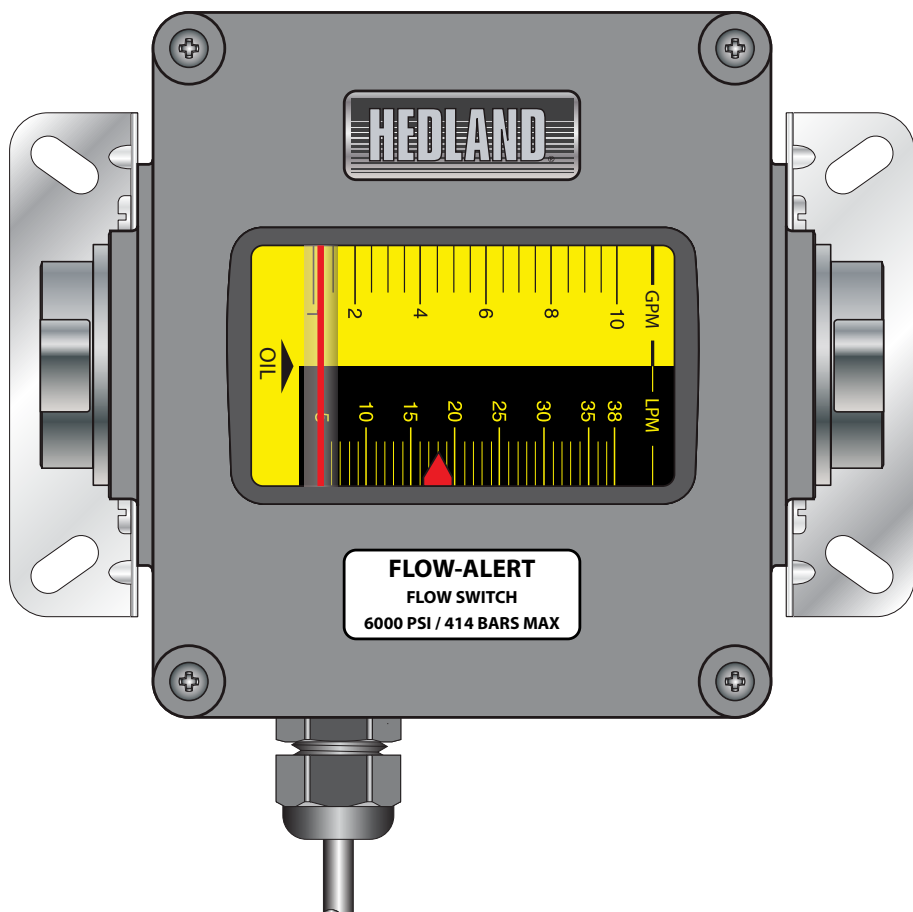




## Flow-Alert Flow Switch

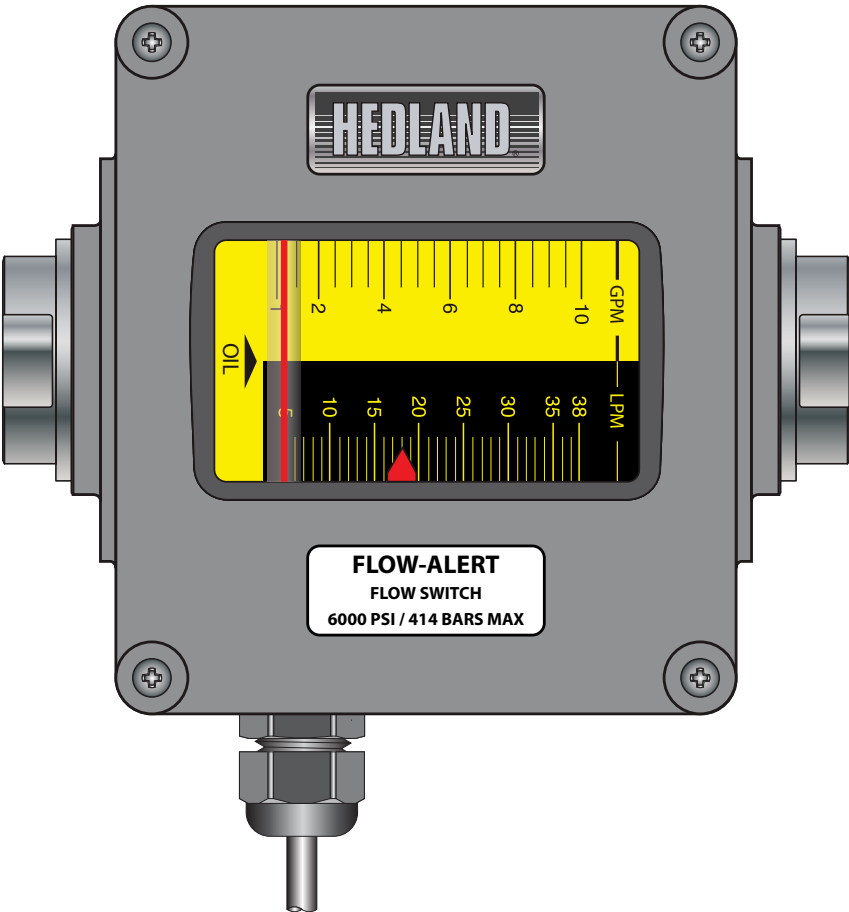


# I - INTRODUCTION

The Flow-Aler flow meter combines the rugged proven technology of a direct reading, piston-type, variable area flow meter, coupled with electrical contacts utilized to signal at selected flow rates. This combination is sealed against industrial contamination by a NEMA 12 and 13 (IP52/54) rated enclosure.

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-Aler flow meter include: bearing lubrication, case drain verification, gun drill cooling, pump flow confirmation, etc.



**FIGURE 1- FLOW-ALERT FLOW METER**

## II - SPECIFICATIONS

### Enclosure Rating

- NEMA 12 & 13  
(equivalent to IP52 & 54)

### Temperature Range

- -20 °F to +240 °F  
(-20 °C to +116 °C)

### Pressure Rating Aluminum/Brass

- Liquids (¼" to 1½"): 3500 psi (241 bar) maximum with a 3:1 safety factor
- Gases (¼" to 1½"): 1000 psi (69 bar) maximum with a 10:1 safety factor

### Pressure Rating Stainless Steel

- Liquids (¼" to ½"): 6000 psi (414 bar) maximum with a 3:1 safety factor
- Liquids (¾" to 1½"): 5000 psi (345 bar) maximum with a 3:1 safety factor
- Gases (¼" to 1½"): 1500 psi (103 bar) maximum with a 10:1 safety factor

### Accuracy

- ±2% of full scale

### Repeatability

- ±1%

### Pressure Drop

- See Appendix for specific meter information

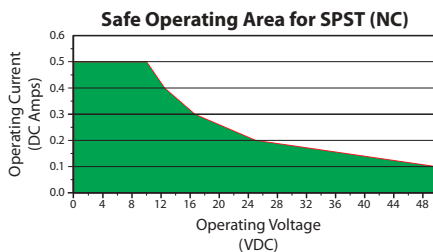
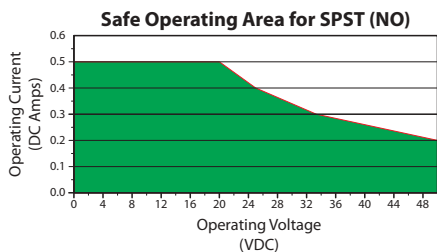
### Micro Switch

- Single (1) or double (2) switch, pre-wired single-pole, double-throw (SPDT), UL recognized and CSA certified switch

- Type: SPDT
- Contact Rating VAC: 250 Volt, 10 Amp
- Contact Rating VDC: 125 Volt, 0.5 Amp
- Cable Single Switch: 34", 4-wire, #18 AWG, SO jacket
- Cable Dual Switch: 18", 7-wire, #16 AWG, SO jacket

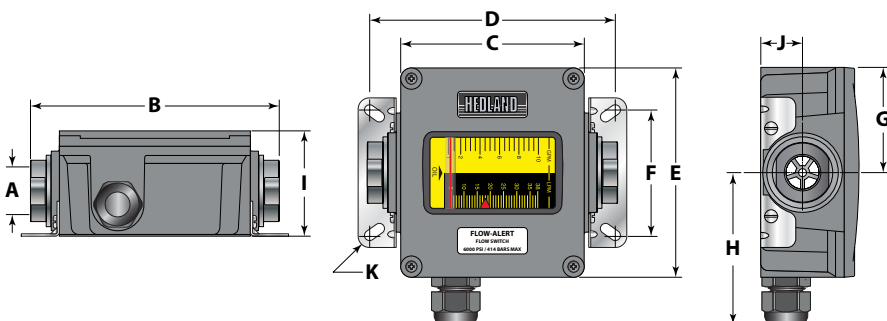
### Reed Switch

- Single (1) or double (2) reed switch, pre-wired single-pole, single-throw normally open (SPST-NO); or single-pole, single-throw normally closed (SPST-NC); UL recognized and CSA certified switch
- Type: SPST
- Contact Rating: (maximum, see **Figure 2**)
  - Normally Open, 10 Watts;
  - Normally Closed, 5 Watts
- Voltage (maximum at switching):
  - Normally Open, 50 VDC;
  - Normally Closed, 50 VDC
- 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' (4.6m), 4-wire, #22 AWG, PVC jacket



**FIGURE 2 - REED SWITCH POWER DISSIPATION**

## DIMENSIONS



**FIGURE 3 - CASE DIMENSIONS**

A Nominal Port Size	B Length	C Length	D Length	E Width	F Width	G Width	H Width	I Depth	J Offset	K Hole Dia.
¼ (SAE 6)	6.60 (168)	5.27 (134)	6.41 (163)	6.00 (152)	3.23 (82)	3.00 (76)	4.20 (107)	2.94 (75)	1.51 (38)	.31 (8)
½ (SAE 10)	6.60 (168)	5.27 (134)	6.41 (163)	6.00 (152)	3.23 (82)	3.00 (76)	4.20 (107)	2.94 (75)	1.51 (38)	.31 (8)
¾ (SAE 12)	7.20 (183)	5.27 (134)	7.04 (179)	6.00 (152)	3.60 (91)	3.00 (76)	4.20 (107)	2.94 (75)	1.27 (32)	.31 (8)
1 (SAE 16)	7.20 (183)	5.27 (134)	7.04 (179)	6.00 (152)	3.60 (91)	3.00 (76)	4.20 (107)	2.94 (75)	1.27 (32)	.31 (8)
1¼ (SAE 20)	12.20 (310)	10.68 (271)	11.65 (296)	7.63 (194)	4.84 (123)	3.82 (97)	5.02 (128)	4.50 (114)	2.20 (56)	.31 (8)
1½ (SAE 24)	12.20 (310)	10.68 (271)	11.65 (296)	7.63 (194)	4.84 (123)	3.82 (97)	5.02 (128)	4.50 (114)	2.20 (56)	.31 (8)
inches (mm)										

**TABLE 1 - DIMENSIONAL INFORMATION**

### III - INSTALLATION

#### CAUTION

**Caution** - This product should be installed and serviced by technically qualified personnel trained in maintaining industrial class flow instrumentation and processing equipment.

#### CAUTION

**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

**Caution** - This 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

#### CAUTION

**Caution** - This standard meter is unidirectional. Attempts to flow fluids in the opposite direction of the flow arrow will result in the 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 meter will result.

#### WARNING

**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

**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

**Caution** - Air/gas 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

The in-line flow meter is a simple device to install. However, the following measures are recommended for reliable, trouble-free operation:

**Do** - Align pipe accurately. Piping should be accurately aligned and of correct length. The high pressure body of the flow meter can withstand shock and flow/pressure pulsation. However, the piping should be firmly supported by external mounting brackets, both upstream and downstream of the meter, to avoid any pipe flexing actions that could reduce meter life.

**Do** - Use rigid mounting. If the flow meter inlet or outlet are to be rigidly mounted, and the opposing port is to be connected to flexible hose, the end connected with the flexible hose must be rigidly mounted.

**Do** - Use Teflon® tape for sealing NPT fitting.

**Do** - Install unions. Install a union near the inlet or outlet of the meter. This will facilitate quick, easy meter removal and inspection during periodic maintenance procedures.

**Do** - Mount the meter either horizontally or vertically (flow arrow pointing to either side or straight up). If the meter must be mounted inverted, special inverted scales are available from the factory.

**Do** - Ensure the fluid is traveling in the direction of the flow arrow (**Figure 4** on page 8).

**Do** - Use at least a 200 mesh (74 micron) filter. The meter will allow particulate to pass that would jam most valves and flow controls. Systems that do not have filtration should be equipped with at least a 200 mesh (74 micron) filter. Most hydraulic systems already have much finer filtration.

Dirt, ferrous metal or sealing agents, such as Teflon® tape may lodge and cause malfunction. If the meter is jammed at a fixed position, follow cleaning and maintenance instructions.

**Don't** - Use thread locking compounds as thread sealant.

**Don't** - Install the flow meter near turbulence producing fittings such as elbows, reducers, close coupled valves, etc. The in-line flow meter does not require flow straighteners or special lengths of straight inlet/outlet piping to stabilize turbulent flow patterns. However, to assure maximum operational reliability, avoid installation of elbows, valves and/or reducers immediately adjacent to the meter inlet.

**Don't** - Install the 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 meter, resulting in inaccuracies or malfunction.

**Don't** - Allow unidirectional meters to be operated against the direction of the flow arrow. The standard flow meter is an unidirectional flow meter. 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 meter components. The flow meter is also available in a modified design, which offers a reverse flow by-pass feature to accommodate bi-directional flow.

**NOTE:** *In-line meters with a reverse flow by-pass feature are available. Consult factory for details.*

**INSTALLING THE FLOW-ALERT**

- 1. See **Figure 4**. Mount the meter so fluid is traveling in the direction of the flow arrow.
- 2. See **Figure 5**. 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. See **Figure 6**. After installation, rotate meter by hand to view flow scale.

**ELECTRICAL CONNECTIONS**

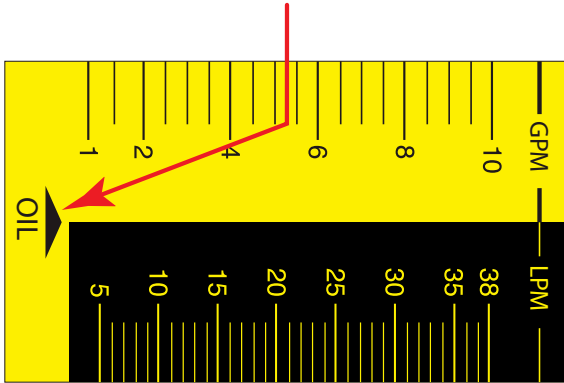
**Micro Switch  
Equipped Models**

All meters (size ¼" to 1½") are offered in single (1) switch or double (2) switch models. The single switch model is equipped with a 34" length of 4-wire #18 AWG type SO jacketed cable. The double switch model is equipped with a 18" length of 7-wire #16 AWG type SO jacketed cable.

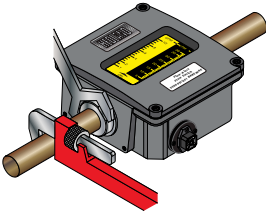
One Switch – 4-Wire Cable	
Red	Normally Closed (NC)
Black	Normally Open (NO)
White	Common
Green	Ground
Two Switch – 7-Wire Cable	
Switch 1	
Red	Normally Closed (NC)
Black	Normally Open (NO)
White	Common
Switch 2	
Orange	Normally Closed (NC)
Blue	Normally Open (NO)
White/Black	Common
Green	Ground

**TABLE 2 - MICRO SWITCH  
WIRE DESIGNATIONS**

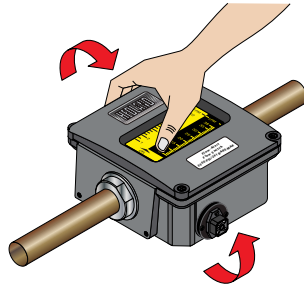
# Flow Direction Arrows



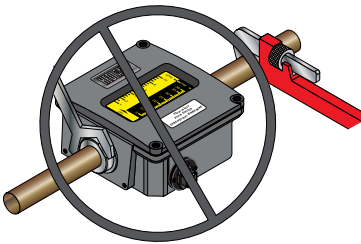
**FIGURE 4 - FLOW DIRECTION ARROWS**



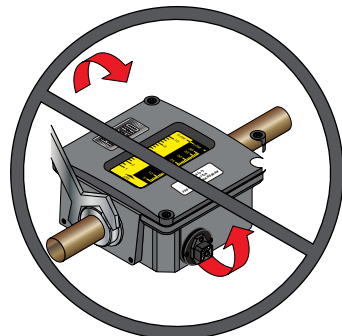
**Place wrench on transmitter flats *on the same side* plumbing is being tightened**



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



**FIGURE 5 - INSTALLING THE METER**



**Never place wrench on transmitter flats opposite plumbing being tightened**

**FIGURE 6 - ROTATING THE METER**



A 4-pin Brad Harrison® quick-disconnect plug is available upon special order.

4-Pin Connector used with SPDT Micro Switch	
Red	Normally Closed (NC)
Black	Normally Open (NO)
White	Common
Green	Ground

**TABLE 3 - 4-PIN CONNECTOR  
MICRO SWITCH  
WIRE DESIGNATIONS**

**NOTE:** If the factory supplied cable is removed for hard wiring the meter, switches must be connected with 0.187" × 0.020" insulated flag terminals designed for the appropriate wire gauge for the application.

**REED SWITCH MODELS**

Safe operation of the reed switch is dependent on not exceeding the maximum wattage for that switch.

For example the normally open reed switch has a maximum power rating of 10 Watts. If the switch is to operate at 24 VDC the maximum current is found by dividing the wattage by the voltage.

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

All meters (size ¼" to 1½") are offered in single (1) switch or double (2) switch models and come equipped with a 4-pin Hirschmann connector. All units are quipped with a 15' length of 4-wire #22 AWG type PVC jacketed cable.

4-Pin Connector used with SPST Reed Switch	
Red	Switch 1 Contact
Black	Switch 1 Contact
White	Optional Switch 2 Contact
Green	Optional Switch 2 Contact

**TABLE 4 - 4-PIN CONNECTOR  
REED SWITCH  
WIRE DESIGNATIONS**

**ALL MODELS**

The strain relief connection on the outside of the enclosure is water-tight. Be sure to consult local wiring codes before applying power. Some installations will require rigid conduit. By removing the black strain relief connections from the outside of the enclosure, a conduit connection is accessible.

## Wiring Configurations

## IV - OPERATION

**NOTE:** Refer to the Appendix for application information and fluid charts.

### MICRO SWITCH ADJUSTMENT

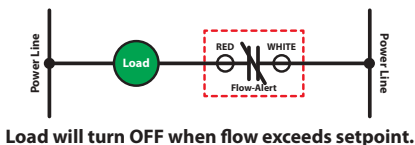
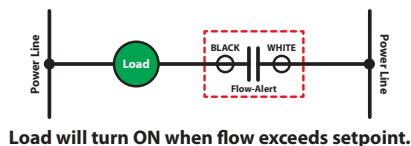
1. Remove cover screws and front cover.

**NOTE:** On meters equipped with dual micro switches, the right-side is the decreasing flow switch; the left-side is the increasing flow switch.

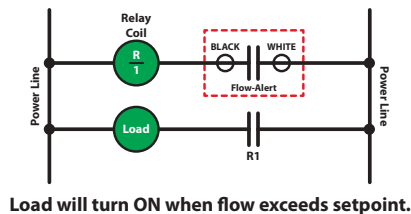
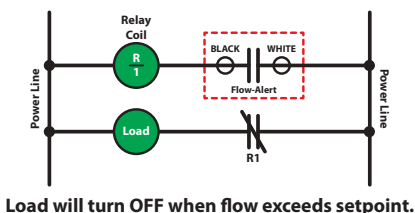
2. Loosen the screws securing the switching roller and latching rollers to the guide bar. Turn each screw one full turn maximum.
3. All rollers are secured as a set to the spacer strip. Slide the entire roller set until pointer is at the desired setting.

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

4. Make sure roller brackets are flush against the guide bar. Tighten roller screws.
5. For dual switch models, repeat steps 1-4 for left-side switch setting.

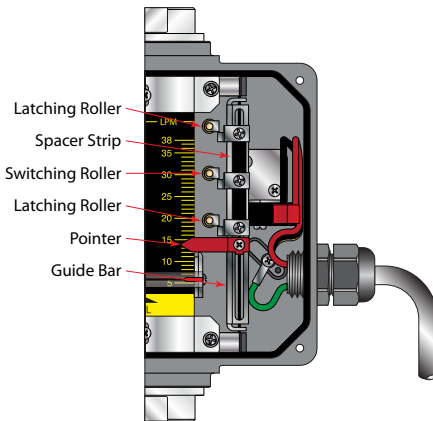


**FIGURE 7 - WIRING CONFIGURATION  
FOR LOADS WITHIN  
FLOW-ALERT CONTACT RATINGS**

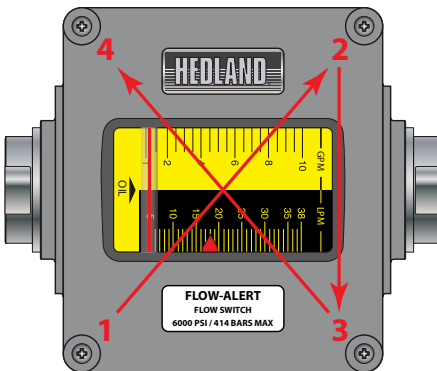


**FIGURE 8 - WIRING  
CONFIGURATION FOR LOADS THAT  
EXCEED FLOW-ALERT  
CONTACT RATINGS**

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 as show in **Figure 10**.



**FIGURE 9 - SNAP SWITCH  
ADJUSTMENT**



**FIGURE 10 - COVER SCREW  
TIGHTENING SEQUENCE**

### **Reed Switch Adjustment for ¼" Models**

1. Loosen the screw securing the switch assembly (**Figure 11**).
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.

### **Reed Switch Adjustment for ¼" to 1½" Models**

1. Remove cover screws and front cover.
2. Loosen the screw securing the switch assembly (**Figure 12**).

**NOTE:** On meters equipped with dual switches, the right-side is the decreasing flow switch; the left-side is the increasing flow switch.

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 left-side setting.
6. Install the front cover and gasket. To properly seat the cover gasket, tighten cover screws in a crisscross pattern as shown in **Figure 10**.

## V. MAINTENANCE

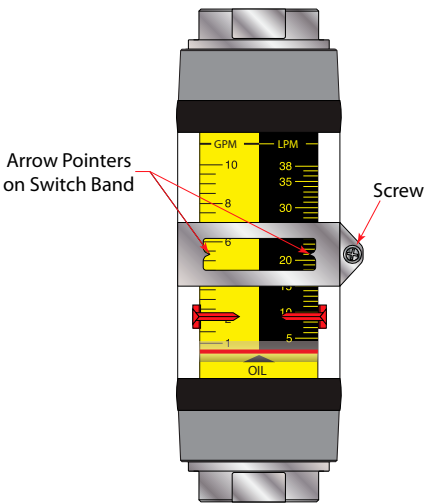
### **⚠ WARNING**

**Warning** - Disconnect electrical power before removing meter cover. Failure to follow these instructions could result in serious personal injury or death and/or damage to the equipment.

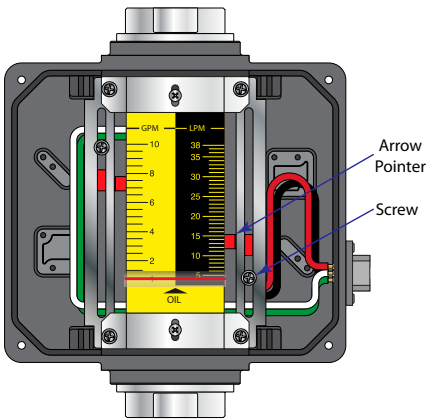
### **SWITCH REPLACEMENT**

#### **Micro Switch (Figure 13)**

1. Disconnect cable connection to the meter.
2. Remove screws securing cover and remove cover.
3. Note the positions of the colored wire connections on the switch. Disconnect the wires from the switch.
4. Remove the two mounting bracket screws at the bottom of the meter.
5. Remove mounting bracket/switch assembly from the meter. Remove the two screws securing switch to mounting bracket.
6. Install new switch to mounting bracket using screws removed in step 5.
7. Install wires to terminals on switch as marked in step 3.
8. Install mounting bracket/switch assembly to meter using screws removed in step 4.
9. Install the front cover and



**FIGURE 11 - REED SWITCH  
ADJUSTMENT - 1/4" MODELS**



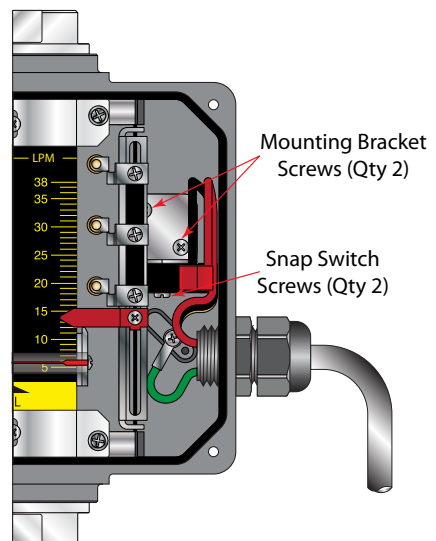
**FIGURE 12 - REED SWITCH  
ADJUSTMENT FOR  
1/4" - 1 1/2" MODELS  
(DUAL SWITCH SHOWN)**

gasket. To properly seat the cover gasket, tighten cover screws in a crisscross pattern as shown in **Figure 10** on page 10.

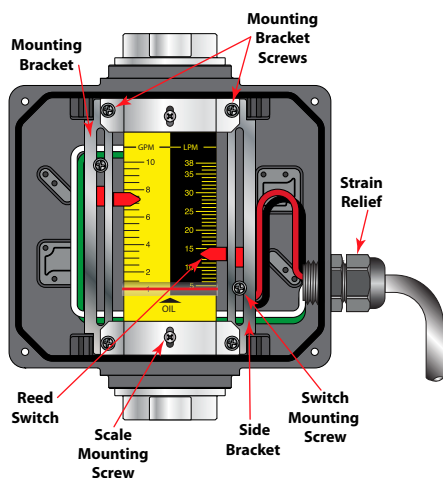
### Reed Switch (Figure 14)

1. Disconnect the Hirschmann connector and remove connector from wires.
2. Remove screws securing cover and remove cover.
3. Remove the two scale mounting screws.
4. Remove the screws securing the two mounting brackets and remove the brackets.
5. Loosen the two slide bracket screws.
6. Remove the switch mounting screw and remove mounting block/switch assembly from slide bracket.
7. Remove the two mounting screws securing switch to mounting block and pointer. Make note of switch position.
8. Install new switch to mounting block and pointer using screws removed in step 7.
9. Remove the strain relief.
10. Install mounting block/switch assembly to slide bracket using screw removed in step 6.
11. Tighten the slide bracket screws.
12. Install strain relief.

13. Install mounting brackets to scale using scale mounting screws. Do not fully tighten yet.
  14. Secure mounting brackets using screws removed in step 4.
  15. Tighten screws installed in step 10.
  16. Solder Hirschmann connector to new switch wires.
- NOTE:** For  $\frac{1}{4}$ ",  $\frac{1}{2}$ ",  $\frac{3}{4}$ " and 1" units, wire should be cut to 5" length. For  $1\frac{1}{4}$ " and  $1\frac{1}{2}$ " units, wire should be cut to 10" length.
17. Install the front cover and gasket. To properly seat the cover gasket, tighten cover screws in a crisscross pattern as shown in **Figure 10**.



**FIGURE 13 - MICRO SWITCH REPLACEMENT**



**FIGURE 14 - REED SWITCH  
REPLACEMENT**

### Cartridge Cleaning (Figure 15)

1. Disconnect the meter cable.
2. Remove the meter from the line. Remove excess piping from meter.

### **WARNING**

**Warning** - Before attempting to remove the 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.

**NOTE:** It is not necessary to remove the aluminum housing from the meter to remove it from the line.

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

### **CAUTION**

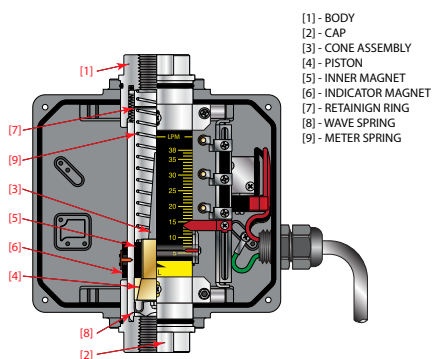
**Caution** - Do not use aromatic hydrocarbons, halogenated hydrocarbons, ketones or ester based fluids on polycarbonate lens. Failure to follow these instructions could result in damage to the meter.

4. Remove the inlet end fitting, retaining spring, and metering cone/spider plate assembly from the cartridge.
5. Gently push the cartridge assembly towards the outlet port while holding magnetic indicator assembly in place.
6. The cartridge internal parts are secured with a retaining ring. Remove the retaining ring and the remaining internal parts from the cartridge.

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

7. Place all parts on a clean work surface. Clean and inspect all parts. Replace any that appear worn or damaged.
8. Check inlet port O-ring for damage and replace if required.

9. Reassemble spring, then piston/magnet assembly and retaining ring into cartridge.
10. Gently push cartridge assembly into housing while holding the magnetic flow indicator in position.
11. Install metering cone/spider plate assembly, retaining spring, and secure with inlet fitting.
12. Reinstall meter to the line. Reconnect electrical power.



**FIGURE 15 - CARTRIDGE COMPONENTS**

## Quick Re-Coupling

This 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 meter.

However, on occasion, 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 re-couple 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 re-couple to the indicator ring.
- Remove cover and manually re-attach external flow indicator to internal magnet/piston assembly.
- For rigorous cyclical applications where de-coupling may occur frequently, consult the technical services staff for further recommendations.

VI - APPENDIX

APPLICATION  
INFORMATION - LIQUID

Viscosity Effect (SUS/cSt)

The design utilizes 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. Generally, high flow models of each meter size provide good accuracy over a viscosity range of 40 to 500 SUS (4.2 to 109 cSt).

Density Effect  
(specific gravity)

Any fluid density change from stated standards has a proportional effect on 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 meters

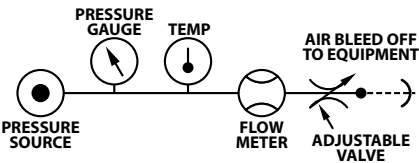
$$\sqrt{\frac{0.876}{\text{Specific Gravity}}}$$

for petroleum-based meters

APPLICATION  
INFORMATION - PNEUMATIC

**NOTE:** Pressure and temperature readings must be taken at the flow meter inlet to ensure 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 s.g. (70 °F @ 100 psi), and liter per second (lps) at 1.0 s.g. (21 °C @ 6.9 bar).



Conversion Chart

The Conversion Chart provides a series of simplified mathematical formulas to “correct” the graduated scale for changes in pressure (**Table 1**), temperature (**Table 2**), and/or specific gravity (**Table 3**). *Special scales can be made to accommodate other pressures, temperatures and specific gravity.*

The conversion chart can also be used to “correct” (adjust) the Multi-pressure Flow Scale to indicate flow rates in applications beyond the parameters stated on the scale.



**To adjust Pressures beyond  
(above or below) scale limits:**

**Step 1.** Locate point at which the brightly colored indicator line intersects the vertical 100 PSIG pressure line.

**Step 2.** Divide this reading by the Pressure Correction Factor ( $f_1$ ) indicated in the Conversion Chart.

**To adjust for changes  
in Temperature :**

**Step 1.** Divide the 100 PSIG flow rate reading by the Temperature Correction Factor ( $f_2$ ).

**To adjust for changes  
in Specific Gravity:**

**Step 1.** Establish the square root of the new specific gravity.

**Step 2.** Divide the 100 PSIG flow rate reading by the Specific Gravity Correction Factor ( $f_3$ ).

DETERMINE FLOW RATES USING DIFFERENT PRESSURES & 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 Pressure $f_3$ = Conversion Factor for Inlet Pressure					
Table 1 - Pressure Correction Factor ( $f_1$ ) Operating Pressure										
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	1.00	.902	.835	.778	.731	.692	.658
$f_1 = \sqrt{\frac{114.7}{14.7 + psig}} \qquad f_1 = \sqrt{\frac{7.914}{1.014 + BAR}} \qquad f_1 = \sqrt{\frac{790.857}{101.357 + kPa}}$										
Table 2 - Temperature Correction Factor ( $f_2$ )										
°F	+10	+30	+50	+70	+90	+110	+130	+150	+170	+190
°C	-12.2	-1.1	+9.9	+21.0	+32.1	+43	+54	+65	+76	+88
$F_2$	.942	.962	.981	1.00	1.018	1.037	1.055	1.072	1.090	1.107
$f_2 = \sqrt{\frac{460 + ^\circ F}{530}} \qquad f_2 = \sqrt{\frac{273 + ^\circ C}{293}}$										
Table 3 - Specific Gravity Correction Factor ( $f_3$ )										
$f_3 = \sqrt{Sp.Gr.}$										

FIGURE 16 - CONVERSION CHART

LIQUIDS												
Fluid	Specific Gravity	Correction Factor		Aluminum	Brass	T316 SST	T303 SST	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 Disulphide	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

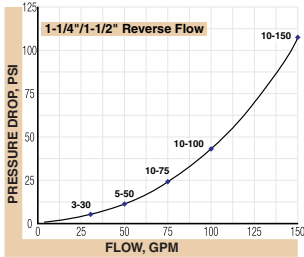
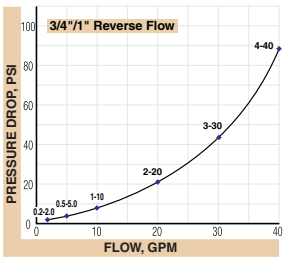
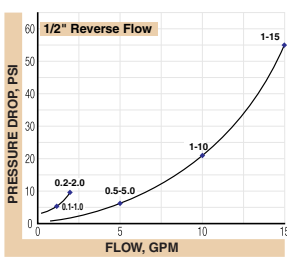
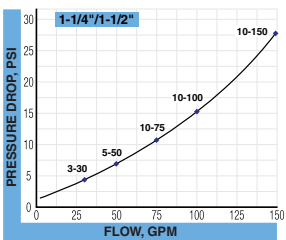
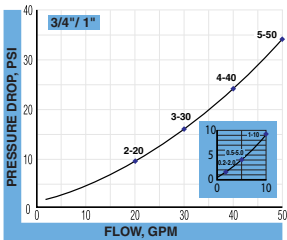
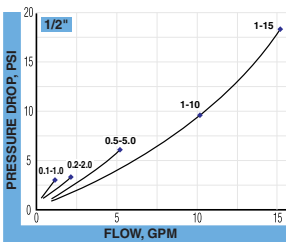
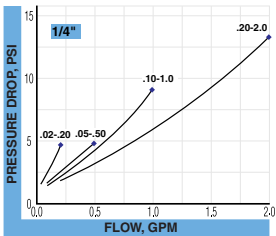
R - Recommended N - Not Recommended C - Consult Factory

**FIGURE 17 - FLUID SELECTION CHART (LIQUIDS)**

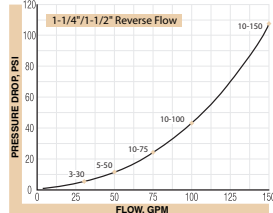
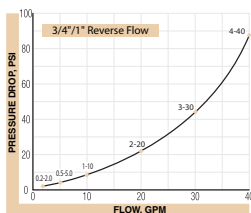
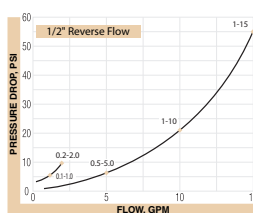
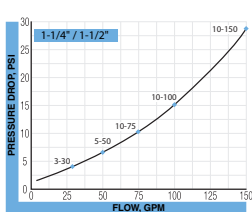
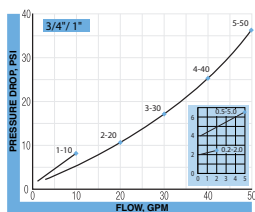
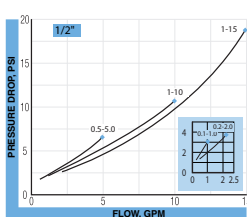
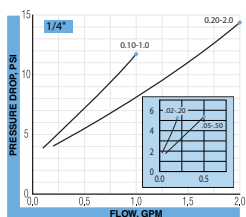
GASES											
Fluid	Specific Gravity	Correc- tion Factor	Aluminum	Brass	T316 SST	T303 SST	Viton®	EPR	Polycarbonate	Nylon	Pyrex®
Air	1.0	1.000	R	R	R	R	R	R	R	R	R
Argon (A)	1.38	1.175	R	R	R	R	R	R	R	R	R
Carbon Dioxide (CO <sub>2</sub> )	1.53	1.237	R	R	R	R	R	R	R	R	R
Freon 11 (CCl <sub>3</sub> F)	4.92	2.218	R	R	R	R	R	R	R	R	R
Freon 12 (CCl <sub>2</sub> F)	4.26	2.060	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 <sub>2</sub> )	0.07	0.265	R	R	R	R	R	R	R	R	R
Natural Gas	0.60	0.775	C	C	R	C	R	<b>N</b>	C	R	R
Nitrogen (N <sub>2</sub> )	0.97	0.985	C	C	R	R	R	R	C	R	R
Oxygen (O <sub>2</sub> )	1.10	1.049	R	R	R	R	R	R	R	R	R
Propane (C <sub>3</sub> H <sub>8</sub> )	1.57	1.253	R	R	R	R	R	<b>N</b>	<b>N</b>	R	R
R - Recommended <b>N</b> - Not Recommended C - Consult Factory											

**FIGURE 18 - FLUID SELECTION CHART (GASES)**

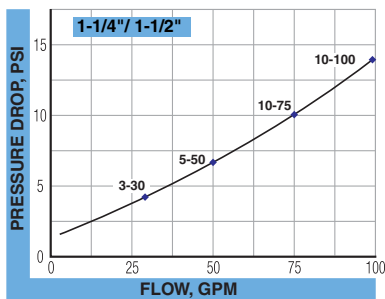
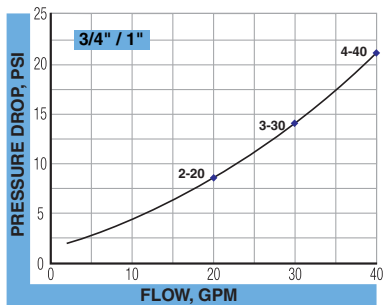
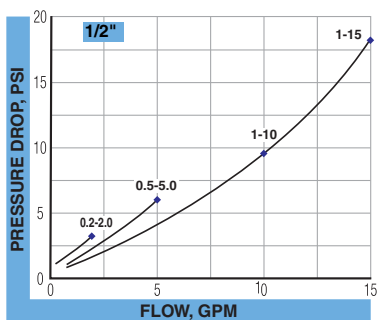
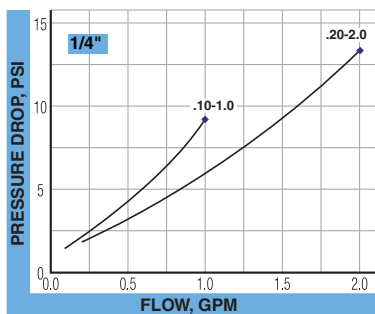
# FLOW VS. PRESSURE DROP



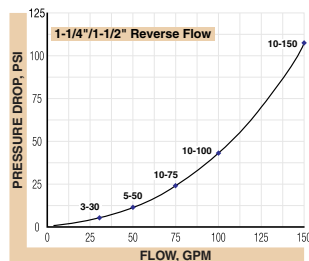
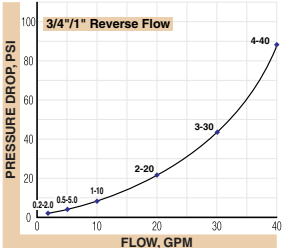
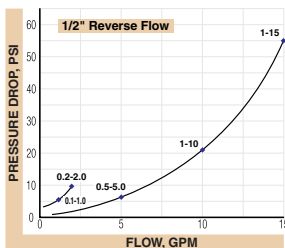
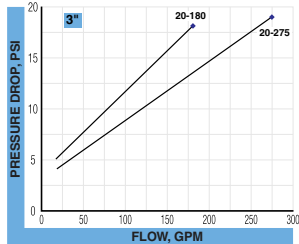
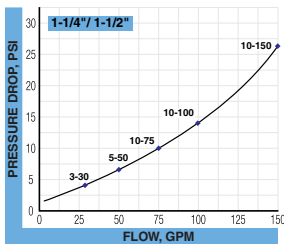
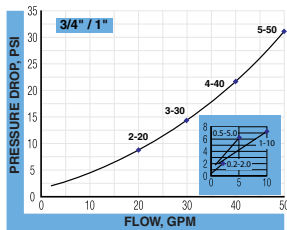
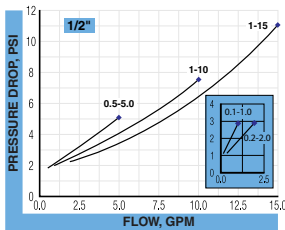
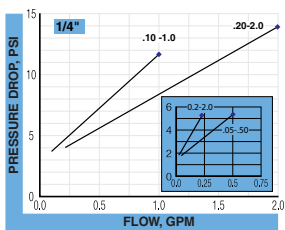
## PETROLEUM FLUIDS



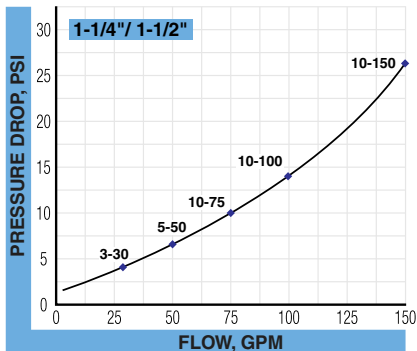
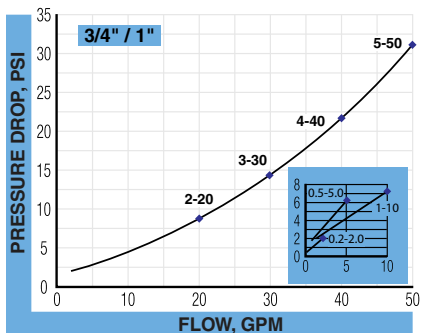
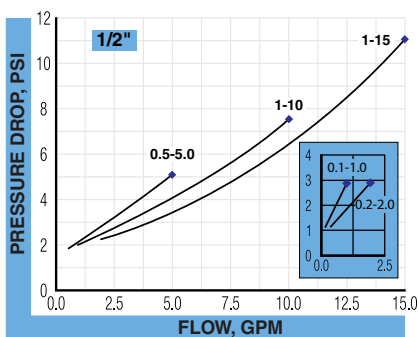
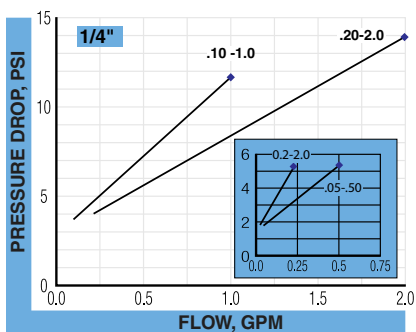
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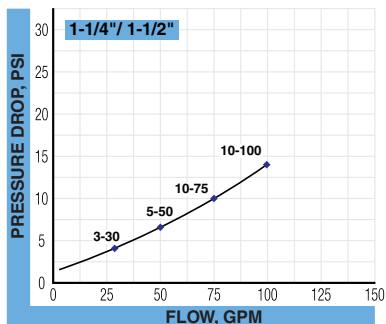
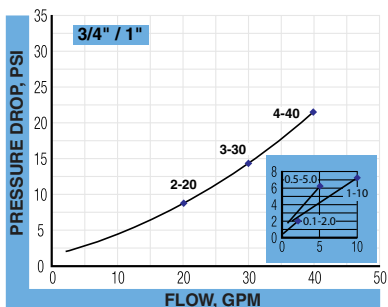
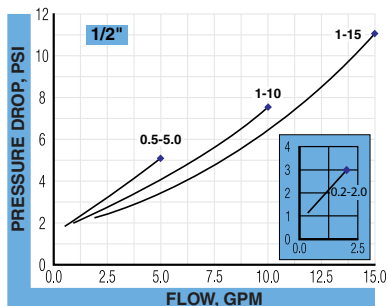
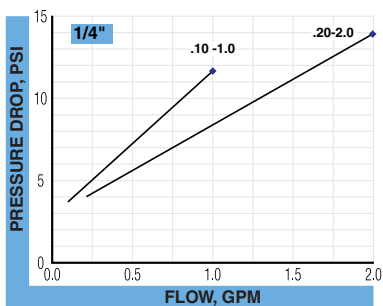
## A.P.I. OIL



## WATER-BASED FLUIDS

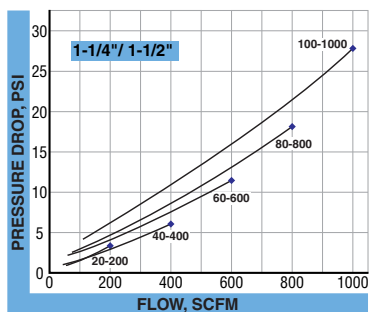
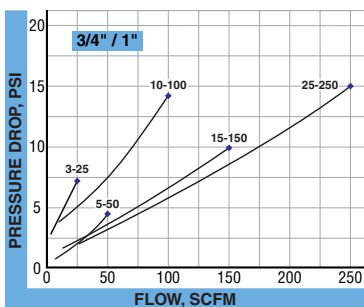
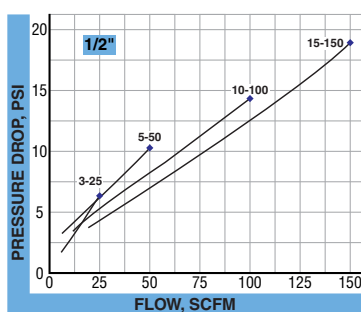
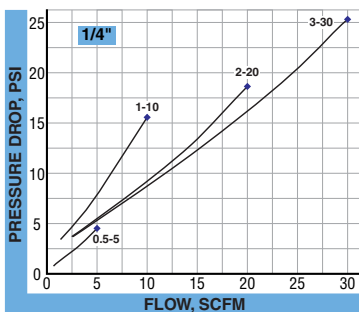


## WATER

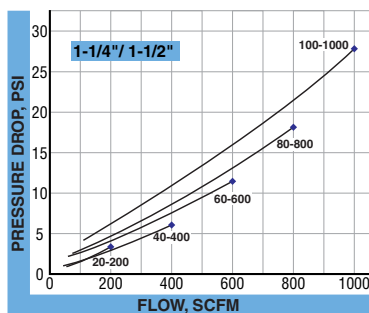
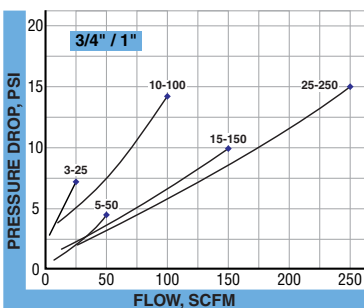
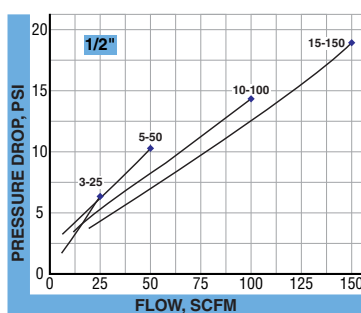
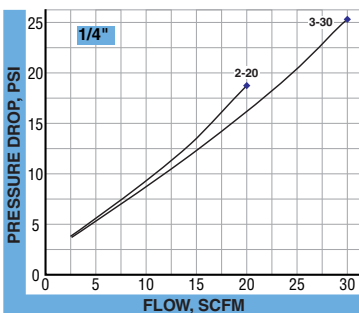


## CAUSTIC AND CORROSIVE LIQUIDS





## AIR / COMPRESSED GASES



## AIR / CAUSTIC AND CORROSIVE GASES

# NOTES



## Badger Meter Warranty Flow-Alert Flow Switch

### PRODUCTS COVERED

The Badger Meter warranty shall apply to the Hedland Flow-Alert Flow Switch ("Product").

### MATERIALS AND WORKMANSHIP

Badger Meter warrants the Product to be free from defects in materials and workmanship for a period of 12 months from the original purchase date.

### PRODUCT RETURNS

Product failures must be proven and verified to the satisfaction of Badger Meter. The Badger Meter obligation hereunder shall be limited to such repair and replacement and shall be conditioned upon Badger Meter receiving written notice of any asserted defect within 10 (ten) days after its discovery. If the defect arises and a valid claim is received within the Warranty Period, at its option, Badger Meter will either (1) exchange the Product with a new, used or refurbished Product that is at least functionally equivalent to the original Product, or (2) refund the purchase price of the Product. **DO NOT RETURN ANY PRODUCT UNTIL YOU HAVE CALLED THE BADGER METER CUSTOMER SERVICE DEPARTMENT AND OBTAINED A RETURN AUTHORIZATION.**

Product returns must be shipped by the Customer prepaid F.O.B. to the nearest Badger Meter factory or distribution center. The Customer shall be responsible for all direct and indirect costs associated with removing the original Product and reinstalling the repaired or replacement Product. A replacement Product assumes the remaining warranty of the original Product or ninety (90) days from the date of replacement, whichever provides longer coverage.

### LIMITS OF LIABILITY

This warranty shall not apply to any Product repaired or altered by any Product other than Badger Meter. The foregoing warranty applies only to the extent that the Product is installed, serviced and operated strictly in accordance with Badger Meter instructions. The warranty shall not apply and shall be void with respect to a Product exposed to conditions other than those detailed in applicable technical literature and Installation and Operation Manuals (IOMs) or which have

been subject to vandalism, negligence, accident, acts of God, improper installation, operation or repair, alteration, or other circumstances which are beyond the reasonable control of Badger Meter.

With respect to products not manufactured by Badger Meter, the warranty obligations of Badger Meter shall in all respects conform and be limited to the warranty extended to Badger Meter by the supplier.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES WHATSOEVER, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (except warranties of title).

Any description of a Product, whether in writing or made orally by Badger Meter or its agents, specifications, samples, models, bulletins, drawings, diagrams, engineering sheets or similar materials used in connection with any Customer's order are for the sole purpose of identifying the Product and shall not be construed as an express warranty. Any suggestions by Badger Meter or its agents regarding use, application or suitability of the Product shall not be construed as an express warranty unless confirmed to be such, in writing, by Badger Meter.

### EXCLUSION OF CONSEQUENTIAL DAMAGES AND DISCLAIMER OF OTHER LIABILITY

Badger Meter liability with respect to breaches of the foregoing warranty shall be limited as stated herein. Badger Meter liability shall in no event exceed the contract price. **BADGER METER SHALL NOT BE SUBJECT TO AND DISCLAIMS: (1) ANY OTHER OBLIGATIONS OR LIABILITIES ARISING OUT OF BREACH OF CONTRACT OR OF WARRANTY, (2) ANY OBLIGATIONS WHATSOEVER ARISING FROM TORT CLAIMS (INCLUDING NEGLIGENCE AND STRICT LIABILITY) OR ARISING UNDER OTHER THEORIES OF LAW WITH RESPECT TO PRODUCTS SOLD OR SERVICES RENDERED BY BADGER METER, OR ANY UNDERTAKINGS, ACTS OR OMISSIONS RELATING THERETO, AND (3) ALL CONSEQUENTIAL, INCIDENTAL AND CONTINGENT DAMAGES WHATSOEVER.**

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