



▶ Liquid Flow Meters

Installation, Operating & Maintenance Manual

Technical Specifications

Measuring Accuracy

±2.0% of full scale

Repeatability

±1% of full scale

Flow Measuring Range

0.1-150 GPM (0.5-550 LPM)

Maximum Operating Pressure

Aluminum and brass meters: 3500 PSIG (240 Bar)

Stainless steel meters: 6000 PSIG (410 Bar)

Maximum Operating Temperature

240°F (116°C) Note: for operation to 600°F (316°C), see our High Temperature Data sheet.

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

Filtration Requirements

74 micron filter or 200 mesh screen minimum

Viscosity

Standard viscosities up to 110 cSt. For viscosities between 110 to 430 cSt contact factory.

DTE 25 is a registered trademark of Exxon Mobil.

Materials of Construction (non-wetted components)

	Aluminum	Brass	Stainless Steel
Window Tube	Polycarbonate	Polycarbonate	Polycarbonate
Window Seals	Buna-N® (STD), PTFE	Buna-N® (STD), PTFE	Buna-N® (STD), PTFE

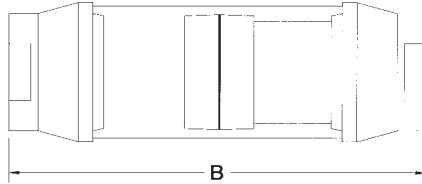
Materials of Construction (Wetted Components)

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

Buna-N is a registered trademark of Chemische Werke Huls.

Mechanical - Size Code

DIM	Series 3	Series 4	Series 5	Series 5 (2" port only)
A	1-7/8" (48mm)	2-3/8" (60 mm)	3-1/2" (90mm)	3-1/2" (90mm)
B	6-9/16" (167mm)	7-5/32" (182mm)	10-1/8" (258mm)	12-5/8" (322mm)



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.

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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. The flow indicator is sealed inside the Polycarbonate or Pyrex window tube to 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 which can cause deformation of the window tube and scale (Polycarbonate tube only).
4. 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 6-7 for reverse and bi-directional flow options)
2. The window tubes of standard meters are made of Polycarbonate. Be sure to use cleaning agents only compatible with Polycarbonate.
3. 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.
4. All 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)

5. 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.
6. It is not recommended to install meters to unsupported piping.
7. Operating Temperature: In standard meters, several components have a maximum temperature rating of 240°F (116°C). High temp version: 400°F (204°C) and Ultra high temp version: 600°F (315°C).
8. Operating Pressure: Meters should not be used above the maximum rated operating pressure.
9. 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.
10. 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.
11. 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 flow 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 150% 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 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, the factory 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, for that Bi-Directional meters are available. 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 on the flow rate scale without any damage to the meter's internals.

Bi-Directional Flow Measurement

In certain situations it may be necessary to measure flow rates in both directions. For a small additional fee, an option for bi-directional flow measurement may be specified. Meters that include this option are designated by a “-BI” suffix attached to the end of the standard 8-digit model code.

***Not all flow ranges are available in Bi-Directional meters. Contact factory for more information on reverse and bi-directional flow.**

Operation

Operating Principles

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”.

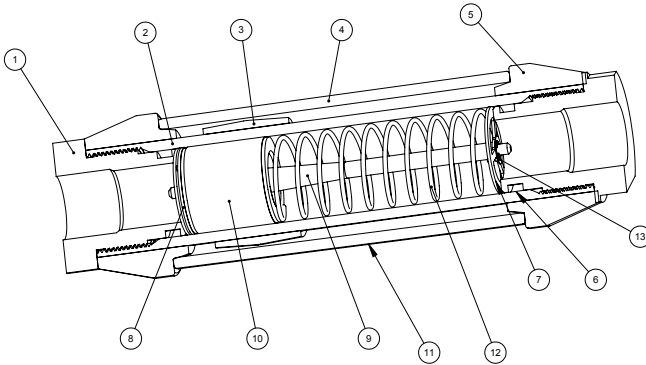
The meters are tubular, with all internal wetted parts sealed within the body casing. Running through the center of the body casing is a tapered center shaft which is centered in the bore by pilot disks at each end. Encircling the shaft is a sharp-edged, floating orifice disk, transfer magnet and return 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 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).

Illustration 1

Flow Meter (Cross Section)



- | | |
|--------------------|-------------------------------------|
| 1. End Porting | 8. Flowing Sharp-Edged Orifice Disk |
| 2. Body Casing | 9. Tapered Center Shaft |
| 3. Magnet Follower | 10. Transfer Magnet |
| 4. Window Tube | 11. Scale |
| 5. Window Seal | 12. Return Spring |
| 6. Seal Assembly | 13. Retainer Ring |
| 7. Pilot Disk | |
- *Cartridge contains: 7, 8, 9, 10, 12 & 13*

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 or oil with a specific gravity of .873. The meter is affected by fluid density as are most other similar type meters. Our 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 water meters use: $\sqrt{1.0/\text{specific gravity} \times \text{scale reading}}$

For oil meters use: $\sqrt{.873/\text{specific gravity} \times \text{scale reading}}$

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:

- 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.

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 from returning.

Horizontal/Vertical Mount

A surge or shock in the fluid flow moved the internal magnet faster than 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:

Using incompatible cleaning solution on polycarbonate window tube.

Corrective Action:

Use soap & water or a mild degreaser (Stoddard or Naptha) to clean window tube.

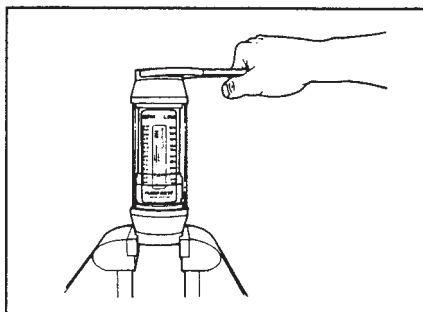
Disassembly

IMPORTANT: It is not necessary to remove window tube or window seals to clean the meter. Note also how the meter disassembles for ease of reassembly.

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

1. Use a clean dry cloth to remove all foreign material from exterior of meter, especially around threaded ends.
2. Remove meter from the flow line.
3. With the arrow on the scale pointing upward, mount the meter in a vice. See **Illustration 2**. Use the flats of the inlet end porting when securing the meter in the vice.

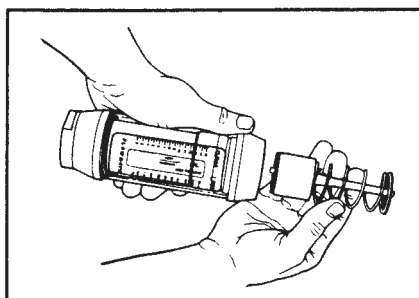
Illustration 2



IMPORTANT: DO NOT wrench or tighten vice on window tube.

4. 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.
5. Remove meter from vice. Hold the meter so the end port that is loose, is on top. Remove loose end porting.

Illustration 3



6. Tilt the open end of meter over a clean cloth to expose inner cartridge. See **Illustration 3**. Remove inner cartridge assembly from body casing. Note: Because the transfer magnet is magnetically coupled to the magnetic follower, you will notice a slight resistance when removing cartridge. If cartridge does not slide out, insert a wooden dowel in opposite end of meter and push or lightly tap on dowel until cartridge comes loose.

IMPORTANT: If inner cartridge does not slide out freely, it may be sign of contamination. The transfer magnet is a powerful magnet. Keep it away from metal chips and fillings. They may be hard to remove when reassembling and will cause premature failure.

7. Examine inner cartridge or level of contamination.
8. If inner cartridge has a low level of contamination and is functioning properly, no further disassembly is required. Proceed to "Cleaning and Inspection. If the inner cartridge is damaged or contaminated beyond repair, the complete meter can be sent to the manufacturer for evaluation. The manufacturer will repair or replace parts as needed.

Cleaning & Inspection

1. Inspect 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.
6. Clean the window tube with soap and water, or a compatible cleaning solvent.

IMPORTANT: Some solvents may cause damage to the polycarbonate tube, check compatibility of solvent being used.

7. Clean and inspect seal assemblies (O-rings and seals) for nicks or cuts. Replace as needed.

Properly filtered meters will provide years of trouble-free service. If the meter is not properly filtered, it may be damaged and malfunction. Meter damage caused by excessive contamination is not covered under warranty.

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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