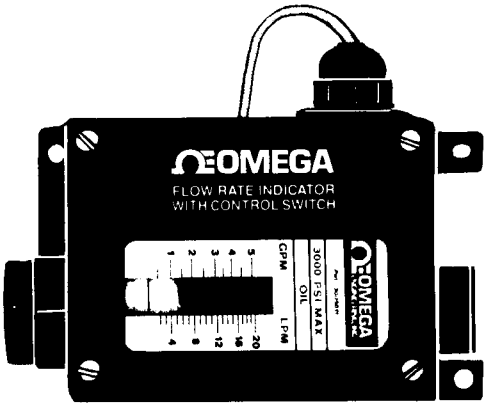
FL-6100-SS, 6300-SS, 6700-SS Series

In-Line Flowmeters



OMEGA®
An OMEGA Technologies Company

Operator's Manual
M0381/0293

TABLE OF CONTENTS
FL-6100-SS, 6300-SS, 6700-SS Series

SECTION 1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The OMEGA FL-6000-SS Series Flowmeters offer high accuracy flow rate indication for oil or water, and the ability to either control the flow rate or alarm on high or low flow rates. These units feature an SPDT switch, which can be triggered at any point along the flow range.

1.2 FEATURES

- ±4% Full Scale Accuracy
- ±1% Full Scale Repeatability
- Direct Reading for Oil or Water
- Built-in Limit Switch for Alarm and Control
- Mount in any Direction
- Easy Setpoint Adjustment
- Splash-proof Construction
- Compact Size
- 1/2" FNPT Connections

1.3 AVAILABLE MODELS

Model No.	Media Sp. Gr.	Range (GPM)	Connections	Pressure Drop (PSID)
FL-6101-SS	Oil .876	.1-1 GPM	½" NPT	1.2
FL-6102-SS	Oil .876	.2-2 GPM	½" NPT	1.2
FL-6318-SS	Water	.2-1.8	½" NPT	2
FL-6304-SS	Water	.5-4 GPM	½" NPT	3
FL-6312-SS	Water	1-12 GPM	½" NPT	9
FL-6720-SS	Air 100 PSI	2-20 SCFM	½" NPT	2

SECTION 2 UNPACKING

Remove the packing list and verify that all equipment has been received. If there are any questions about the shipment, please call the OMEGA Customer Service Department at 1-800-622-2378 or (203) 359-1660.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material in the event reshipment is necessary.

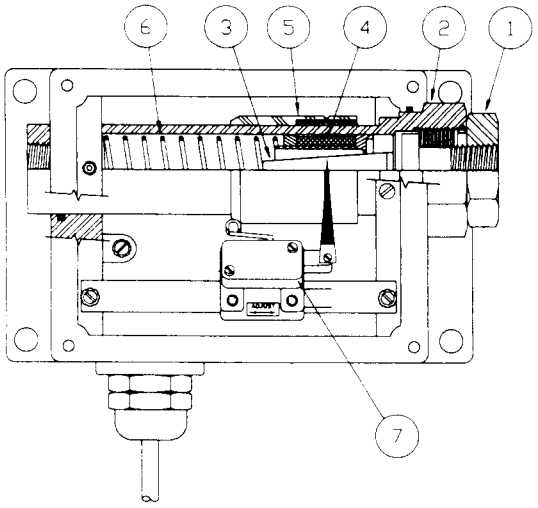
SECTION 3 OPERATION

3.1 PRINCIPLE OF OPERATION (Refer to Figure 3-1)

The FL-6000-SS is a variable area flowmeter, using a sharp-edged annular orifice formed between the piston assembly (4) and the tapered metering cone. The piston assembly, containing a permanent ring magnet, is held in a "no flow" position at the base of the cone, by a calibrated retention spring (6).

Flow through the meter creates a pressure differential across the piston orifice, moving the piston against the retaining spring. Piston movement and orifice area are proportional to rate of flow. Therefore, the greater the rate of flow, the further the piston moves along the tapered metering cone.

Externally, the flow rate indicator ring (5) encircling the high pressure flowmeter cartridge (2) is magnetically coupled to the high flux density magnet, integral to the piston assembly (4). The orange line on the indicator ring is simply read against the pre-calibrated scale, mounted on the inner surface of the transparent viewing window. The SPDT snap action switch (7) is activated by the indicator ring as flow exceeds or falls below the preset position.



(1) Inlet Cap
(2) Flow Cartridge
(3) Metering Cone
(4) Piston Assembly with Ring Magnet
(5) Flow Rate Indicator
(6) Retention Spring
(7) Adjustable SPDT Snap Action Switch

Figure 3-1. Parts Diagram

3.2 INSTALLATION

RECOMMENDED INSTALLATION PRACTICES

Water hammer and surges can be damaging to any flowmeter and must always be avoided.

Water hammer occurs when a liquid flow is suddenly stopped as with quick closing and solenoid operated valves. Surges occur when flow is suddenly begun, as when a pump is turned on at full power or a valve is quickly opened.

Liquid surges are particularly damaging to flowmeters if the pipe is originally empty. To avoid damaging surges, fluid lines should remain full (if possible) and pumps should be brought up to power slowly and valves opened slowly. In addition, to avoid both water hammer and surges, a surge chamber should be installed.

CAUTION

The flowmeter contains a residual amount of petroleum-based test fluid at the time of shipment. This fluid should be removed prior to installation, as it may be incompatible or hazardous with some compressed gases.

Do not install this unit within two (2) feet from electrical transformers, high strength electric motors or other electro-magnetic devices that could adversely affect the magnetic coupling between the flow indicator and the piston magnet.

3.2.1 PIPING (Plumbing)

1. Use pipe threaded within commercial tolerances. The female pipe threads are 1/2" NPTF. This is a dry seal thread so pipe dope and Teflon tape probably won't be needed.

2. Piping should be aligned and of correct length. The high pressure body of the meter can withstand shock and flow/pressure pulsation, but it will have limited life if it becomes the fulcrum of the plumbing system.

3. Install a union near the inlet or outlet of the flowmeter. This will make periodic maintenance less time-consuming.

4. Do not use pipe wrenches on the flowmeter body. Use the smaller hex flats for securing the inlet, and the larger flats for tightening the flowmeter cartridge outlet.

5. If the flowmeter cartridge inlet or outlet are to be rigidly mounted, and the opposing port is to be connected with flexible hose, the end connected with the flexible hose **must** be rigidly mounted. Mounting brackets are enclosed for this purpose.
6. Inlet and outlet straight plumbing are not required, but elbows, valves and reducers immediately adjacent to the meter inlet should be avoided, if possible.

3.2.2 FLOW DIRECTION

The FL-6000-SS is a unidirectional flowmeter. The piston acts as a check valve to block flow in a reverse direction, causing an excessive pressure differential, which could result in damage to internal components.

Therefore, caution should be taken to align the Flow Arrow, located on the meter scale, in the same direction as the anticipated line flow.

3.2.3 MOUNTING ORIENTATION

The design of the flowmeter provides the installer the flexibility to mount the product in any plane without sacrificing (hindering) flow rate accuracy. The flowmeter is calibrated in the horizontal axis, and will provide the highest degree of accuracy in that orientation.

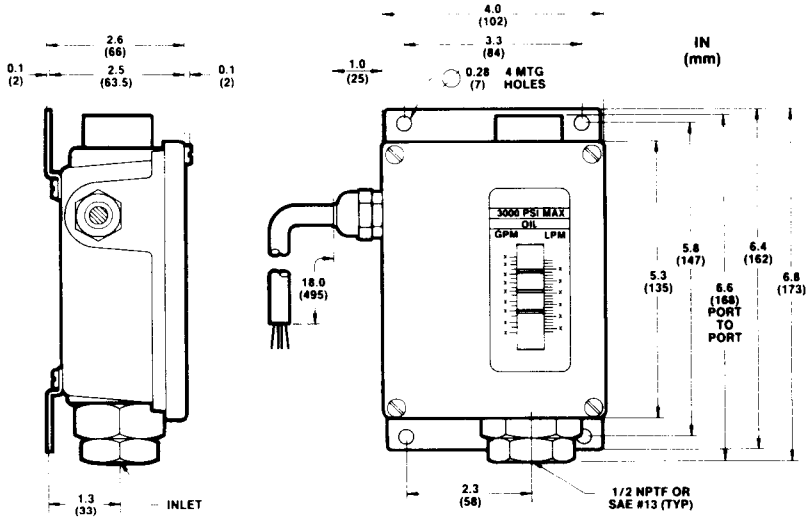


Figure 3-2. Installation Dimensions

3.3 ELECTRICAL CONNECTIONS

CAUTION: Disconnect electrical power before removing cover.

3.3.1. SWITCH ADJUSTMENT

1. Loosen four (4) cover screws. (These are captive screws. They will remain in cover.) Remove cover and let hang by chain.

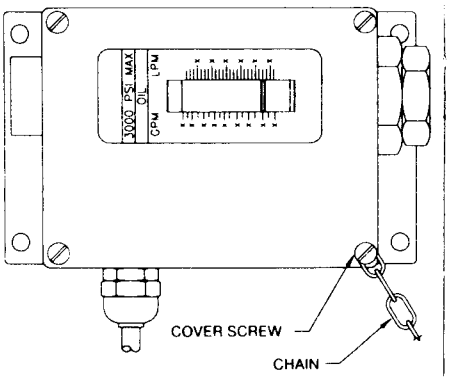


Figure 3-3. Removing the Cover

2. Loosen two (2) set screws (1/16" allen wrench). See Figure 3-4.

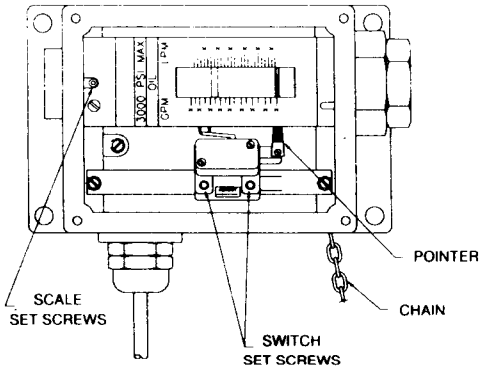


Figure 3-4. Location of Set Screws

3. Position switch using pointer as guide. See Figure 3-4.

4. Confirm switch setting by snugging two (2) switch set screws and manually moving the white indicator ring up toward full flow capacity and then back down toward "zero" flow. A distinct "click" should be heard as the orange indicator passes the switch set point.

5. Secure set screws. Do not overtighten.

6. Replace cover and secure four (4) cover screws.

3.3.2 WIRING

The electrical data and UL codes for the snap-action switch used in the 1/2" series flowmeters are:

Circuitry: Single-pole, double-throw UL and CSA listed: 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)

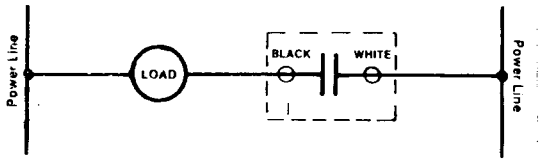
Wire color coding is as follows: (This information is also located inside the front cover of the meter).

Wire Color	Switch Connection (Zero Flow)
Red	NC (Normally Closed)
Black	NO (Normally Open)
White	Common
Green	Ground

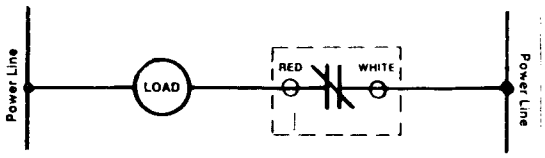
The 1/2" series flowmeters are supplied with an 18" length of 4-wire #18 AWG. The strain relief connection on the outside of the enclosure is water-tight. Be sure to consult local wiring codes before applying power. Some installations will require rigid conduit. By removing the black strain relief connection from the outside of the enclosure, a 1/2" NPT conduit connection will be available.

Wiring Configurations

1. Controlling loads with current and/or voltage demands **within** microswitch recommendations.

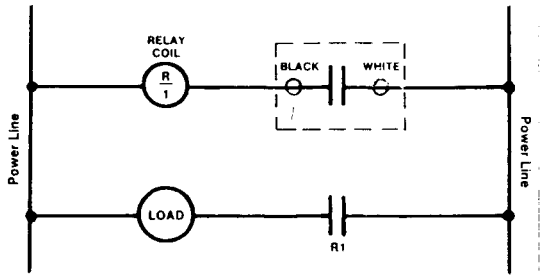


Load will turn "on" as flow rate exceeds set point.

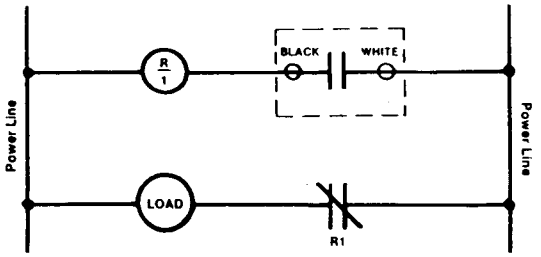


Load will turn "on" as flow drops below set point.

2. Controlling loads with current and/or voltage in **excess** of microswitch recommendations.

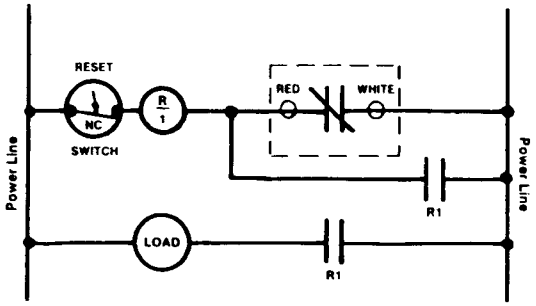


Load will turn "on" as flow rate exceeds set point.



Load will turn "on" as flow rate drops below set point.

3. For Latching Systems



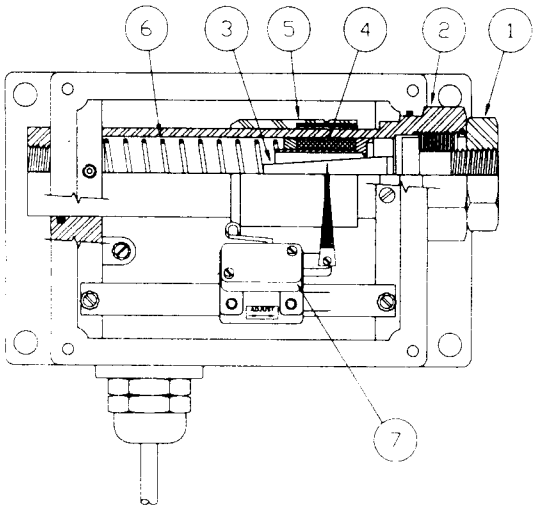
Load will turn "on" as flow rate drops below set point and remain latched "on" until the reset button is pressed.

SECTION 4 CLEANING AND MAINTENANCE

4.1 CARTRIDGE REPLACEMENT (Flowmeter tube)

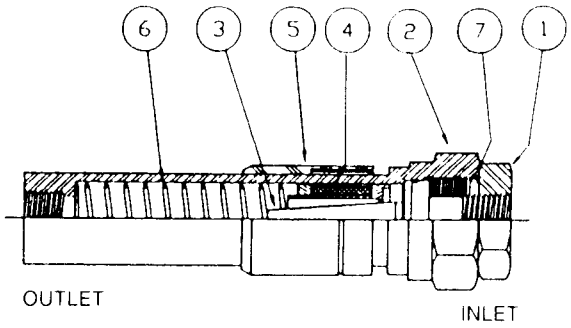
1. Disconnect electric power.
2. Remove plumbing from inlet and outlet of flowmeter cartridge.
3. Loosen (4) cover screws and remove cover. Let hang by chain.
4. Loosen set screw located at flowmeter outlet (1/8" allen wrench).
5. Gently push cartridge out of the enclosure from the outlet end. (There are two captive O-ring seals at the inlet and outlet.)

6. Place white plastic indicator on replacement cartridge.
7. Use care during reassembly not to damage the switch or O-rings. A small amount of lubricant on the O-rings will help assembly.



(1) Inlet Cap
(2) Flow Cartridge
(3) Metering Cone
(4) Piston Assembly with Ring Magnet
(5) Flow Rate Indicator
(6) Retention Spring
(7) Adjustable SPDT Snap Action Switch

4.2 CARTRIDGE DISASSEMBLY AND CLEANING



(1) Inlet Cap
(2) Flow Cartridge Body
(3) Metering Cone
(4) Piston Assembly with Ring Magnet
(5) Flow Rate Indicator
(6) Retention Spring
(7) O-Ring Seal

1. Remove cartridge from enclosure following the procedure in Sec. 4.1.
2. Thoroughly wipe off outside of cartridge assembly, removing all foreign matter.
3. Separate inlet cap from flow cartridge body using 2 wrenches (1-5/8" and 1-3/8" wrenches).

4. Remove internal parts by taping the cartridge inlet on a wooden surface. If parts are jammed, refer to Section 4.3.

5. Place all meter parts on a clean work surface in order of disassembly.

6. Clean and inspect all internal parts. If parts are worn, pitted or corroded, replace with new components.

7. Inspect the bore of the flowmeter body for scratches, nicks and burrs. The body can be lightly honed if needed.

8. Reassemble all clean parts into cartridge body. Check O-ring seal (7) on inlet cap for nicks, cracks or excessive compression. If necessary, replace.

9. Wipe off the O-ring seals on each side of the electrical enclosure box. A small amount of lubricant on the O-rings will help with reassembly.

10. Clean white plastic indicator ring, and place it on the cartridge, wedge end facing the outlet.

11. Push cartridge assembly into the enclosure. The inlet hex must be contacting the enclosure to ensure proper sealing and accuracy.

12. Tighten set screw at the outlet end of the enclosure (1/8" allen wrench).

13. Replace protective cover and tighten four screws evenly to compress gasket.

When the cartridge is disassembled, observe the following:

1. Did the parts come out of the cartridge body freely? If not, push parts out by inserting a wooden dowel into the outlet end.

2. Look for foreign matter within the internal parts and cartridge body.
   a. Determine the source of the contaminant.
   b. Take steps to eliminate the contaminant from the system.

3. If parts are worn or corroded:
   a. Replace any badly worn parts.
   b. Meters can be sent back to OMEGA for service and recalibration.

Note: Before reinstalling the flowmeter into the system, the cause of contamination should be detected and eliminated. This will eliminate repeated problems.

4.3 FILTRATION

The flowmeter will allow particulate to pass that would jam most valves and flow controls. Systems which do not have filtration should be equipped with at least a 200 mesh sieve or 74 micron filter. Most hydraulic systems would already have a much finer filtration.

Within the cartridge, 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 instructions in Section 4.1.

SECTION 5 SPECIFICATIONS

SWITCH:	Micro SPDT 10 @ 250 Vac
CABLE:	3 ft. cable supplied with units
MAXIMUM TEMPERATURE AND PRESSURE:	180°F/600 PSI for air; 180°F/3000 PSI for water and oil
WETTED PARTS:	Oil Meters - Aluminum, Alnico, polyacetal and 316 SS; Water Meters - Brass, Nickel-Plated Alnico, 316SS and polyacetal Air Meters - Aluminum, Nickel-Plated Alnico, 316SS and polyacetal
DIMENSIONS (D x W x LAY LENGTH):	4" x 2.82" x 6.56"

EFFECTS OF VARIOUS FLUID PARAMETERS

1. Density-Hydraulic Meters

   a. Oil meters calibrated for petroleum-based fluids Specific Gravity .876.
   b. WBF (water-based fluid) meters calibrated for fluids with corrosion inhibitors, Specific Gravity 1.0.
   c. Water meters calibrated for Specific Gravity 1.0.

Operating this flowmeter with fluid density other than the calibrated specific gravity will lead to inaccuracies. This inaccuracy can be corrected by the following correction factor.

Oil Meters
Actual Flow Rate = (Indicated Flow Rate)

$$\times \left(\sqrt{\frac{.876}{\text{Specific Gravity}}}\right)$$

1.0 Specific Gravity Meters
Actual Flow Rate = (Indicated Flow Rate)

$$\times \left(\sqrt{\frac{1.0}{\text{Specific Gravity}}}\right)$$

2. Viscosity-Hydraulic Meters

The design of the flowmeter provides operating stability and accuracy over a wide range of viscosities. Consult OMEGA for further data on viscosities over 200 SUS.

FLUID SELECTION			
Fluid	Specific Gravity Average	Correction Factor of Standard Scale	
		Oil	Water
Acetic Acid	1.06	.9090	.97
Acetone	.79	1.503	1.12
Alcohol	.83	1.027	1.10
Ammonia	.89	.992	.95
Benzine	.69	1.126	1.20
Carbon Disulphide	1.26	.833	.89
Castor Oil	.97	.950	1.02
Cotton Seed Oil	.93	.970	1.04
Ethylene Glycol 50/50	1.12	.884	.94
Freon II	1.46	.774	.83
Gasoline	.70	1.118	1.20
Glycerin	1.26	.833	.89
Kerosene	.82	1.033	1.10
Liquid Propane (LPG)	.51	1.310	1.40
Mineral Oil	.92	.975	1.40
Naphtha	.76	1.073	1.15
Perchloroethylene	1.62	.735	.79
Petroleum Oil	.876	1.00	1.09
Phosphate Ester	1.18	.861	.92
Phosphate Ester Base	1.26	.833	.89
Phosphoric Acid	1.78	.701	.75
Sea Water	1.03	.922	.99
Synthetic Petroleum Base	1.00	.935	.96
Water	1.00	.935	1.00
Water Glycol 50/50	1.07	.904	.97
Water-in-Oil	.93	.970	1.04

Field Conversion Of . . .

Flow Meter Scale To Other Special Fluids

Special Fluid Flow
Correction Factor = Scale Reading
Special Fluid Flow = Scale Reading × Correction Factor

EFFECTS OF VARIOUS PNEUMATIC PARAMETERS

The flowmeter has a graduated Air Flow Scale, calibrated in Standard Cubic Feet Per Minute (SCFM). The Standard Cubic Foot of air is defined as a cubic foot of air at 70°F, at atmospheric pressure (14.7 PSI at sea level).

The meter is calibrated for inlet conditions at 100 PSIG at 70°F. A correction factor must be used to relate actual operating pressure to atmospheric pressure. Therefore, the following Conversion Chart offers quick, convenient recalibration equations for field conversions.

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 temperature,
f_3 = Conversion factor for specific gravity

TABLE 1 PRESSURE CORRECTION FACTOR (f_1)

OPERATING PRESSURE, psig										
psig	25	50	75	100	125	150	175	200	225	250
f_1	1.700	1.331	1.131	1.00	.902	.835	.778	.731	.692	.658

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

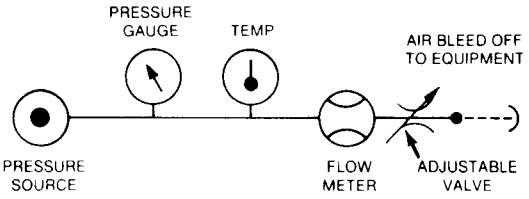
TABLE 2 TEMPERATURE CORRECTION FACTOR (f_2)

OPERATING TEMPERATURE, °F										
°F	10	30	50	70	90	110	130	150	170	190
f_2	.942	.962	.981	1.00	1.018	1.037	1.055	1.072	1.090	1.107

$$f_2 = \sqrt{\frac{460 + °F}{530}}$$

TABLE 3 SPECIFIC GRAVITY CORRECTION FACTOR (f_3)

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



*Note: Pressure and Temperature readings must be taken at the flowmeter **inlet** to assure accurate correction factors.

If possible, the flowmeter should be mounted upstream of solenoid valves to prevent indicator magnetic decoupling.

COMPRESSIBILITY OF GASES

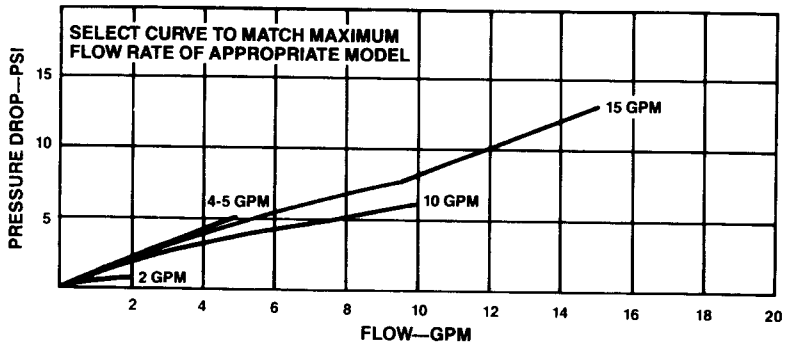
Since gases are significantly compressible, the density of a gas will vary under various pressures. Use Table 1 in the Conversion Chart to convert the "indicated" flow rates to "actual" flow rates in your specific application.

EFFECTS OF SPECIFIC GRAVITY

The Flow Scales are calibrated for gases with a Specific Gravity of 1.0. For heavier or lighter gases, refer to Table 3 in the Conversion Chart to establish the actual flow range.

Gas	Specific Gravity	Correction Factor
Air	1.00	1.00
Argon	1.38	1.17
Carbon Dioxide	1.53	1.23
Freon II	4.92	2.21
Helium	.14	.37
Hydrogen	.07	.26
Nitrogen	.97	.98
Natural Gas	.60	.77
Oxygen	1.10	1.04
Propane	1.57	1.25

PRESSURE DIFFERENTIAL



Approximate pressure losses in meters using oil at low and normal temperatures. Add 10% to pressure for equal water flows.

MADE IN USA

WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that our customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. Our Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

We are glad to offer suggestions on the use of our various products. Nevertheless OMEGA only warrants that the parts manufactured by it will be as specified and free of defects.

OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

LIMITATION OF LIABILITY: The remedies of buyer set forth herein are exclusive and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

Every precaution for accuracy has been taken in the preparation of this manual; however, OMEGA ENGINEERING, INC. neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages that result from the use of the products in accordance with the information contained in the manual.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA ENGINEERING Customer Service Department. Call toll free in the USA and Canada: 1-800-622-2378, FAX: 203-359-7811; International: 203-359-1660, FAX: 203-359-7807.

BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, YOU MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OUR CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems you are having with the product.

FOR **NON-WARRANTY** REPAIRS OR **CALIBRATION**, consult OMEGA for current repair/calibration charges. Have the following information available BEFORE contacting OMEGA:

1. Your P.O. number to cover the COST of the of the repair/calibration,
2. Model and serial number of product, and
3. Repair instructions and/or specific problems you are having with the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. That way our customers get the latest in technology and engineering.

OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

OMEGA®... Your Source for Process Measurement and Control

TEMPERATURE

- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

PRESSURE/STRAIN FORCE

- Transducers & Strain Gauges
- Load Cells & Pressure Gauges
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition and Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters