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# INSTRUCTIONS FOR FM4460N SERIES HIGH PRESSURE, METAL TUBE FLOWMETERS

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THIS BOOKLET CONTAINS PROPRIETARY INFORMATION OF  
ADVANCED SPECIALTY GAS EQUIPMENT CORP. AND IS PROVIDED  
TO THE PURCHASER SOLELY FOR USE IN CONJUNCTION WITH  
FM4460N SERIES FLOWMETERS.



## IMPORTANT

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These instructions are for experienced operators who know the general principles and safety precautions to be observed in handling specialty gases and operating specialty gas equipment. If you are not certain you fully understand the safety precautions for handling gases, we urge you to obtain and read the Material Safety Data Sheet (MSDS) for each gas being used.

Do not permit untrained persons to install, operate, or maintain this flowmeter. Do not attempt to install or operate this equipment until you have read and fully understand these instructions. If you do not fully understand these instructions, contact your Advanced Specialty Gas Equipment Distributor.

**Be sure this information reaches the operator. Your supplier has extra copies.**



## **SAFETY PRECAUTIONS**

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Protect yourself and others. Read and understand the following instructions before attempting to use these flowmeters. Failure to understand and follow these instructions could result in serious personal injury and/or damage to equipment.

- Know and understand the physical and chemical properties of the gas being used.
- Observe general precautions for the use of gases.
- Observe safety precautions for the gas being used.
- Read and follow precautions on cylinder labels.
- Never use these flowmeters with gases not compatible with the materials of construction. The use of gases not compatible with the materials of construction may cause damage to equipment or injury to personnel.
- If flammable gases are used with these flowmeters, do not locate them near open flames or any other source of ignition.
- If toxic or flammable gases are used with these flowmeters, emergency equipment applicable to the gases in use should be available in the operating area.
- Many gases can cause asphyxiation by displacing oxygen in the atmosphere. Make certain the area where this equipment is operated is well ventilated. Provide a device to warn personnel of oxygen depletion in the work area.
- Do not release toxic or flammable gases in the vicinity of personnel. Use this equipment only in well ventilated areas. Vent gases to the outside atmosphere, and in an area away from personnel. Be sure that venting and disposal methods are in accordance with Federal, State and local requirements. Locate and construct vent lines to prevent condensation or gas accumulation. Be sure the vent outlet cannot be obstructed by rain, snow, ice, insects, birds, etc. Do not interconnect vent lines; if more than one vent is needed, use separate lines.
- Relief devices should be installed and properly vented in all gas handling systems to protect against overpressurization.
- Never use oil or grease on these flowmeters. Oil and grease are easily ignited and may combine violently with some gases under pressure.
- Never connect this equipment to a supply source having a pressure greater than the maximum rated pressure of the flowmeter. Refer to Product Specifications (page 7) for maximum inlet pressure.

## **MANUFACTURER STATEMENT**

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The information contained in this instruction booklet has been compiled by Advanced Specialty Gas Equipment Corp., (the Company), from what it believes are authoritative sources and is offered solely as a convenience to its customers. While the Company believes that this information is accurate and factual as of the date printed, the information including design specifications is subject to change without prior notice.

## **DESCRIPTION**

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The FM4460N Series flowmeter is a variable area, metal tube, flow rate indicating meter designed for applications where glass tube meters are not practical because of high pressure, high temperature or hazardous fluids. Suitable for both plant and laboratory use, these flowmeters have an accuracy of  $\pm 5\%$  of full scale at calibrated conditions.

The flowmeter body, tube, integral magnetic float and metering valve are constructed of Type 316L Stainless Steel. The float stop springs are constructed of Inconel® and seals of Viton®. The indicator housing is epoxy painted aluminum and contains the easy-to-see direct reading scale and follower. Because the follower is magnetically balanced with respect to the magnetic float, the follower has a unique position for a given float height.

FM4460N Series Flowmeters are supplied with a direct reading scale calibrated with air in standard liters per minute (slpm) at 70°F and 14.7 psia.

## **INSTALLATION**

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**WARNING:** Before attempting to install and operate these flowmeters, read and fully understand the safety precautions on page 2 in this booklet. Failure to follow the safety precautions may result in serious personal injury and/or damage to equipment.

1. Inspect the flowmeter for physical damage or contamination. Flowmeters are shipped completely assembled and tested and should not require tightening or adjustment before installation. If it is damaged or contaminated, contact your Advanced Specialty Gas Equipment Distributor to arrange for repair or replacement.

**CAUTION:** Oil or grease in the presence of high pressure oxygen is explosive.

2. Flowmeters must be mounted within 6 degrees of true vertical with the inlet connection to the flowmeter at the bottom. Be sure that piping is adequately supported to prevent undue strain on the meter.
3. The built-in metering valve provides flow control through the flowmeter. These control valves are designed for fine control. Although the valve will provide bubble-tight shutoff, excessive tightening may damage the valve seat and limit its effectiveness as a fine control valve. If tight shut-off is required, a separate shut-off valve must be installed before the flowmeter.
4. The Series FM4460N Flowmeter can be mounted on the front of a panel by using the predrilled holes and (2) 10-32 x 5/16 screws provided on the rear of the flowmeter (Fig. 2, see pg. 9).

## **OPERATION**

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**WARNING:** DO NOT exceed pressure and temperature specifications during operation. DO NOT operate the flowmeter under any circumstances if it is leaking or otherwise malfunctioning. Injury or death to personnel and/or damage to equipment may result.

1. The flowmeter is ready for operation after it has been installed in the flow system and connections have been tested for leaks with nitrogen or air and either a soap solution, such as Snoop® or a gas leak detector. Do not exceed 1500 psig during the leak test procedure. Vent all pressure from the system and repair any leaks before proceeding.
2. Gradually introduce gas or liquid into the flowmeter to prevent a pressure surge or thermal shock to the flowmeter. Do not exceed 1500 psig during operation. Adjust the metering valve to obtain the desired flow rate.

## **SHUTDOWN OR REMOVAL FROM SERVICE**

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1. Shut off the gas or liquid supply to the flowmeter. It should always be shut off when the system is not in use.

**WARNING: Hazardous gases must be discharged into a safety vent. Be sure to use a venting procedure that is environmentally acceptable and complies with Federal, State and local requirements.**

2. Vent the system to atmospheric pressure. If the flowmeter was used with a hazardous gas, purge the flowmeter and entire system with clean dry nitrogen gas. Continue purging until the hazardous gas level in the system is below the TLV for the hazardous gas.

## **CLEANING AND DISASSEMBLY** (Fig 1, see pg. 8)

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Complete disassembly of the meter is generally unnecessary except for occasional cleaning or replacement of parts. Dirt or foreign materials adhering to the float or the inside of the tube may cause inaccuracy and sticking of the float. The flowmeter tube and related parts may be cleaned ultrasonically or with a compatible solvent if necessary.

**Note:** The meter need not be removed from the line for cleaning if the meter has been properly purged and vented (see “Shutdown or Removal from Service”).

1. Remove the seal plug (5), O-Ring (4) and the outlet float stop spring (3).
2. Using the following procedure, remove the float. The float is magnetic and will adhere to a metallic rod inserted into the flow tube (a hex wrench is ideal). The rod should not exceed 0.25 inches in diameter. Exercise extreme care in handling the float, and replace it in the proper position. Any damage to the float will result in a malfunction or failure of the meter.

## CALIBRATION

Flowmeters are calibrated using Air at normal temperature (70°F) and pressure (14.7 psia) to an accuracy of ±5% of full scale from 10% to 100% of range. Approximate flow rates for other gases or conditions can be mathematically derived using the following flowmeter conversion formulas.

**Note:** These are approximate flow corrections; if precise flow corrections are required, on site calibration of the flowmeter should be performed.

$$\text{Gas Conversion Factor} = \sqrt{\frac{1}{\text{Specific Gravity of Process Gas}}}$$

$$\text{Pressure Conversion Factor} = \sqrt{\frac{\text{Actual Operating Pressure in psia}}{14.7 \text{ psia}}}$$

$$\text{Temperature Conversion Factor} = \sqrt{\frac{530}{\text{Actual Temperature in } ^\circ\text{F} + 460}}$$

Determine the corrected flow rate by multiplying the flow reading obtained by one, two and/or three of the conversion factors calculated above.

$$\text{Flow Reading} \times \text{Gas Factor} \times \text{Pressure Factor} \times \text{Temperature Factor} = \text{Corrected Flow Reading}$$

**EXAMPLE:** To calculate corrected flow reading for Argon at the following conditions.

The **Flow Reading** from the tube calibrated for Air at NTP is 3.0 slpm.

The **Gas Conversion Factor** is calculated for Argon. (Specific gravity of Argon at 70°F (Air=1) is 1.378)

$$\sqrt{\frac{1}{1.378}} = 0.85$$

The **Pressure Conversion Factor** is calculated for a pressure of 30 psia through the flow tube. (Measured at outlet of flowmeter)

$$\sqrt{\frac{30 \text{ psia}}{14.7 \text{ psia}}} = 1.43$$

The **Temperature Conversion Factor** is calculated for a gas temperature of 60°F.

$$\sqrt{\frac{530}{60^\circ\text{F} + 460}} = 1.01$$

$$3.0 \text{ slpm} \times 0.85 \times 1.43 \times 1.01 = 3.7 \text{ slpm}$$

Flow Reading      Gas Factor      Pressure Factor      Temperature Factor      Corrected Flow Reading

## **MAINTENANCE AND REPAIRS**

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Periodically inspect the tube and float, and clean if necessary (see cleaning and disassembly section).

Repairs beyond those contained in this instruction booklet must be made by Advanced Specialty Gas Equipment Corp. who have the special tools, test equipment and trained personnel required to make a safe repair. Contact your Advanced Specialty Gas Equipment Distributor to arrange for repair.

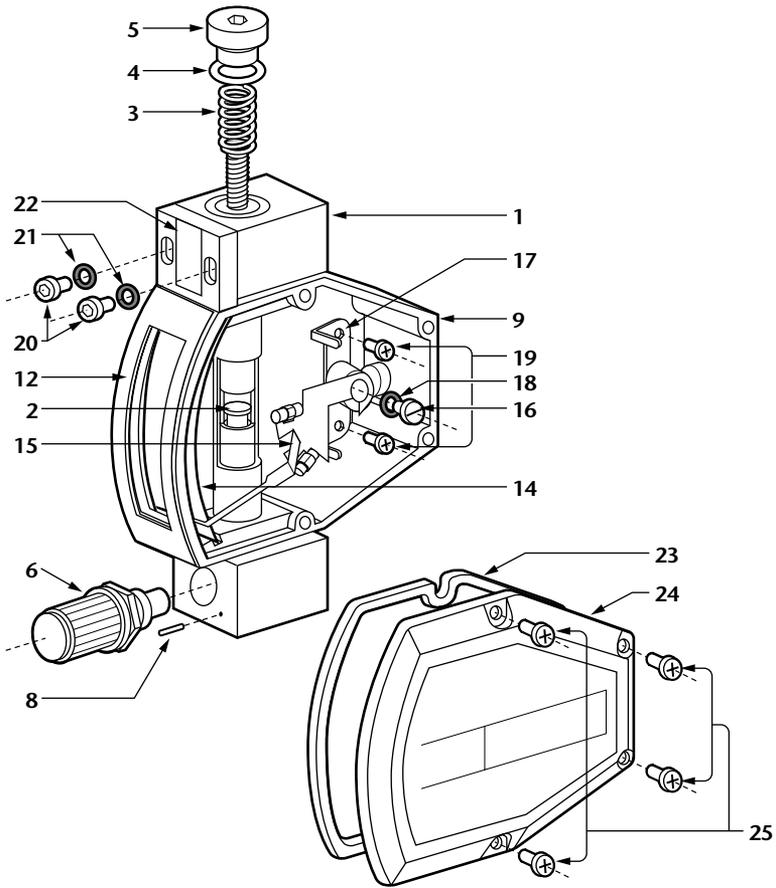
*Warranty Repairs* are only available through Advanced Specialty Gas Equipment Corp., and will be performed at no charge for parts and labor. For information on warranty, see the last page of this instruction booklet.

*Non-Warranty Repairs* are available through your distributor. Upon receipt at the factory, the flowmeter will be inspected and you will be contacted by your distributor with a repair cost estimate. No item will be repaired until approval is received. There will be an evaluation charge assessed for equipment not repaired.

## **SPECIFICATIONS**

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Maximum Operating Pressure	1500 psig
Maximum Operating Temperature	400°F
Accuracy	±5% of full scale from 10% to 100% of range.
Repeatability	Within 1% of full scale
Tube Graduations	Standard liters per minute (slpm) of air
Scale Length	55 millimeters
Inlet and Outlet Connections	1/4" NPT female
Weight (approx.)	2 lbs.



- 1. Body Weldment
- 2. Float
- 3. Outlet Float Strip
- 4. O-Ring for Seal Plug
- 5. Seal Plug
- 6. Valve Assembly
- 8. Valve Locking Pin
- 9. Individual Housing
- 12. Window Bezel
- 14. Scale
- 15. Pointer Assembly
- 16. Shoulder Screw
- 17. Mounting Bracket
- 18. Lock Washer

- 19. Screws: pointer to housing
- 20. Screws: housing to outlet fitting
- 21. Lock Washers: housing to outlet fitting
- 22. Front Label
- 23. Gasket for cover to housing
- 24. Housing Cover
- 25. Screws: cover to housing

**Items Not Shown:**

- 11. Window Glass
- 13. Screw: window bezel to housing
- 27. Screw: standard panel mounting
- 28. Flat Washers: standard panel mounting

Figure 1 – FM4460N Series Flowmeter Assembly

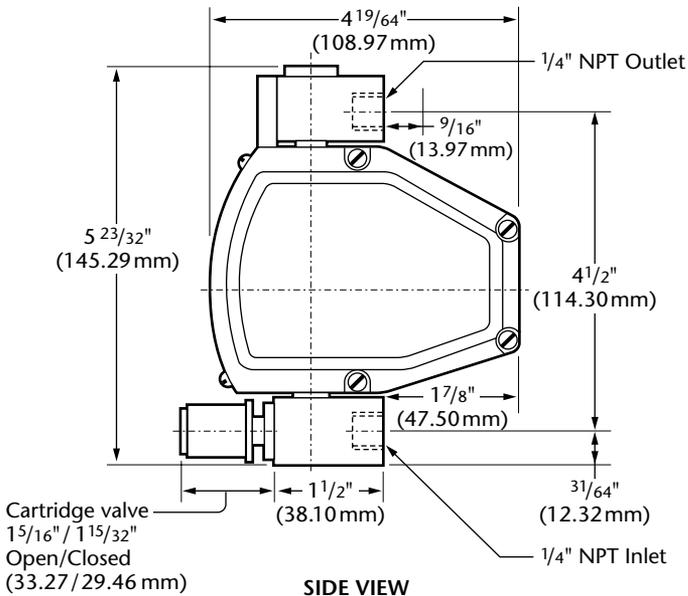
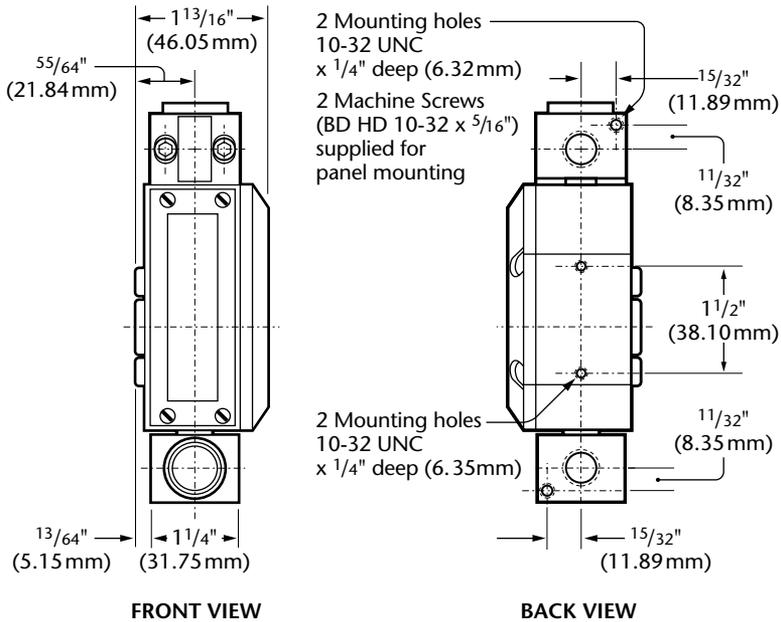


Figure 2 – FM4460N Series Flowmeter Dimensions

## MATERIALS OF CONSTRUCTION

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Tubes, Fittings, Clean-Out Plug, and Float Stop	Type 316L Stainless Steel
Housing	Epoxy Painted Aluminum
Float	Type 316L Stainless Steel (integral magnet)
Float Stop Spring	Inconel® 625
Seals	Viton®
Valve	Type 316L Stainless Steel

**Table 1**

Part Number	Air Flow Rate Range at 70°F and 14.7 psia	
	Actual Graduations (slpm)	Reference (scfh)
FM4460N	0.1–1.0	0.2–2.2
FM4461N	0.23–2.3	0.5–4.9
FM4462N	0.6–6.0	1.3–12.7
FM4463N	1.0–11	2.1–23.3
FM4464N	2–26	4.2–55

## **WARRANTY**

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Advanced Specialty Gas Equipment Corp., (the Company), warrants to the initial purchaser of each flowmeter described herein, that such equipment will be free from defects in material and workmanship which result in breakdown or failure under normal use during a period of 12 months from date of shipment by the Company if used and maintained according to Advanced Specialty Gas Equipment written instructions. This warranty does not cover damage or malfunction due to corrosion. Purchaser is aware that this equipment is designed for specific applications and that using this equipment for the wrong application may damage or corrode the unit and cause personal injury. If there is any doubt about application, consult your Advanced Specialty Gas Equipment Corp. distributor.

The Company's liability under this warranty shall be limited to the repair, or at its option, replacement or refund of the purchase price, of such equipment which proves to be defective, provided; however, that this warranty shall only apply if the purchaser (1) gives the Company written notice within (10) days after discovery of such defect, (2) immediately on discovery of the claimed defect, discontinues all use of such equipment, and (3) returns such equipment freight prepaid to plant of manufacture.

**THERE ARE NO EXPRESS WARRANTIES OTHER THAN THOSE SPECIFIED HEREIN. NO WARRANTIES BY ADVANCED SPECIALTY GAS EQUIPMENT CORP. (OTHER THAN WARRANTY OF TITLE AS PROVIDED IN THE UNIFORM COMMERCIAL CODE) SHALL BE IMPLIED OR OTHERWISE CREATED UNDER ANY APPLICABLE LAW, INCLUDING BUT NOT LIMITED TO WARRANTY OF MERCHANTABILITY AND WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.** No claim against the Company of any kind, whether as to equipment delivery or for nondelivery of equipment and whether or not based on contract, warranty, negligence, strict liability in tort or otherwise, shall be greater in amount than the purchase price of the equipment in respect of which such claim is made. Without limiting the generality of the foregoing, Advanced Specialty Gas Equipment Corp. shall not be liable for any special, indirect, or consequential damage, such as failure of parts resulting from corrosion.

If it is determined by Advanced Specialty Gas Equipment Corp. that the equipment is to be repaired or replaced under the terms of this warranty, the cost of returning said equipment to the initial purchaser will be paid by the Company. If, however, equipment returned to the Company in connection with a claim under this warranty is found by the Company not to be defective hereunder, then such equipment will be returned to the initial purchaser, shipping charges collect, and additionally, a service will be paid by the purchaser to the Company to cover the cost of handling and testing such equipment.



*241 Lackland Drive, Middlesex, NJ 08846*  
*Phone: 732-271-9300 Fax: 732-271-1630 [www.asge-online.com](http://www.asge-online.com)*

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