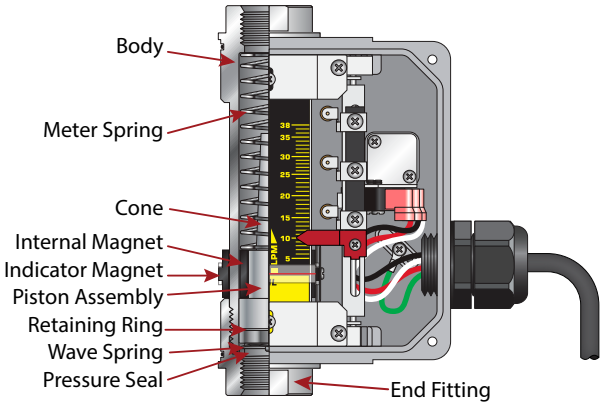


Figure 9: Cartridge Components

1. Disconnect the flow meter cable from the power source.

⚠WARNING ***BEFORE ATTEMPTING TO REMOVE THE FLOW METER FROM THE LINE, CHECK THE SYSTEM TO CONFIRM THAT LINE PRESSURE HAS BEEN REDUCED TO ZERO PSI. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH AND/OR DAMAGE TO THE EQUIPMENT.***

2. Remove wiring, as needed, used for the flow switch(es).

NOTE: For configurations with an aluminum enclosure, wiring inside the enclosure does not need to be disconnected, unless additional cleaning is required. Microswitch-equipped configurations may need to have wiring disconnected from the system to facilitate complete removal from the line. Reed switch configurations have a Hirshmann connector that can be disconnected from the enclosure.

3. Remove the flow meter from the line. Remove excess piping from the flow meter.

⚠CAUTION ***DO NOT USE AROMATIC HYDROCARBONS, HALOGENATED HYDROCARBONS, KETONES, OR ESTER BASED FLUIDS ON THE POLYCARBONATE LENS. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN DAMAGE TO THE FLOW METER.***

4. Thoroughly wipe off the entire flow meter surface using mild detergent or isopropyl alcohol.

NOTE: For configurations with an aluminum enclosure, remove cover screws and front cover.

5. Using the end fitting flats, clamp the outlet end fitting, then remove the inlet end fitting by rotating it counterclockwise.
6. For configurations with an aluminum enclosure, remove the body from the enclosure by gently pushing the body towards the outlet end of the enclosure, while holding the magnetic indicator assembly in place.
7. For configurations with the strap assembly, remove the inlet end cap, the plastic guard and guard seals, flow scale and indictor magnet assembly. Remove the outlet end cap by pulling it toward the inlet.
8. The remaining parts are secured with a retaining ring inside the body. Remove the retaining ring, piston/internal magnet and spring. Use caution to not bend or damage the retaining ring.

NOTE: If internal parts do not slide freely from the body, use a wooden dowel inserted into the outlet port of the flow meter to push the parts out.

9. Place all parts on a clean work surface for cleaning and inspection. If parts appear to be damaged, consult factory for repair/replacement options. Check the pressure and end fitting/cap O-rings for damage and replace if required.
10. In reverse order, gently reassemble all parts back to their original configuration. Use the groove on the indicator magnet and the middle fin on the back of the flow scale to ensure proper alignment of the two. Ensure the flow scale is in its original location.
11. Reinstall the spring, followed by the piston/internal magnet and then the retaining ring.
12. Reinstall the cone/spider plate assembly and retaining spring, and secure with the inlet end fitting. If the configuration has an aluminum enclosure, secure the lid and ensure proper seating of the cover gasket by tightening the screws in a crisscross pattern. See *"Figure 6: Cover screw tightening sequence" on page 8*.
13. Reinstall the flow meter in the line. Reconnect the electrical power.

APPLICATION INFORMATION

Liquid

Viscosity Effect (SUS/cSt)

The design uses a precision machined, sharp-edged orifice and biasing calibration spring that assures operating stability and accuracy over the wide viscosity range, common to many fluids. High flow models of each flow meter size provide good accuracy over a viscosity range of 40…500 SUS (4.2…109 cSt).

Density Effect (specific gravity)

Any fluid density change from stated standards has a proportional effect on flow meter accuracy. Special scales can be supplied if actual specific gravity decreases accuracy beyond application limits. Corrections for more or less dense fluids can be made to standard scales using the following correction factor:

$\sqrt{\frac{1.0}{\text{Specific Gravity}}}$ for water/water-based flow meters

$\sqrt{\frac{0.876}{\text{Specific Gravity}}}$ for petroleum-based flow meters

Pneumatic

NOTE: Pressure and temperature readings must be taken at the flow meter inlet to provide accurate correction factors.

The pneumatic flow meter is offered with a standard graduated dual scale, calibrated for air in standard cubic feet per minute (scfm) at 1.0 sg (70° F @ 100 psi) and liter per second (lps) at 1.0 sg (21° C @ 6.9 bar).

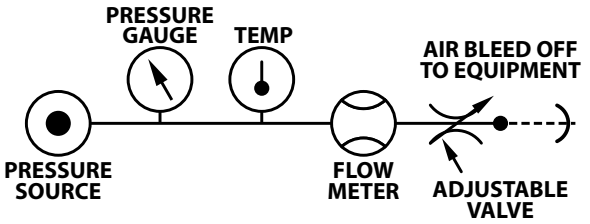


Figure 10: Pneumatic flow meter

CONVERSION CHART

The conversion chart provides a series of simplified mathematical formulas to adjust the graduated scale for changes in pressure (*Table 5*), temperature (*Table 6*), and/or specific gravity (*Table 7*).

NOTE: Special scales can be made to accommodate other pressures, temperatures and specific gravity.

The conversion chart can also be used to adjust the multi-pressure flow scale to indicate flow rates in applications beyond the parameters stated on the scale.

To adjust the pressures beyond (above or below) scale limits:

1. Locate the point at which the brightly colored indicator line intersects the vertical 100 Psig pressure line.
2. Divide this reading by the pressure correction factor (f_1) indicated in *Table 5*.

To adjust for changes in temperature:

1. Divide the 100 Psig flow rate reading by the temperature correction factor (f_2).

To adjust for changes in specific gravity:

1. Establish the square root of the new specific gravity.
2. Divide the 100 Psig flow rate reading by the Specific Gravity Correction Factor (f_3).

Conversion Chart

Determine flow rates using different pressures and temperatures.

$$scfm\,(actual) = \frac{scfm\,(indicated)}{f_1 \times f_2 \times f_3}$$

Where: f_1 = conversion factor for inlet pressure
f_2 = conversion factor for inlet temperature
f_3 = conversion factor for inlet specific gravity

psig	25	50	75	100	125	150	175	200	225	250
BAR	1.7	3.5	5.2	6.9	8.6	10.4	12.1	13.8	15.5	17.2
kPa	172	345	517	689	862	1034	1207	1379	1551	1724
f_1	1.700	1.331	1.131	1.000	0.902	0.835	0.778	0.731	0.692	0.658
$f_1 = \sqrt{\frac{114.7}{14.7 + psig}}$				$f_1 = \sqrt{\frac{7.914}{1.014 + BAR}}$			$f_1 = \sqrt{\frac{790.857}{101.357 + kPa}}$			

Table 5: Pressure correction factor

°F	+10	+30	+50	+70	+90	+110	+130	+150	+170	+190
°C	–12.2	–1.1	+909	+21.0	+32.1	+43	+54	+65	+76	+88
f_2	0.942	0.962	0.981	1.000	1.018	1.037	1.055	1.072	1.090	1.107
$f_2 = \sqrt{\frac{460 + °F}{530}}$					$f_2 = \sqrt{\frac{273 + °C}{293}}$					

Table 6: Temperature correction factor

$$f_3 = \sqrt{Sp.Gr.}$$

Table 7: Specific gravity correction factor

Fluid	Specific Gravity	Correction Factor		Aluminum	Brass	T316SS	T303SS	Viton®	EPR	Polycarbonate	Nylon	Pyrex
		Oil	Water									
Acetic Acid (Air Free)	1.06	0.909	0.971	C	N	R	R	R	R	C	N	R
Acetone	0.79	1.053	1.125	R	R	R	R	N	R	N	R	R
Alcohol Butyl (Butanol)	0.83	1.027	1.098	C	C	R	R	C	R	R	R	R
Alcohol Ethyl (Ethanol)	0.83	1.027	1.098	C	C	R	R	C	R	R	N	R
Ammonia	0.89	0.992	1.060	R	C	R	R	N	R	N	C	R
Benzine	0.69	1.127	1.204	C	R	R	C	R	N	N	R	R
Carbon Disulfide	1.26	0.834	0.891	R	N	R	R	R	N	N	R	R
Castor Oil	0.97	0.950	1.015	C	R	R	C	R	N	C	C	R
Cotton Seed Oil	0.93	0.970	1.037	C	R	R	R	R	N	R	R	R
Ethylene Glycol 50/50	1.12	0.884	0.945	R	R	R	R	R	R	R	C	R
Freon II	1.46	0.774	0.828	R	R	R	R	R	N	R	R	R
Gasoline	0.70	1.119	1.195	R	R	R	R	R	N	C	R	R
Glycerin	1.26	0.834	0.891	R	R	R	R	R	R	R	C	R
Kerosene	0.82	1.033	1.104	R	R	R	R	R	N	R	R	R
Liquid Propane (LPG)	0.51	1.310	1.400	R	R	R	R	R	N	N	R	R
Mineral Oil	0.92	0.976	1.042	R	N	R	R	R	N	R	R	R
Naphtha	0.76	1.074	1.147	R	N	R	R	R	N	C	R	R
Perchloroethylene	1.62	0.735	0.786	C	N	R	R	R	N	N	N	R
Petroleum Oil	0.876	1.000	1.068	R	R	R	R	R	N	R	R	R
Phosphate Ester	1.18	0.862	0.921	R	R	R	R	N	R	N	R	R
Phosphate Ester Base	1.26	0.833	0.891	R	R	R	R	N	R	N	R	R
Phosphoric Acid (Air Free)	1.78	0.701	0.749	N	N	R	N	R	N	R	N	R
Sea Water	1.03	0.922	0.985	N	N	C	C	N	R	R	R	R
Synthetic Petroleum Base	1.00	0.936	1.000	R	C	R	R	R	N	R	R	R
Water	1.00	0.936	1.000	N	R	R	R	N	R	R	R	R
Water Glycol 50/50	1.07	0.905	0.967	R	R	R	R	R	N	R	R	R
Water-in-Oil	0.93	0.970	1.037	R	R	R	R	N	R	R	R	R

Table 8: Fluid selection chart

R = Recommended
N = Not Recommended
C = Consult Factory

Fluid	Specific Gravity	Correction Factor of Standard Scale	Internal Body Material				External Pressure Seals		Dust Guards		
			Aluminum	Brass	T316SS	T303SS	Viton®	EPR	Polycarbonate	Nylon	Pyrex®
Air	1.00	1.000	R	R	R	R	R	R	R	R	R
Argon (A)	1.38	1.175	R	R	R	R	R	R	R	R	R
Carbon Dioxide (CO_2)	1.53	1.237	R	R	R	R	R	R	R	R	R
Freon 11 (CCl_3F)	4.92	2.218	R	R	R	R	R	R	R	R	R
Freon 12 (CCl_2F)	4.26	1.060	R	R	R	R	R	R	R	R	R
Helium (HE)	0.14	0.374	R	R	R	R	R	R	R	R	R
Hydrogen (H_2)	0.07	0.265	R	R	R	R	R	R	R	R	R
Natural Gas	0.60	0.775	C	C	R	C	R	N	C	R	R
Nitrogen (N_2)	0.97	0.985	C	C	R	R	R	R	R	R	R
Oxygen (O_2)	1.10	1,049	R	R	R	R	R	R	R	R	R
Propane (C_3H_8)	1.57	1.253	R	R	R	R	R	R	N	R	R

Table 9: Fluid selection chart (gases)

R = Recommended
N = Not Recommended
C = Consult Factory

Flow vs Pressure Drop

Petroleum Fluids

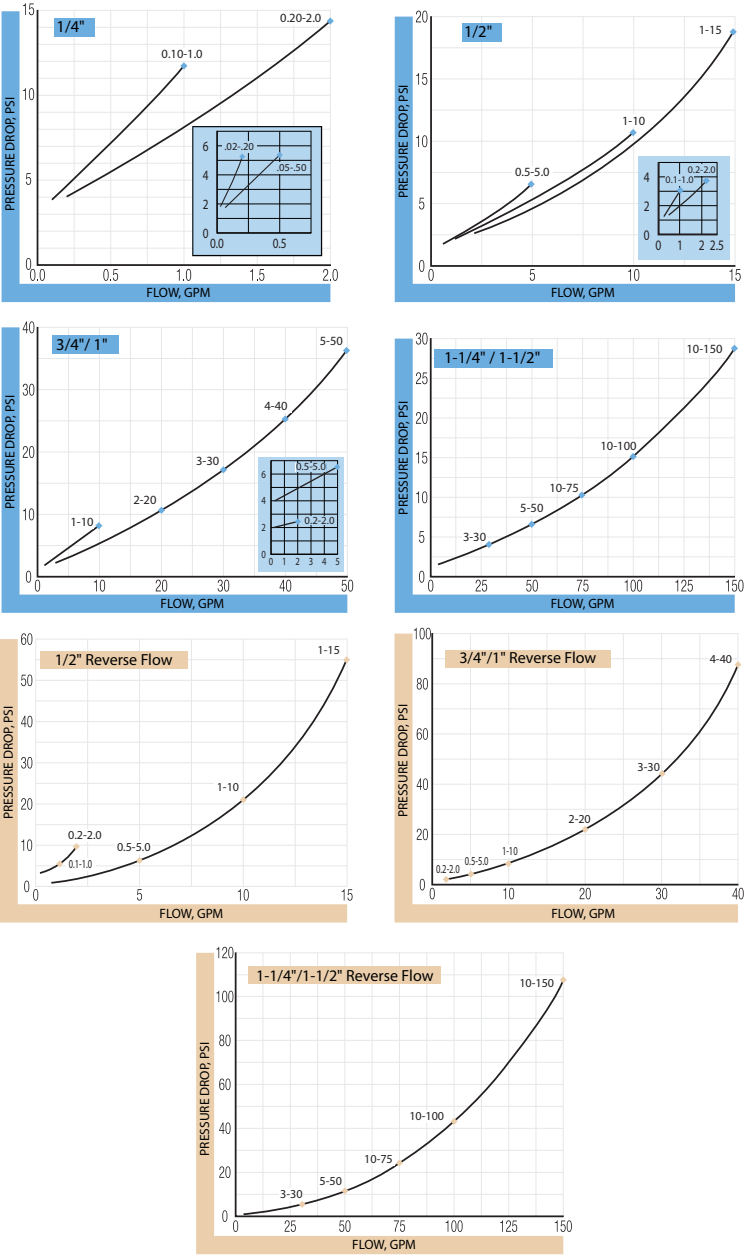


Figure 11: Petroleum fluids flow vs pressure drop

Phosphate Esters

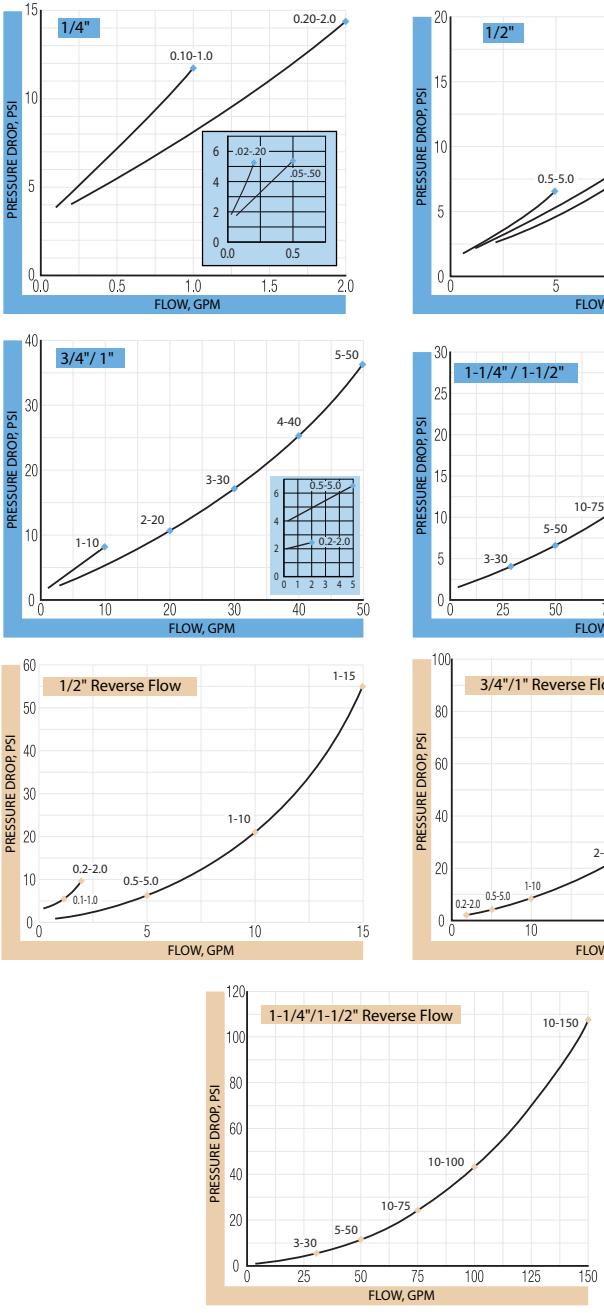


Figure 12: Phosphate esters flow vs pressure drop

A.P.I. Oil

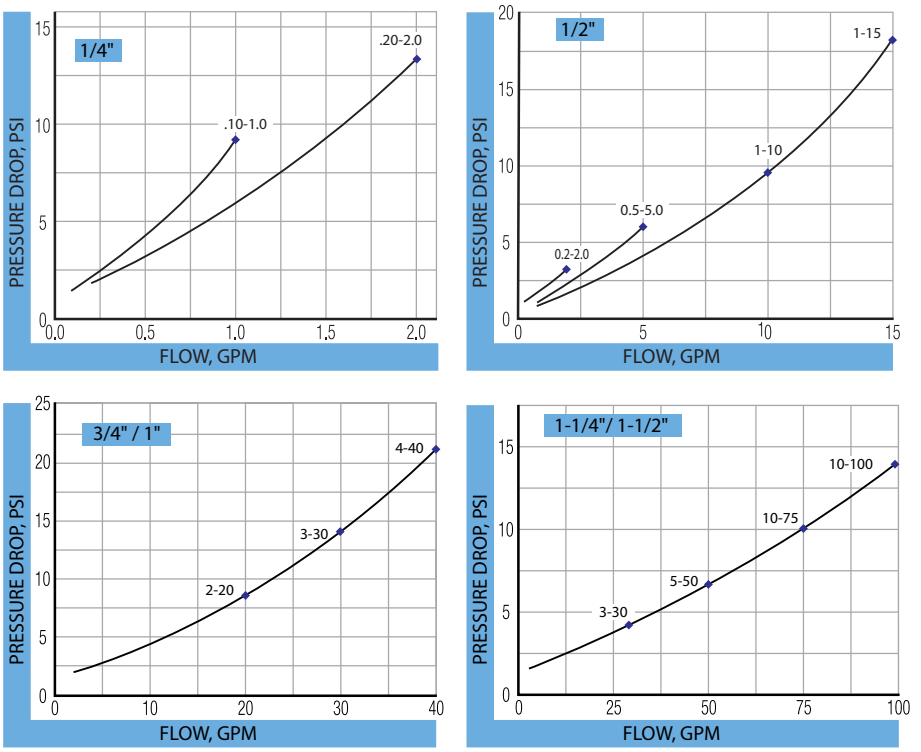


Figure 13: A.P.I. oil flow vs pressure drop

Water-Based Fluids

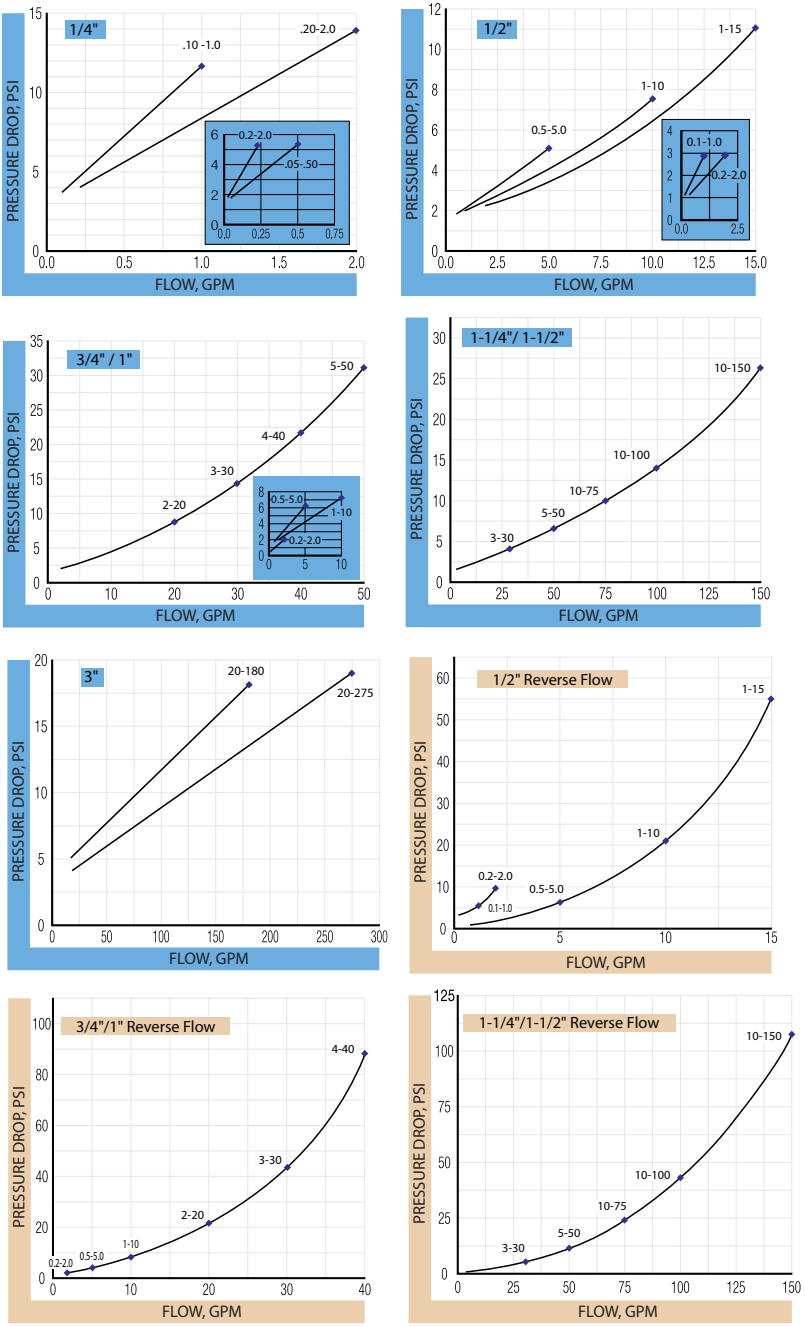


Figure 14: Water-based fluids flow vs pressure drop

Water

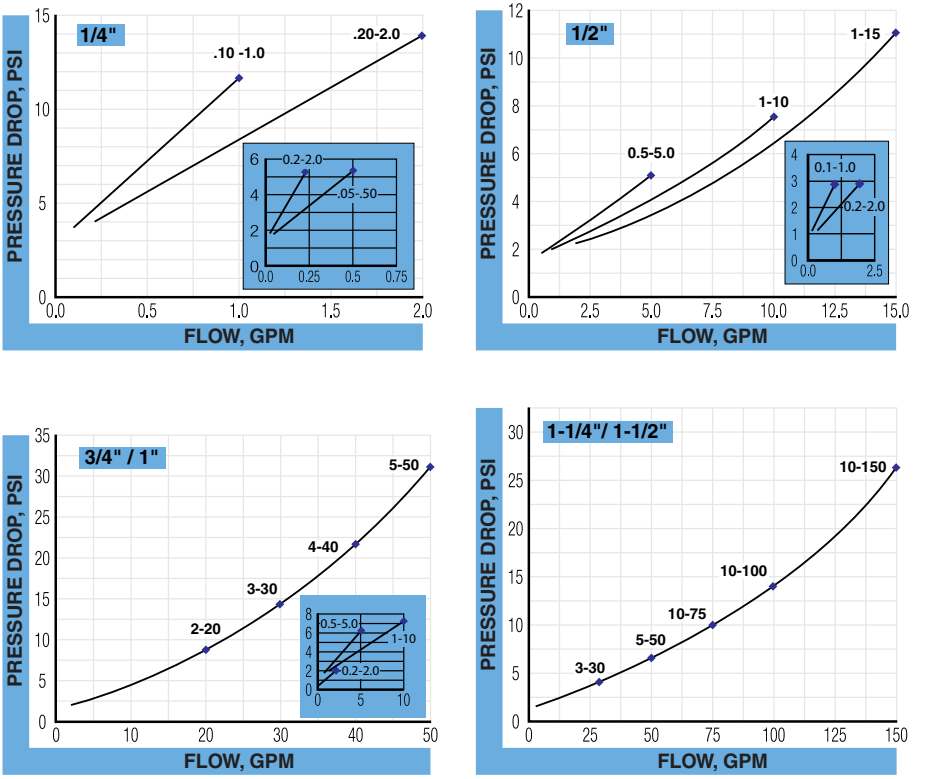


Figure 15: Water flow vs pressure drop

Caustic and Corrosive Liquids

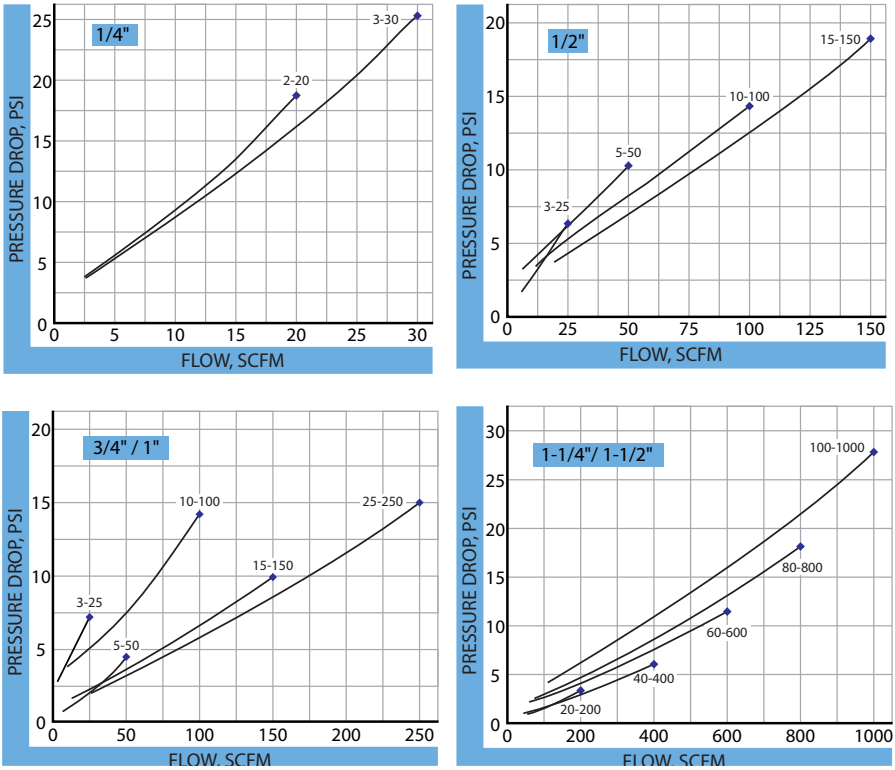


Figure 16: Caustic and corrosive liquids flow vs pressure drop

Air/Compressed Gases

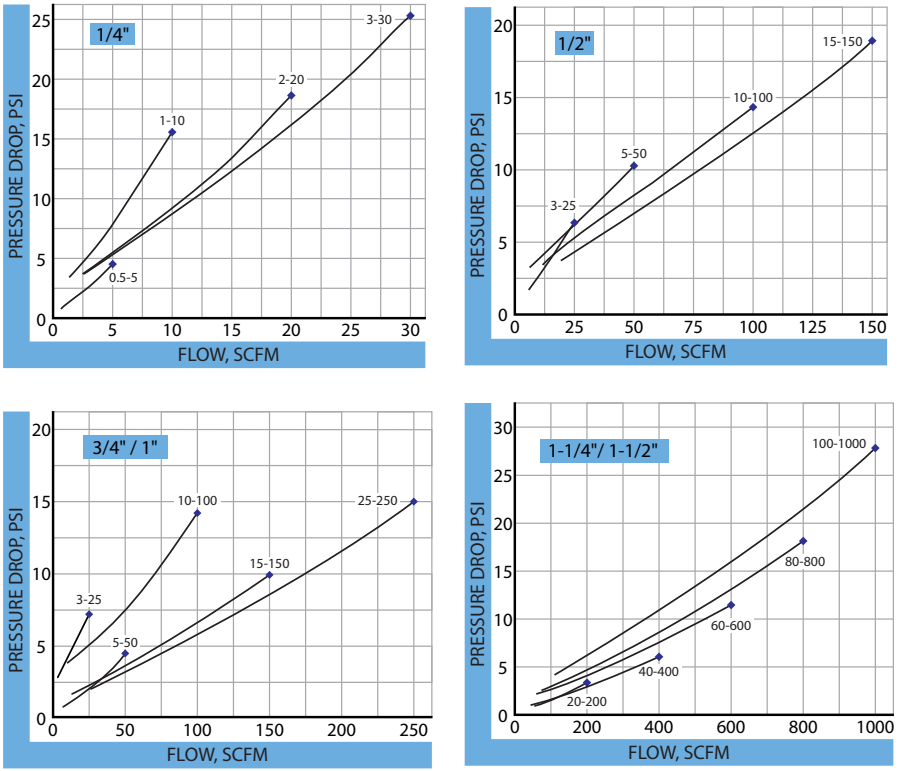


Figure 17: Air and compressed gasses flow vs pressure drop

Air/Caustic and Corrosive Gases

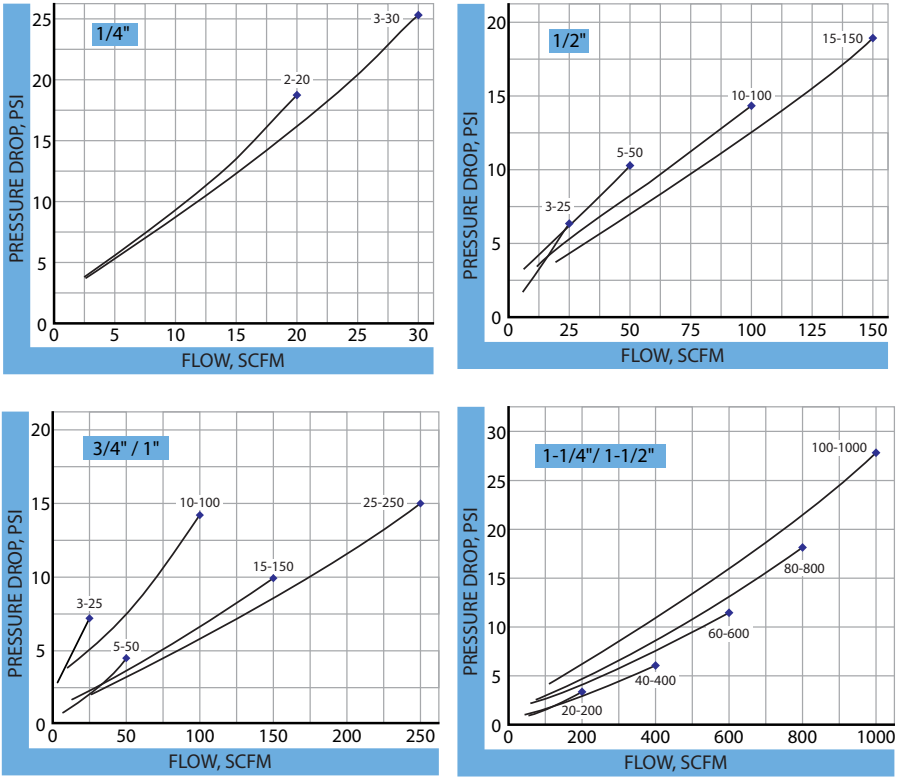


Figure 18: Air/caustic and corrosive gasses flow vs pressure drop

SPECIFICATIONS

Enclosure Rating	NEMA 12 & 13 (equivalent to IP52 & 54) **NOTE:** Does not apply to 1/4 in. flow meter with strap	
Temperature Range	–20…240° F (–20…116° C)	
Pressure Rating (Aluminum/Brass)	Liquids (1/4…1-1/2 in.)	3500 psi (241 bar) maximum with a 3:1 safety factor
	Gases (1/4…1-1/2 in.)	1000 psi (69 bar) maximum with a 10:1 safety factor
Pressure Rating (Stainless Steel)	Liquids (1/4…1/2 in.)	6000 psi (414 bar) maximum with a 3:1 safety factor
	Liquids (3/4…1-1/2 in.)	5000 psi (345 bar) maximum with a 3:1 safety factor
	Gases (1/4…1-1/2 in.)	1500 psi (103 bar) maximum with a 10:1 safety factor
Accuracy	±2% of full scale; 7% of full scale for 1/4 in. flow meters	
Repeatability	±1%	
Pressure Drop	See *"Flow vs Pressure Drop" on page 16* for specific flow meter information	

Microswitch

Single or double switch, pre-wired single-pole, double-throw (SPDT), UL recognized and CSA certified switch	
Type	SPDT
Contact Rating	V AC: 250V, 10 Amp
	V DC: 125V, 0.5 Amp
Cable Single Switch	1/4…1 in. flow meters: 42 in. cable; 1-1/4…1-1/2 in. flow meters: 50 in. cable
Cable Dual Switch	1/4…1 in. flow meters: 28 in. cable; 1-1/4…1-1/2 in. flow meters: 35 in. cable

Reed Switch

Single or double reed switch, pre-wired single-pole, single-throw normally open (SPST-N.O.); or single-pole, single-throw normally closed (SPST-N.C.); UL recognized and CSA certified switch	
Type	SPST
Contact Rating	Maximum see *Figure 1 on page 5* Normally open, 10 Watts Normally closed, 5 Watts
Voltage (maximum at switching)	Normally open, 50V DC Normally closed, 50V DC
Current (maximum amps at switching, resistive load)	Normally open, 0.5 Amp Normally closed, 0.5 Amps
Initial contact resistance	0.100 Ohms
Cable	15 ft (4.6 m), 4-wire, #22 AWG, PVC jacket (for most configurations; see *Table 3 on page 7* for exceptions)

Table 10: Specifications

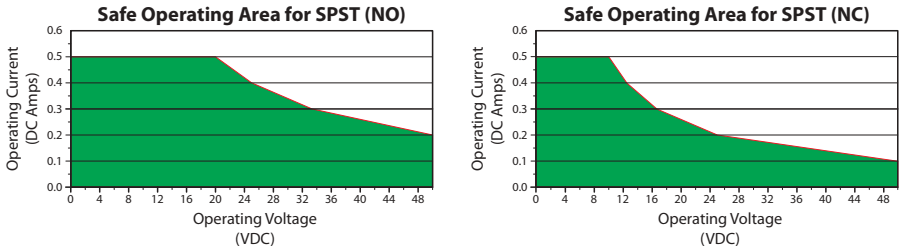


Figure 11: Reed switch power dissipation

DIMENSIONS

Reed Switch Configuration with Enclosure

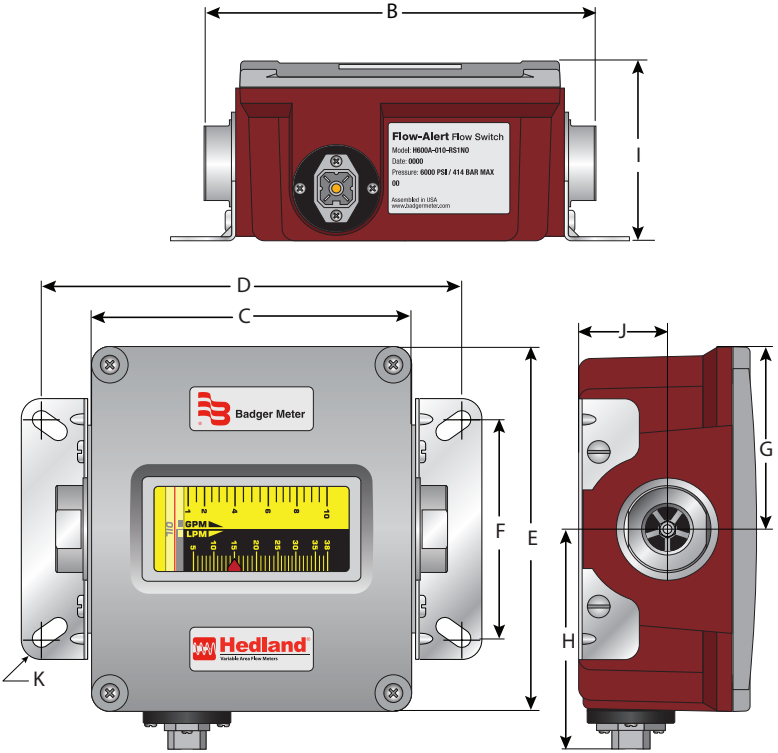


Figure 19: Reed switch configuration with enclosure

Nominal Port Size	B Length in. (mm)	C Length in. (mm)	D Length in. (mm)	E Width in. (mm)	F Width in. (mm)	G Width in. (mm)	H* Cable in. (mm)	I Depth in. (mm)	J Offset in. (mm)	K Hole Dia. in. (mm)
1/4 in. SAE 6	6.60 (167.64)	5.27 (133.86)	6.92 (175.77)	6.00 (152.40)	3.60 (91.44)	3.00 (76.20)	3.60 (91.44)	2.94 (74.68)	1.46 (37.08)	0.28 (7.11)
1/2 in. SAE 10	6.60 (167.64)	5.27 (133.86)	6.92 (175.77)	6.00 (152.40)	3.60 (91.44)	3.00 (76.20)	3.60 (91.44)	2.94 (74.68)	1.46 (37.08)	0.28 (7.11)
3/4 in. SAE 12	7.20 (182.88)	5.27 (133.86)	6.92 (175.77)	6.00 (152.40)	3.60 (91.44)	3.00 (76.20)	3.60 (91.44)	2.94 (74.68)	1.46 (37.08)	0.28 (7.11)
1 in. SAE 16	7.20 (182.88)	5.27 (133.86)	6.92 (175.77)	6.00 (152.40)	3.60 (91.44)	3.00 (76.20)	3.60 (91.44)	2.94 (74.68)	1.46 (37.08)	0.28 (7.11)
1-1/4 in. SAE 20	12.20 (309.88)	10.68 (271.27)	11.65 (295.91)	7.63 (193.80)	4.84 (122.94)	3.82 (97.03)	4.20 (106.68)	4.50 (114.30)	2.20 (55.88)	0.28 (7.11)
1-1/2 in. SAE 24	12.20 (309.88)	10.68 (271.27)	11.65 (295.91)	7.63 (193.80)	4.84 (122.94)	3.82 (97.03)	4.20 (106.68)	4.50 (114.30)	2.20 (55.88)	0.28 (7.11)

Table 12: Reed switch configuration with enclosure

NOTE: Fractional sizes apply to NPT and BSP configurations.
* Cable (not shown) adds 0.62 in. (15.75 mm) to length.

Microswitch Configuration

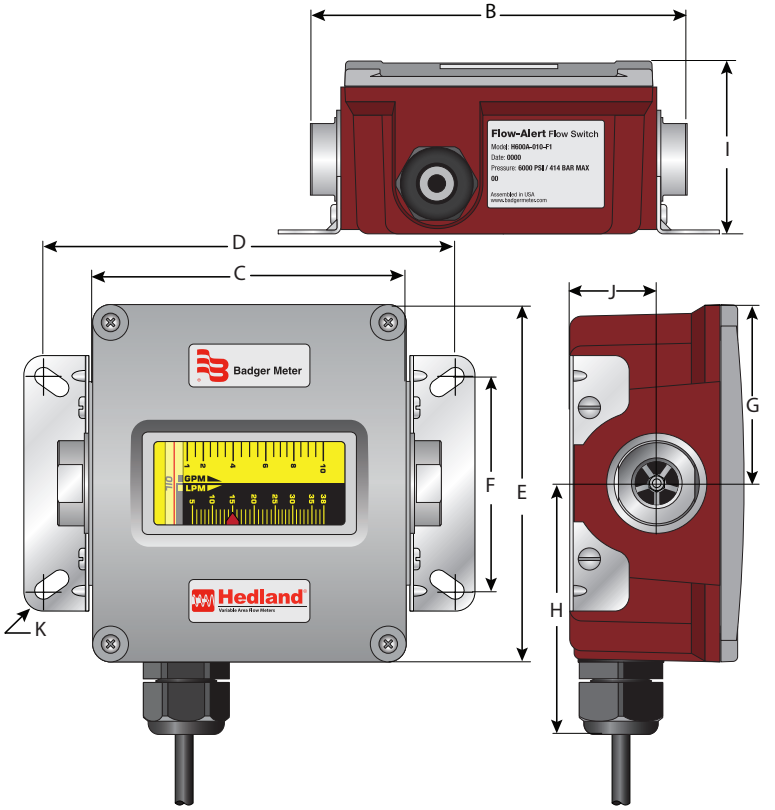


Figure 20: Microswitch configuration

Nominal Port Size	B Length in. (mm)	C Length in. (mm)	D Length in. (mm)	E Width in. (mm)	F Width in. (mm)	G Width in. (mm)	H * Cable in. (mm)	I Depth in. (mm)	J Offset in. (mm)	K Hole Dia. in. (mm)
1/4 in. SAE 6	6.60 (167.64)	5.27 (133.86)	6.92 (175.77)	6.00 (152.40)	3.60 (91.44)	3.00 (76.20)	4.20 (106.68)	2.94 (74.68)	1.46 (37.08)	0.28 (7.11)
1/2 in. SAE 10	6.60 (167.64)	5.27 (133.86)	6.92 (175.77)	6.00 (152.40)	3.60 (91.44)	3.00 (76.20)	4.20 (106.68)	2.94 (74.68)	1.46 (37.08)	0.28 (7.11)
3/4 in. SAE 12	7.20 (182.88)	5.27 (133.86)	6.92 (175.77)	6.00 (152.40)	3.60 (91.44)	3.00 (76.20)	4.20 (106.68)	2.94 (74.68)	1.46 (37.08)	0.28 (7.11)
1 in. SAE 16	7.20 (182.88)	5.27 (133.86)	6.92 (175.77)	6.00 (152.40)	3.60 (91.44)	3.00 (76.20)	4.20 (106.68)	2.94 (74.68)	1.46 (37.08)	0.28 (7.11)
1-1/4 in. SAE 20	12.20 (309.89)	10.68 (271.27)	11.65 (295.91)	7.63 (193.80)	4.84 (122.93)	3.82 (97.03)	5.02 (127.51)	4.50 (114.30)	2.20 (55.89)	0.28 (7.11)
1-1/2 in. SAE 24	12.20 (309.89)	10.68 (271.27)	11.65 (295.91)	7.63 (193.80)	4.84 (122.93)	3.82 (97.03)	5.02 (127.51)	4.50 (114.30)	2.20 (55.89)	0.28 (7.11)

Table 13: Microswitch configuration with enclosure

NOTE: Fractional sizes apply to NPT and BSP configurations.

***** Allow extra space for cable.

Reed Switch Configuration with Strap Assembly

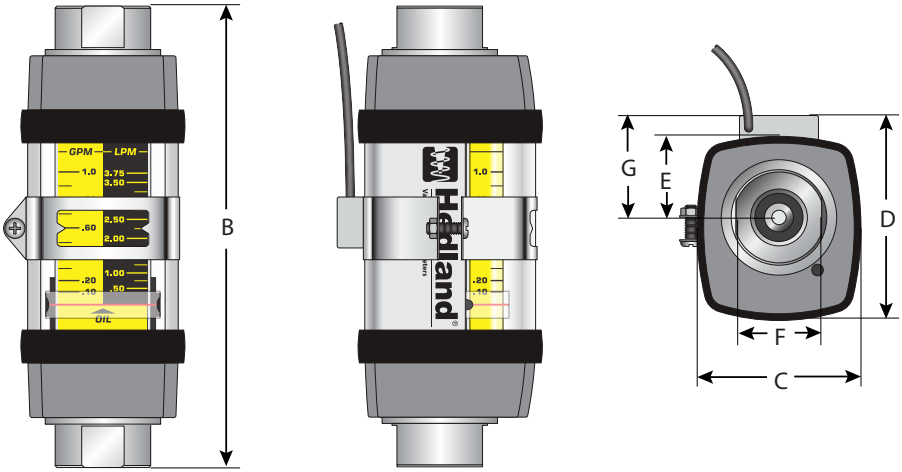


Figure 21: Reed switch configuration with strap assembly

Nominal Port Size	B Length in. (mm)	C Width in. (mm)	D Depth in. (mm)	E Offset in. (mm)	F Flats in. (mm)	G in. (mm)
1/4 in. SAE 6	4.80 (121.92)	1.68 (42.67)	2.10 (53.34)	0.84 (21.34)	0.88 (22.35)	1.00 (25.40)

Table 14: Reed switch configuration with strap assembly

NOTE: Fractional sizes apply to NPT and BSP configurations.

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