AW-LAKE COMPANY | LAKE MONITORS

Flow Rate Alarms

Installation, Operating & Maintenance Manual

Technical Specifications

Measuring Accuracy
±2.0% of full scale (liquid)
±2.5% of full scale in the center third of the measuring range (pneumatic); ±4% in upper and lower thirds (pneumatic)

Repeatability
±1% of full scale

Flow Measuring Range
0.1–150 GPM (0.5–550 LPM)
2.0–1300, SCFM (1.0–600 SLPS)

Maximum Operating Pressure
Aluminum and brass meters: 3500 PSIG (240 Bar)
Stainless steel meters: 6000 PSIG (410 Bar)
Aluminum & brass: 600 PSIG (40 Bar) & 1000 PSIG (69 Bar) (pneumatic)
Stainless steel: 1000 PSIG (69 Bar) (pneumatic)

Maximum Operating Temperature
Media: 185˚F (85°C)
Ambient: 185˚F (85°C)

Standard Calibration Fluids
Oil meters: DTE 25® @ 110°F (43°C), 0.873 sg
Water meters: tap water @ 70°F (21°C), 1.0 sg
Air meters: air @ 70°F (21°C), 1.0 sg and 100 PSIG (6.8 Bar)

Alarm Switch Dead-band
4% of full scale

Alarm Switch Contacts
SPDT (dry contact), UL/CSA rating: 10 amps and 1/4 hp, 125 or 250 VAC. 1/2 amp, 125 VDC; 1/4 amp, 250 VDC; 3 amps, 125 VAC “L” (lamp load)

Filtration Requirements
74 micron filter or 200 mesh screen minimum

24 – Port sizes availble from 1/4” to 2” in NPTF, SAE, and BSPP

DTE 25 is a registered trademark of Exxon Mobil.

Enclosure Materials of Construction (non-wetted components)

Enclosure & Cover	Painted Aluminum
Seals	Buna-N®
Window	Pyrex®
Din Connector	Polyamide

Buna-N® is a registered trademark of Chemische Werke Huls. Pyrex® is a registered trademark of Corning Incorporated.

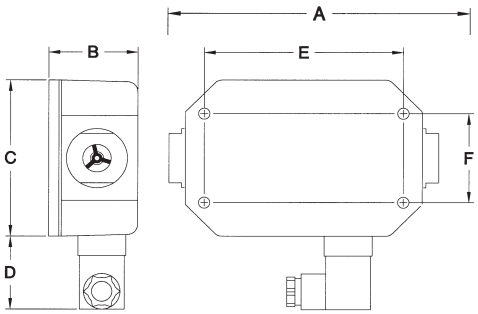
Flow Meter Materials of Construction (Wetted Components)

Casing & End Ports	Anodized Aluminum	Brass	Stainless Steel
Seals	Buna-N® (STD), EPR, FKM or Kalrez®	Buna-N® (STD), EPR, FKM or Kalrez®	FKM with PTFE backup (STD), Buna-N®, EPR or Kalrez®
Transfer Magnet	PTFE coated Alnico	PTFE coated Alnico	PTFE coated Alnico
All other internal parts	Stainless Steel	Stainless Steel	Stainless Steel

Kalrez is a registered trademark of DuPont Incorporated.

Mechanical - Size Code

DIM	Series 3	Series 4	Series 5	Series 5 (2” port only)
A	6-9/16” (167mm)	7-5/32” (182mm)	10-1/8” (258mm)	12-5/8” (322mm)
B	2-3/16” (56mm)	2-15/16” (75mm)	3-13/16” (97mm)	3-13/16” (97mm)
C	4” (101mm)	4-1/2” (114mm)	5-5/16” (135 mm)	5-5/16” (135mm)
D	1-7/8” (47mm)	1-7/8” (47mm)	1-7/8” (47mm)	1-7/8” (47mm)
E	4-7/8” (128mm)	5” (127mm)	6-3/4” (172mm)	6-3/4” (172mm)
F	2-1/4” (57mm)	2-7/8” (73mm)	3-3/4” (95mm)	3-3/4” (95mm)



Introduction

This manual is a service guide produced by the manufacturer and provides specific procedures and/or illustrations for disassembly, assembly, inspection, cleaning, and filtration. When followed properly, these procedures will keep your flow meter in top operating condition.

It is important for operators and maintenance personnel to be safety conscious when operating or repairing equipment. Developing a thorough knowledge of the precautionary areas and following safe operating procedures can prevent equipment damage and/or personal injury. Before making any repair, read all of the repair procedures to learn the correct method and all precautions.

Table of Contents

Basic Application Information

The flow meter can be installed directly in the fluid line without flow straighteners or special piping. The meter is used to measure the flow rate of most liquids which do not contain particles greater than 74 micron.

1. Internal components are sealed inside a painted aluminum enclosure which permit use in areas where the meter may be sprayed or washed with soap and water.
2. Mount the meter in the most convenient location to allow easy access for reading and maintenance.
3. The meter should NOT be mounted near hot pipes or equipment that can increase the ambient temperature above the meter rating. The meter should be mounted at least one foot (.3 meter) from large electric motors, or the internal magnet may weaken or become demagnetized.

Warning and Precautionary Areas

1. The standard meters are designed to operate in systems that flow in only one direction: the direction of the arrow on the flow scale. Attempting operation in the reverse direction may cause damage to the meter or other system components. (See page 7 for reverse flow information)
2. To retain accuracy and repeatability many internal moving parts are precision machined and require filtration of at least 74 micron or a 200 mesh screen.
3. All liquid meters are tested and calibrated at our test facility using a light hydraulic oil (DTE 25®) or water. The units are well drained, but some oil residue may still remain within the meters. Please check the compatibility with your fluid. The meter may have to be cleaned before use. (See "Cleaning & Inspection" section)
4. When installing aluminum or brass meters onto steel pipe caution should be

taken not to over tighten the pipe connections. The thread in the meter end fittings may strip if over tightened.

5. It is not recommended to install meters to unsupported piping.
6. Operating Pressure: Meters should not be used above the maximum rated operating pressure.
7. Pressure and flow surges may disengage the outer magnet follower from the transfer magnet. If this occurs, a shock suppressor should be used to eliminate malfunction.
8. Thread seal tape: Caution should be used when using Thread seal tape on pipe thread joints. Leave the first thread of pipe thread exposed from end of pipe when applying tape.
9. These meters, as well as many other meters, use an internal transfer magnet in the design. Because of this magnet, be aware of the following:
    a) Do not install near highly magnetic devices
    b) If metal particles are moving through the system, a magnetic filter may be required.

WARNING: Never subject an empty flow meter to an immediate high fluid flow. Always purge air from meters by gradually increasing system fluid flow. A sudden slug of high velocity liquid into an empty flow meter can cause permanent damage to the internals.

Installation

Basic Installation Instructions

The meters are mounted in-line and are direct reading. The meters can be mounted in a vertical or horizontal position as long as the fluid is flowing in the direction of the arrow on the scale. No straight pipe is required before or after the meter.

When installing a meter, apply “Thread seal Tape” or “Liquid Thread Sealant” on pipe threads. If tape is used, be sure to leave the first pipe thread on end of pipe exposed. Position filter in front of meter and in a location that allows easy access for routine maintenance. Refer to “Warnings and Precautionary Areas” for additional information.

INSTALLATION DOS AND DON’T

To obtain satisfactory operation from a flow meter, the following points should be considered:

DO:

- Install a pressure gauge near the inlet of the meter
- Place throttling valves at the outlet of the meter
- Use pipe sealer on the connections
- Install a union on one side of the meter for easy removal for maintenance and calibration
- Install solenoid valves at meter outlet (as far downstream as possible)
- Mount either vertically or horizontally

DO NOT:

- Use in systems where reverse flow is possible unless using RF option
- Place meter in non-aligned piping
- Over-flow the meter by more than 50% of maximum reading
- Operate at pressures and temperatures greater than specified
- Install restrictions between pressure gauges and the meter inlet
- Install solenoid valves at the meter inlet

Fluid Flow in Reverse Direction

The standard meter should not see flow in the reverse direction (opposite direction to the arrow printed on the flow rate scale). Prolonged flow in the reverse direction will cause damage to the standard meter's internal mechanism that could result in inaccurate readings or premature failure of the meter. If the standard meter will be installed in a system where reverse flow is possible, Lake recommends that a check valve be installed in parallel with the meter in order to facilitate reverse flow around the meter. Check valves are readily available through fluid component distributors.

Alternatively, flow meters designed to allow reverse flow may be specified. These meters do not measure in reverse flow. These meters are designated by a "-RF" suffix attached to the end of the standard 8-digit model code.

Reverse flow meters will allow flows in the reverse direction of up to the maximum flow rate printed on the flow rate scale without any damage to the meter's internals.

Operation

Operating Principles: Mechanical

We have developed a line of unique flow meters which combine the simplicity of a sharp-edged orifice disk and a variable area flow meter. See Illustration 1 “Flow Meter Cross Section”.

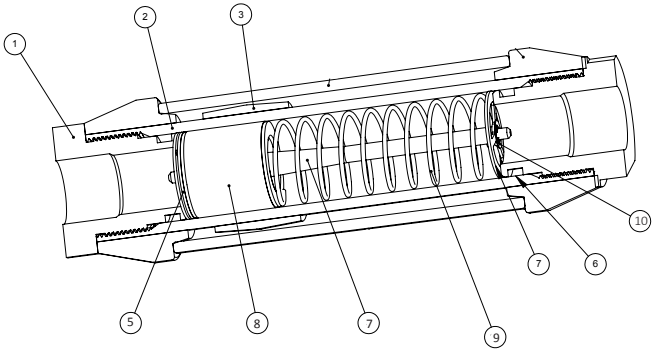
The meters are tubular, with all internal wetted parts sealed within the body casing. Running through the center of the body casing is a tapered center shaft which is centered in the bore by pilot disks at each end. Encircling the shaft is a sharp-edged, floating orifice disk, transfer magnet and return spring. The disk and transfer magnet are held in the “no flow” position by the biased return spring.

As the flow moves through the meter it creates a pressure differential across the floating orifice disk, forcing the disk and transfer magnet against the return spring. As flow increases, the pressure differential across the disk increases, forcing the disk and transfer magnet to move along the tapered center shaft. As flow decreases, the biased return spring forces the disk and transfer magnet down the tapered center shaft, returning to the “no flow” position.

In metal casing meters the movement of the floating orifice disk and transfer magnet cannot be seen because they are sealed inside the body casing. Therefore, a magnet follower is positioned around the outside of the body casing

Illustration 1

Flow Meter (Cross Section)



1. End Porting
2. Body Casing
3. Magnet Follower
4. Seal Assembly
5. Pilot Disk
6. Flowing Sharp-Edged Orifice Disk
7. Tapered Center Shaft
8. Transfer Magnet
9. Return Spring
10. Retainer Ring

and is magnetically coupled to the internal transfer magnet. As the flow rate increases, the internal magnet moves along the tapered center shaft (inside the body casing) and the magnet follower moves along the outside of the body casing (under the scale).

Reading the Meter

Notice the black reference line which runs 360° around the white magnetic follower. This reference line moves under the scale in direct relation to the movement of the internal orifice disk. When fluid is flowing, the flow rate through the meter is read by lining up the black reference line with the closest rate line on the external flow scale.

Specific Gravity or Density Effect

Standard meters are calibrated for either water with a specific gravity of 1.0, oil with a specific gravity of .873 or air at specific gravity 1.0. The floating disk meter is affected by fluid density as are most other similar type meters. These meters have less of this effect because of the sharpness of the floating orifice disks being used.

The indicated flow reading will read high for heavier fluids and low for lighter fluids. A corrective factor can be applied to the standard scale or a special scale can be added at a slight additional costs. When measuring fluids with other specific gravities, the basic equations below can be used to develop corrected readings.

For AIR Meters use: √1.0/Specific Gravity x scale reading
For WATER Meters use: √1.0/Specific Gravity x scale reading
For OIL Meters use: √.873/Specific Gravity x scale reading

Viscosity Effect

The meters incorporate a unique floating, sharp-edged orifice disk. The floating, sharp-edged orifice disk offers greater operating stability and accuracy over a wide range of viscosities. Standard viscosities up to 110 cSt. For viscosities between 110 to 430 cSt contact factory.
Special Scales
Special calibrations can be performed by the factory to correct for the following system characteristics:
•

Special Scales

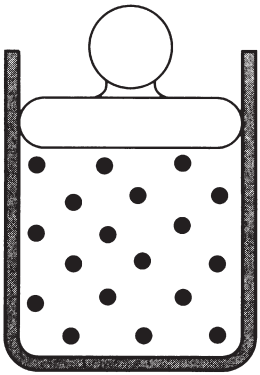
- Special calibrations can be performed by the factory to correct for the following system characteristics:
- System temperature
- Media specific gravity
- Various measuring units (i.e. LPM, LPS, m3/hr, etc.)
- Viscosity
- Any combination of the above

Consult factory or your distributor for details and prices.

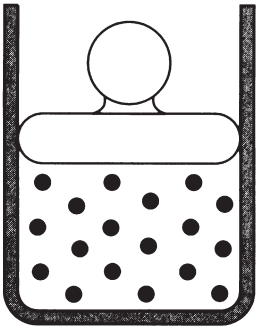
Pneumatic Meter

Illustration 2

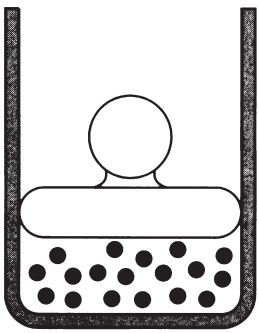
14.7 PSIA (0 PSIG)



29.4 PSIA (14.7 PSIG)



58.8 PSIA (44.1 PSIG)



Standard Cubic Feet

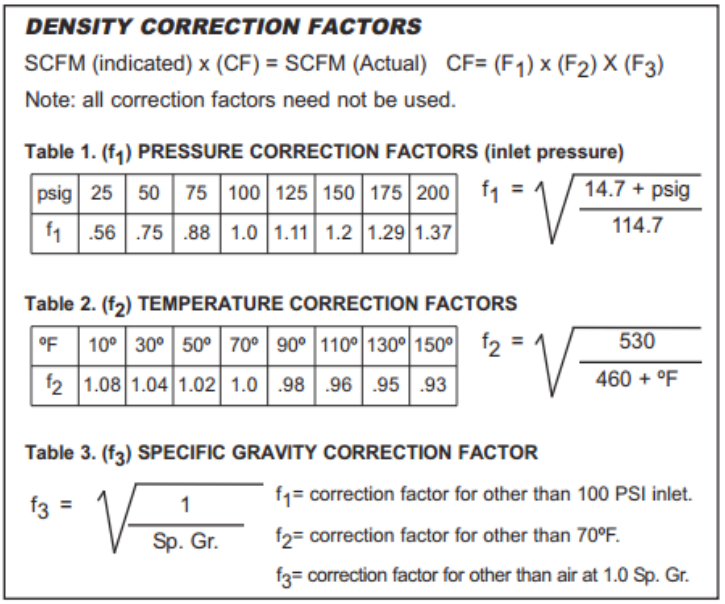
Pneumatic meters are calibrated to measure the flow of compressible media (gases) in SCFM – standard cubic feet per minute. A "standard" cubic foot is defined as a cubic foot of dry air at standard atmospheric conditions: 70°F and 14.7 PSIA (0 PSIG) measured at sea level.

When a standard cubic foot of air is compressed, its actual volume will decrease proportionally as absolute pressure increases. For example, a standard cubic foot of air's actual volume will decrease by 50% and density will increase by 100% as the air is compressed from atmospheric pressure 14.7 PSIA (0 PSIG) to 29.4 PSIA (14.7 PSIG). **See Illustration 2**.

There are three factors that affect the Flow Meter Calibration: specific gravity, pressure and temperature. Pneumatic meters are calibrated for air (specific gravity of 1.0) at 70°F and 100 PSIG. Most low pressure rotameters are calibrated at 0 PSIG and require corrections for use at any other pressure.

Pneumatic products are designed for pneumatic systems where pressures between 90 –110 PSIG are used. In these common applications, a meter with a standard calibration can be read directly without applying corrections.

Figure 1.



DENSITY CORRECTION FACTORS

SCFM (indicated) x (CF) = SCFM (Actual) CF= $(F_1) \times (F_2) \times (F_3)$

Note: all correction factors need not be used.

Table 1. (f_1) PRESSURE CORRECTION FACTORS (inlet pressure)

psig	25	50	75	100	125	150	175	200
f_1	.56	.75	.88	1.0	1.11	1.2	1.29	1.37

$$f_1 = \sqrt{\frac{14.7 + psig}{114.7}}$$

Table 2. (f_2) TEMPERATURE CORRECTION FACTORS

°F	10°	30°	50°	70°	90°	110°	130°	150°
f_2	1.08	1.04	1.02	1.0	.98	.96	.95	.93

$$f_2 = \sqrt{\frac{530}{460 + °F}}$$

Table 3. (f_3) SPECIFIC GRAVITY CORRECTION FACTOR

$$f_3 = \sqrt{\frac{1}{Sp.\ Gr.}}$$

f_1= correction factor for other than 100 PSI inlet.

f_2= correction factor for other than 70°F.

f_3= correction factor for other than air at 1.0 Sp. Gr.

Correction Factors

If a flow meter is installed in a system where conditions differ from the standard listed in Figure 1. correction factors will need to be applied to retain the design accuracy of the meter. The appropriate correction factor equations are detailed above. To assure the best monitoring accuracy, pressure and temperature measurements should be taken directly at the meter's inlet port.

Selecting the Proper Meter

To order a pneumatic flow meter the following information is required:

- Pipe size and port style
- Media (air, nitrogen, argon etc.) – for material compatibility and specific gravity considerations
- Flow range required
- Nominal System pressure
- System temperature

General Information

The Flow Alarms incorporates a NO (normally open) or NC (normally closed) switch that can be used to signal a limit setting. The switch may be used to turn on a warning light, sound a bell or horn, or even to shut down a process. The switches on the alarm can be configured to open or close a contact for an increasing or decreasing set point. Single switch units are built to switch in the lower 2/3 of the scale. For units that need to switch in the upper 2/3 of the scale, please contact the factory.

Overview

Illustration 1 shows the primary mechanism for a single-switch flow alarm. Dual-switch flow alarms contain two sets of these same components, but have a slightly different electrical wiring diagram (Wiring to the DIN connector is described on page 18.) The factory default configuration for the alarm switch is for decreasing flow, as shown in Illustration 1. Dual alarm units contain one additional switch configured for increasing flow. If an increasing flow alarm is desired, it should be specified when the unit is ordered.

The pointer indicates the set point for the alarm switch. In Illustration 1, the switch will be actuated at all flow rates below 4 GPM. To change the set point, simply loosen the switch glide screw one (1) turn and slide the switch to the desired position along the flow rate scale. When the pointer is pointing to the desired flow rate, re-tighten the switch glide screw.

CAUTION: Do not over tighten set screw.

Illustration 1

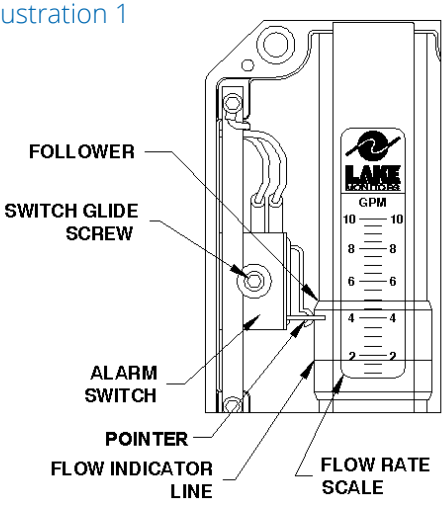


Illustration 2

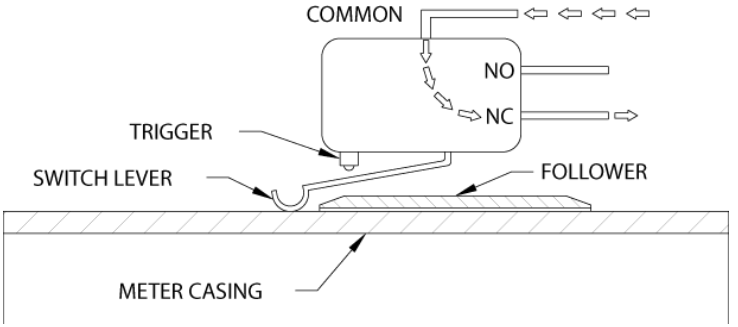
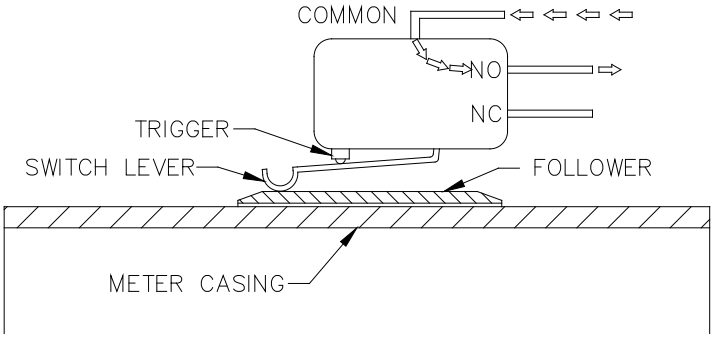


Illustration 3



Switches

The switch is a simulated roller, lever operated low force microswitch. The specifications for this switch are listed on page 18. The switch is actuated when movement of the follower causes the switch lever to be lifted. In Illustration 2, the switch has not yet been actuated, and the electrical circuit is through the normally closed (NC) contact. Illustration 3 shows the switch after it has been actuated. In this scenario, the electrical circuit is through the normally open (NO) contact.

Precautions

- Be certain to properly ground the unit via the ground (G) pin located on the unit's din connector.

- In order to avoid accidentally removing the switch glide screw, never loosen it by more than one or two turns. This screw can be difficult to replace if accidentally removed.
- Avoid over tightening the switch glide screw.
- When the switch adjustments are complete, make certain that the wires that are attached to the switch have not been moved into a location that will interfere with the follower or the switch lever.
- Do not make any modifications to the unit's internal wiring.

Electrical Connections

Standard Flow Alarms are pre-wired with 4-pin Hirschmann-type DIN connectors which consist of a male section as shown in Illustration 4 and the female section shown in Illustration 5. To open the female section, first remove 16 the screw, then lift the connector portion out of the casing by inserting the head

Illustration 4

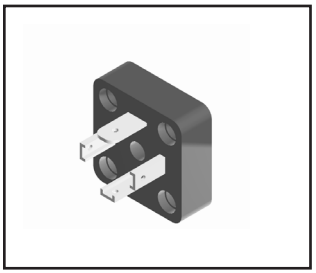


Illustration 5

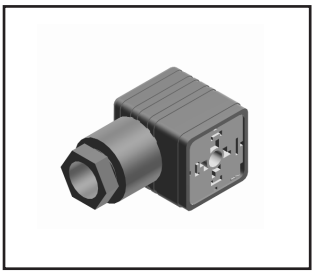
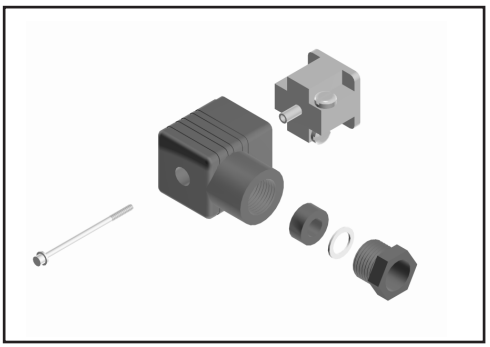


Illustration 6

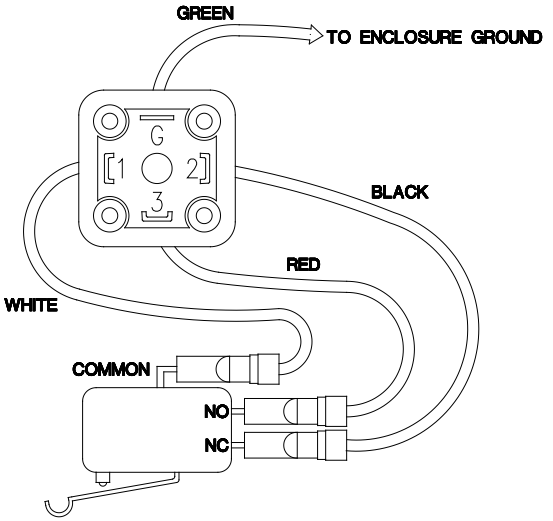


of a screwdriver into the slot marked for that purpose. Illustration 6 shows the disassembled female section.

Illustration 7 shows the connections for a standard, single switch Flow Alarm as they are shipped from the factory. The wiring for other types of connections are outlined in the tables below. For additional details, please consult the factory or your authorized distributor.

Alternates to the standard Hirschmann-type DIN connector are available on a custom basis. The Flow Alarm may be outfitted with a variety of different electrical connections including conduit fittings, cable-type connectors and cord grip/pigtail interfaces.

Illustration 7



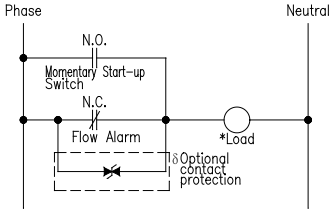
Switches Specifications	
Type	Form C, dry contact
UL/CSA Rating	10 & 1/4 hp, 125 VDC & 1/4A, 250 VDC 4A, 125 VAC "L" lamp load
Mechanical Life	>10,000,000 cycles
Actuating Mechanical	Simulated roller, lever operated, low force
Connectors	0.25" x 0.032"

Wiring Code: Standard Single Switch	
White - Common	Terminal #1 of DIN
Black - N.C. Contact	Terminal #2 of DIN
Red - N.O. Contact	Terminal #3 of DIN
Green - Enclosure Ground	Terminal “G” of DIN

Wiring Code: Dual Switch Alarm	
White - Both Common	Terminal #1 of DIN
Black - Decreasing N.O. Contact	Terminal #2 of DIN
Red - Increasing N.O. Contact	Terminal #3 of DIN
Green - Enclosure Ground	Terminal “G” of DIN

Standard Control Circuits

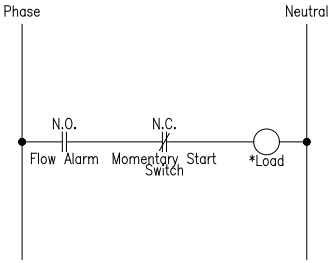
ACTION:
Flow Alarm will turn OFF the circuit.



* The load must be within the Flow Alarm’s contact rating. Please see specifications.

δ If highly inductive loads (large relay coils, solenoids, etc.) are going to be switched repeatedly, an MOV (300 Vrms, 0.4 Watt) will increase switch life.

ACTION:
Flow Alarm will turn ON the circuit.

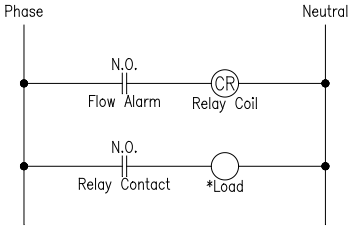


* The load must be within the Flow Alarm’s contact rating. Please see specifications.

Connection of Slave Relays

If the load to be controlled with the Flow Alarm is greater than the carrying capacity of the Flow Alarm’s contacts, a slave relay is required.

ACTION:
Flow Alarm will turn ON the circuit.

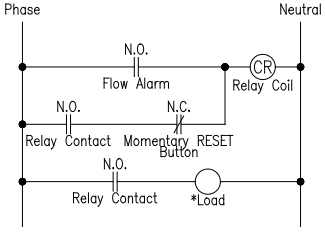


* The load must be within the Flow Alarm’s contact rating. Please see specifications.

Latching Slave Relay Circuit

The alarm circuit will remain energized until either the RESET button is pressed or until power is removed from the circuit.

ACTION:
Flow Alarm will turn ON the circuit.



* The load must be within the Flow Alarm’s contact rating. Please see specifications.

Troubleshooting & Maintenance

TROUBLESHOOTING CHART	
Malfunction: Magnet follower sticks in mid-scale and will not return to the "no flow" position.	
Possible Cause: *Horizontal/Vertical Mount* Particulate, thread seal tape, rust or other foreign matter is holding the internal parts form returning. *Horizontal/Vertical Mount* A surge or shock in the fluid flow moved the internal magnet faster then the external follower could follow, thus separating the follower from the magnet.	**Corrective Action:** Disassemble and inspect meter for contamination. Install proper filtration or problem may reoccur.
WARNING: Shut down systems before removing meter from flow line. Remove meter from system. Tip the meter so the arrow on the flow scale points upward. This should return the magnet follower to the "no flow" position. Add some type of surge protection, or problem may reoccur.	
Malfunction: Meter scale reading is off an equal amount at all points and the magnet follower still moves freely.	
Possible Cause: Reading the scale using the top or bottom edge of the magnet follower.	**Corrective Action:** Be sure to read the scale using the black reference line which runs around the magnet follower.
Possible Cause: Fluid being monitored may not be compatible with standard meter scale.	**Corrective Action:** Standard meters are calibrated for .873 SP. Gr oil at 110°F (43°C) and water 1.0 SG at 70°F (21°C). Check your fluid data for variance or call the factory for assistance.

TROUBLESHOOTING CHART	
Malfunction: Window tube is cracking or crazing.	
Possible Cause:	**Corrective Action:**
Using incompatible cleaning solution on polycarbonate window tube.	Use soap & water or a mild degreaser (Stoddard or Naptha) to clean window tube.

Disassembly

WARNING: Shut down system before removing meter from flow line.

1. Use a clean dry cloth to remove all foreign material from flow line.
2. Use a clean dry cloth to remove all foreign material from exterior of meter, especially around threaded ends.
3. Remove meter from the flow line.
4. Remove cover and scale plate from enclosure.
5. Mount the meter in a vice. See Illustration 3. Use the flats of the inlet end porting when securing the meter in the vice.

IMPORTANT: DO NOT clamp vice on the enclosure.

6. Install a wrench across the flats of the outlet end porting and turn counterclockwise to loosen assembly. Do not remove end porting at this time.
7. Remove meter from vice. Set flat on work bench. Remove loosened port and pull out internal cartridge assembly carefully remove remaining port and casing through opposite end.

Cleaning & Inspection

1. IInspect inner cartridge and body casing for contamination. If the inner cartridge did not slide out freely, it may be a sign of contamination. Locate and eliminate the source of contamination before reconnecting meter to the system or the same problem will reoccur. It may be necessary to install finer filtration or a magnetic filter in the system.
2. Soak inner cartridge assembly in a suitable cleaning solvent. Naptha or Stoddard is recommended.
3. Remove parts from solvent. Use an air hose and/or scrub with a light brush

to remove any remaining contaminants. Remove any magnetized particles from transfer magnet.

4. Inspect inner cartridge for scored or worn parts.
5. Remove any contaminants from inside body casing.

Re-assembly

To re-assemble put casing and fixed port into housing the same way as it was removed. Ensure the white follower is installed around casing.

Insert cartridge assembly with same orientation as it was removed.
Install o-ring on casing and hand tighten port. Place back in vice and tighten port using wrench.

Re-install scale plate and attach cover.

Contamination and Filtration

Recommended Filtration

The manufacturer recommends system filtration of at least 74 micron filter or a 200 mesh screen. It has been found that if inadequate filtration has caused meter failure, it will normally fail in the open position. Some systems may require a magnetic filter.

IMPORTANT: Meter damage caused by excessive contamination is not covered under warranty.

Contamination Sources

Fresh Fluid
When fresh fluid is stored in holding tanks, it may be contaminated with scale or metal flakes from inside the tank. To prevent this type of contamination, be sure to filter fresh fluid before adding to the system.

New Machinery Contamination
When building new machines, a certain amount of built-in contamination is unavoidable. Typical built-in contamination consists of dust, dirt, chips, fiber, sand, flushing solutions, moisture, weld splatters and pipe sealants. Flushing the system before operation can reduce contamination, but cannot eliminate it totally.

Unless the system is flushed at a high velocity, some contamination will not be dislodged until the system is in operation. System contamination can cause fluid component malfunction.

Environmental Contamination

When performing routine maintenance, the system's fluid is commonly exposed to environmental contamination. Exercise caution during routine maintenance to prevent this type of contamination. Be sure to change breather filter and systems air filter regularly.

Self-Generation Contamination

Self-generated contamination is a product of wear, cavitation, fluid breakdown and corrosion. Systems that are carefully flushed, maintained, and have fresh fluid added, mainly have self-generated contamination. In this case, proper filtration can prevent fluid component malfunction.

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