

## Flowmeters

### Flowmeter Tutorial

Flowmeters are **used to measure the rate** of flow of liquids or gases. They do not control the rate of flow unless they are equipped with a control valve or flow controller. There are two basic types of flowmeters; rotameters and electronic mass flowmeters

Rotameters

Rotameters are a simple, precise and economical way to measure flow rates. They consist of a precision tapered glass tube containing one or more spherical floats. A measuring scale is etched on the glass tube. The diameter of the tube at the bottom, or inlet is approximately equal to the diameter of the float.

As fluid enters the tube, the float rises to a point where the area between the float and the tube wall is large enough to permit unrestricted flow, and the float is stationary. This position corresponds to a point on the tube scale and thus permits a reading of the rate of flow.

The capacity, or flow range of a tube can be varied by changing the float material. Materials of a lower density such as pyrex glass or sapphire give a lower flow capacity than materials of a higher density like tantalum or stainless steel (see Figure 1).

Rotameters, unlike mass flowmeters, are affected by temperature and pressure variation (see Figure 2). When equipped with a control valve on the inlet, readings are correct as long as the outlet pressure is equal to the pressure at which the tube was calibrated. When a valve is installed on the outlet, the tube calibration pressure must match the inlet pressure to the flowmeter unit.

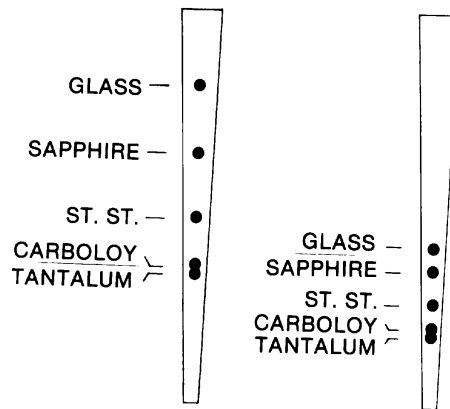


Figure 1

Relative positions of floats of various densities for the same rate of flow with 1 atmosphere outlet pressure

Figure 2

2 Effect of float position for the same rate of flow in Figure 1, but with increased pressure at the flowmeter outlet

## Flowmeter – Series 7920

### Description

The 7920 flowmeters provide the most accurate indication and precise control of fluids available for a wide range of applications. This versatile meter is functionally and dimensionally interchangeable with other current designs while incorporating many innovative features.

All 7920 glass metering tubes have integral float guides to assure accuracy of  $\pm 5\%$  of full scale. Glass and stainless steel floats are standard. The meters are available in a wide range of flows.

Standard with this series is the TUBE CUBE™, a unique design concept. The “cube” a unitized tube holder, aligns the tube quickly and easily for a simple tube installation or replacement, reduces chipped tube ends, broken tubes and misalignment. The TUBE CUBE™ also provides tube protection during handling and storage and affords tube reading. End seals in the design are direct acting and non-rotating for fast alignment and convenient service access.

### Applications

- Carrier and fuel gas chromatography
- Atomic absorption
- Semiconductor manufacture
- Chemical processing
- General research and industrial uses

### Specifications

Maximum Pressure: 250 psig  
Temperature: -20°F to +250°F  
Accuracy:  $\pm 5\%$  of full scale  
Repeatability:  $\pm 0.25\%$  of scale

### Materials

End Blocks: Chrome plated Brass, 316 stainless, or Monel®  
“O” Rings & Packing: Vitron® –standard Buna-N, EPR rubber and Teflon are available options  
Slide Plates: Anodized Aluminum



### Features

- High resolution 150 mm scale length
- Many standard direct reading scales available
- Precision taper, fluted metering tube
- Lowest available pressure drop via maximum flow path area increase available flow rates at low feed pressures
- Standard front panel mounting requires minimum hardware – easy installation, quick access
- Available utility and high precision metering valves do not require special fittings
- Simplified; direct acting non-rotating compression seal

## Flowmeter- Series7920

Model	Material	Valve Type
B7920*	Brass	None
B7920V*	Brass	Standard
B7920HA*	Brass	High Accuracy
S7920	316 Stainless Steel	None
S7920V*	316 Stainless Steel	Standard
S7920HA*	316 Stainless Steel	High Accuracy
M7920*	Monel®	None
M7920V*	Monel®	Standard

\* Each model includes one tube from the table below; specify your choice when ordering.

### Options:

- 1/4" NPT female inlet & outlet
- 1/4" hose barbs inlet & outlet
- 1/4" compression tube fittings inlet & outlet
- 1/8" compression tube fittings inlet & outlet

*Bench stand- model 7920B*

### P/N Suffix:

- P4FF
- HB
- T4FF
- T2FF

How to order	
Model -X-Y	
X=tube required	1,2,3,4,5,6,7,8,9,10
Y=optional fittings	HB=hose barb T4FF= 1/4" compression T2FF= 1/8" compression
Example:	B7920V-2-T4FF is brass unit with a 7920-2 flow tube and 1/4" compression fittings on inlet and outlet.

## Flowmeter Tubes in TUBE-CUBE<sup>â</sup>

Model	Typical Flow Range*		
	Float	Air scc/min.	Water cc./min.
7920-1	Glass	3-56	0.04-0.66
	St Steel	11-158	0.12-3.18
7920-2	Glass	6-91	0.08-1.0
	St Steel	16-271	0.17-5.5
7920-3	Glass	22-388	0.24-7.8
	St Steel	63-845	0.68-17
7920-4	Glass	64-847	1-17
	St Steel	217-1707	2-46
7920-5	Glass	550-2560	6-54
	St Steel	1070-5080	21-135
7920-6	Glass	610-3830	9-89
	St Steel	1330-7670	30-217
7920-7	Glass	820-8610	14-200
	St Steel	2090-16580	53-482
7920-8	Glass	2220-24920	47-568
	St Steel	4190-45920	102-1319
7920-10	Glass	1.0-100	

Selected Correction Factors Flow-air flow x correction factor	
Gas	Correction Factors
air	1.00
acetylene	1.054
ammonia	1.304
argon	0.851
n-butane	0.706
carbon dioxide	0.811
carbon monoxide	1.017
ethane	0.981
helium	2.689
hydrogen	3.810
methane	1.343
nitrogen	1.017
nitrous oxide	0.811
oxygen	0.951
propane	0.810

\*Actual flow rates will vary from one manufacturing lot to another. Calibration data is supplied for each tube.



## Gas Proportioner Series 7950

The gas proportioner meters the flow of each of two gases and mixes them thoroughly in a special mixing tube to produce homogeneous two-component mixtures. Concentration accuracies of 10% of component value are maintained with a standard unit using typical calibration curves. (In a desired mixture of 1% of gas A and 99% of gas B, a concentration between .9% and 1.1 % is maintained.) Individual units can be calibrated for non-corrosive gases to attain an accuracy of 5% of the component value. Individual calibration curves are supplied with these specially calibrated units.

These gas proportioners are back pressure compensated: the readings on the tubes are accurate regardless of the back pressure, so long as the inlet pressures are maintained at the levels for which the tubes were calibrated.

The unit is recommended for 50 psig pressure but can be used at any pressure between 10 and 200 psi.

The control valves are installed at the outlets. The tubes have a single glass float. Typical calibration curves for air at 50 psig using the glass float as provided. Typical maximum flow of air under these conditions is as follows:

7920-1 - 117 ccm	7920-6 - 8043 ccm
7920-2 - 192 ccm	7920-7 - 18081 ccm
7920-3 - 816 ccm	7920-8 - 52332 ccm
7920-4 - 1780 ccm	7920-10 - 218 ccm
7920-5 - 5376 ccm	

These proportioners are available in both aluminum and stainless steel construction. When ordering a gas proportioner, specify the composition of the desired mixture, the gases, the discharge rate, and inlet pressure in addition to the model number.



### HOW TO ORDER

All models include baseplate, mixing tube and two flowmeter tubes of your choice selected from page xx.\* If unsure of correct tubes, provide the composition range of intended mixtures, total outlet flow and operating inlet pressure. We will select the tubes.

## Multi-Tube Units And Mixers

Model	Material	Valve	Connections
7951	Aluminum	Standard	1/8" NPT female
7951 H	Aluminum	Standard	1/4" hose barb
7951 T	Aluminum	Standard	1/4" compression
7952	Aluminum	High Accuracy	1/8" NPT female
7952H	Aluminum	High Accuracy	1/4" hose barb
7952T	Aluminum	High Accuracy	1/4" compression
7953	Stainless Steel	Standard	1/8" NPT female
7953H	Stainless Steel	Standard	1/4" hose barb
7953T	Stainless Steel	Standard	1/4" compression
7954	Stainless Steel	High Accuracy	1/8" NPT female
7954H	Stainless Steel	High Accuracy	1/4" hose barb
7954T	Stainless Steel	High Accuracy	1/4" compression

## Series 7940 And 7941

The Series 7940 multitube flowmeters are available in either Aluminum or 316 Stainless Steel and in two basic configurations.

- 7940 Series has four flowmeter tubes with individual outlets to permit the metering of four separate gas streams. It comes complete with four tubes.
- 7941 Series mixers have three flowmeter tubes and a mixing tube with a single outlet to produce homogenous mixture of three gases to an accuracy of  $\pm 10\%$ . The tubes have a single glass float and calibration curves for most common gases are available at no extra cost.
- All units are backpressure compensated by mounting the control valves on the outlet.
- All are available with a standard valve cartridge or a high accuracy valve to permit very accurate setting of low flowrates.
- All units are provided with a bench stand.



### SPECIFICATIONS

Connection: 1/8" NPTF or 1/4" tube fitting  
 Maximum Inlet Pressure: 250 psig  
 Operating Temperature: 20°F to 250°F  
 Dimensions: 10"H x 4 1/4"W x 1 1/4"D  
 (not including base)  
 Shipping Weight: 6 3/4 lbs

### Series 7940 4 - Tube Flowmeter\*

Model*	Material	Valve	Connections
A7940	Aluminum	Standard	1/8" NPT female
A7940T	Aluminum	Standard	1/4" compression fitting
A7940HA	Aluminum	High Accuracy	1/8" NPT female
A7940THA	Aluminum	High Accuracy	1/4" compression fitting
S7940	316 Stainless Steel	Standard	1/8" NPT female
S7940T	316 Stainless Steel	Standard	1/4" compression fitting
S7940HA	316 Stainless Steel	High Accuracy	1/8" NPT female
S7940THA	316 Stainless Steel	High Accuracy	1/4" compression fitting

### Series 7941 Mixing Units\*

Model*	Material	Valve	Connections
A7941	Aluminum	Standard	1/8" NPT female
A7941 T	Aluminum	Standard	1/4" compression fitting
A7941 HA	Aluminum	High Accuracy	1/8" NPT female
A7941 THA	Aluminum	High Accuracy	1/4" compression fitting
S7941	316 Stainless Steel	Standard	1/8" NPT female
S7941 T	316 Stainless Steel	Standard	1/4" compression fitting
S7941 HA	316 Stainless Steel	High Accuracy	1/8" NPT female
S7941 THA	316 Stainless Steel	High Accuracy	1/4" compression fitting

\*Specify your choice of Flowmeter tubes from the table on page XX.

# Gas Equipment



## Flowmeter Series 7965

The Series 7965 flowmeters use 65 mm Tube-Cubes@ with a single float. They are calibrated to read directly in SCCM, SLPM or SCFH of air. Correction factors are available for a number of common gases. The Series 7965 flowmeters are available in chrome plated brass or stainless steel.

### SPECIFICATIONS

Maximum Inlet Pressure: 250 psig  
 Temperature Range: -200°F to +250°F  
 Valve: Standard or high accuracy needle valve  
 Dimensions: 1 1/4"W x 5 1/2"H x 2 3/4"D  
 Accuracy: ±5% full scale  
 Repeatability: 0.25% of scale reading  
 Inlet and Outlet: 1/8" NPT female



Model	Material
7965B*	Chrome plated brass with Standard valve
7965BHA*	Chrome plated brass with high accuracy valve
7965S*	316 Stainless Steel with standard valve
7965SHA*	316 Stainless Steel with high accuracy valve

### HOW TO ORDER

Model - X - Y

X=tube required

Y=optional fittings

Example: 7965B-J805-P4FF

### Options:

- 1/4" hose barbs inlet and outlet - add suffix "HB"
- 1/4" compression tube fittings inlet and outlet add suffix "T4FF"
- 1/8" compression fitting - add suffix "T2FF"
- Bench stand - model 7920B

### 65mm Tube Cube Selection

Tube Number	Float Material	Flow Range*
J07G	glass	0.6 - 6 sccm
J07ST	SS	2 - 17 sccm
J15G	glass	5 - 49 sccm
J15S	SS	7 - 72 sccm
J009	glass	10 - 130 sccm
J010	SS	30 - 300 sccm
J109	glass	50 - 500 sccm
J110	SS	100 - 1000 sccm
J703 (formerly 1 B)	glass	0.05 - 5 slpm
J704	glass	0.1 - 1 slpm
J705 (formerly 2B)	SS	0.2 - 2 slpm
J802 (formerly 3B)	SS	0.5 - 6 slpm
J803 (formerly 4B)	SS	1 - 10 Slpm
J854 (formerly 5B)	glass	2 - 25 sipm
J853	SS	4 - 40 sipm
J707	glass	0.2 - 2 SCFH
J708	SS	0.5 - 5 SCFH
J755	SS	1 - 10 SCFH
J805	SS	2 - 20 SCFH
J859	glass	5 - 50 SCFH
J513	SS	10- 100 SCFH
J514	carboly	10 - 150 SCFH

## Acrylic Purge Meter For Non-Corrosive Gases Series 7921

The Series 7921 purge meters are a practical, low cost way to measure flow of gases or liquids where great accuracy is not required. The acrylic body is protected by an aluminum frame, and all threads are made in metal to prevent cracking. They can be panel mounted or bench mounted with the optional bench stand. All aluminum cartridge-type needle valve is included.

### SPECIFICATIONS

Maximum Inlet Pressure: 100 psig  
 Maximum Operating Temperature: 160°F  
 Dimensions: 1"W x 4"H x 23/4"D  
 Accuracy: 10% Full Scale  
 Repeatability: ± 1% of scale reading  
 Inlet and Outlet: 1/8" NPT female



### Options:

- 1/4" hose barbs inlet and outlet -add suffix "HB"
- 1/4" compression tube fittings inlet and outlet add suffix '74FF"
- 1/8" compression fitting inlet and outlet - add suffix
- Bench stand - model 7921 B

Model	Flow Range SCFH Air)	Float
7921-1	0.2-3.6	Glass
7921-2	1-18	Glass
7921-3	5-80	Glass
7921-4	20-180	Stainless Steel

## Economic Acrylic Flowmeter Series 7923

The Series 7923 acrylic flowmeters are an ideal low cost tool for measuring flow rates of inert and non-reactive gases. The 1/8" female standard inlet and outlet connections are contained in brass inserts to ensure a secure leak-free connection to prevent cracking of the acrylic body. A needle valve to control the flow rate is included.

### SPECIFICATIONS

Maximum inlet pressure: 100 psig  
 Maximum operating temperature: 150°F  
 Dimensions: 1" wide x 4" high x 2 1/8" deep  
 Accuracy: +5% full scale  
 Repeatability: +1% of scale reading  
 Inlet and Outlet: 1/8" NPT female standard on 3" centers  
 Seals: buna-N



### Options:

- 1/4" hose barbs inlet and outlet -add suffix "HB"
- 1/4" compression tube fittings inlet and outlet add suffix '74FF"
- 1/8" compression fitting inlet and outlet - add suffix 72FF"

Model	Flow Range (SCFH Air)	Float
7923-2AO0	0.1 -1 SCFH	glass
7923-2AO1	0.2 -2 SCFH	SS
7923-2AO2	0.5 -5 SCFH	glass
7923-2AO3	0.5 - 10 SCFH	glass
7923-2AO4	2 -20 SCFH	SS
7923-2AO5	3 -30 SCFH 4 -50 SCFH	SS
7923-2AO6	4 -50 SCFH	glass
7923-2AO7	10 - 100 SCFH	SS
7923-2AO8	20 -200 SCFH	SS

## Large Flow Acrylic Flowmeters Series 7974 & 7975

The Series 7974 and 7975 acrylic flowmeters are useful in a wide varied of of applications involving non-corrosive gases where flow rates exceed those of traditional laboratory models. All units have direct reading scales in either liters/minute or cubic feet/minute of air. Correction factors for other gases can be provided.

### Features

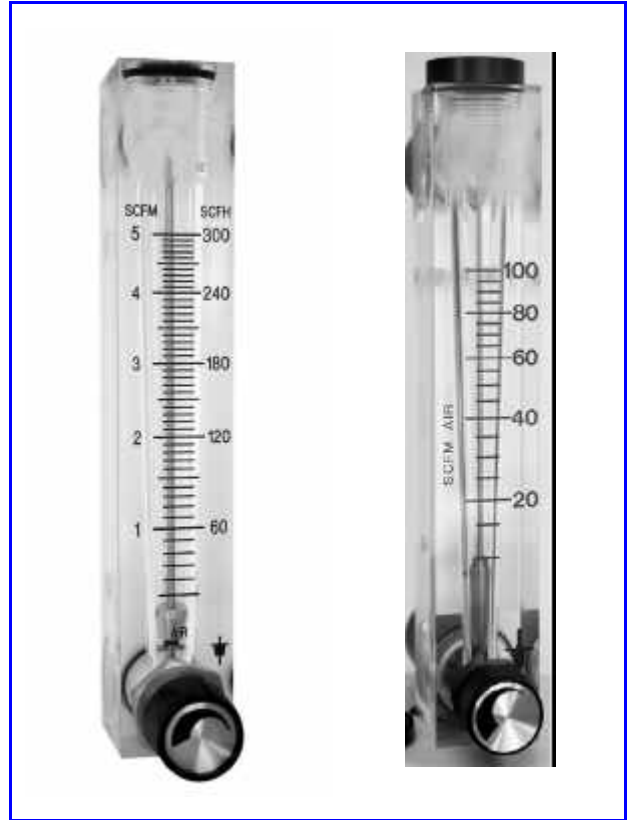
- Easy to read scales
- Air ranges from 14 lpm. to 3400 lpm(0.5 to 100 scfm)
- Durable one-piece clear acrylic construction
- Optional built-in cartridge type valve available

### SPECIFICATIONS

Max. Operating Pressure: 100 psig  
 Operating Temp. Range: 00 to +1500°F  
 Body Inlet and Outlet: 7974 - 1/4" NPT female  
 7975 - 1" NPT female  
 Accuracy: 7974 Series - +3% of full scale  
 7975 Series - +2% of full scale

### MATERIALS OF CONSTRUCTION

Body: clear acrylic  
 Fittings: 7974 series - brass  
 7975 series - PVC  
 Valve: brass  
 Seals: Buna-N

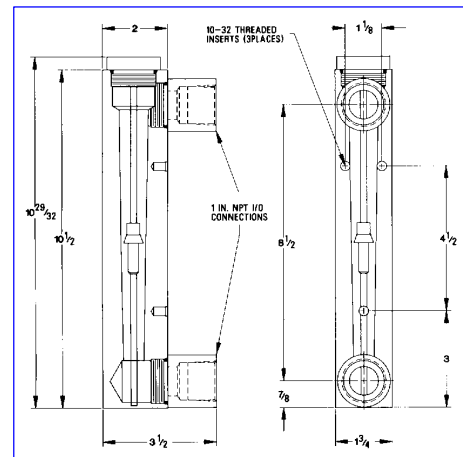
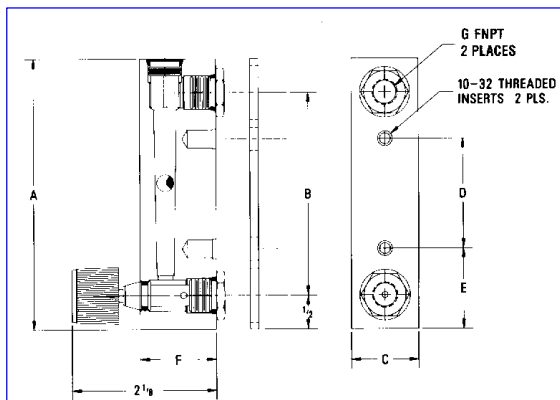


Model Number	Flow Range
B7974-1	0.5-5.0 SUM
B7974-2	1- 10 SUM
B7974-3	2- 20 SUM
B7974-4	14-140 lpm
B7974-5	30-280 lpm
B7974-6*	60-560 lpm

Option: Inlet needle valve - add suffix "V" to model number,i.e. 7974V-1

Model Number	Flow Range
7975-1	3-25 SCFM
7975-2	4-50 SCFM
7975-3	10-100 SCFM
7975-4	100-700 lpm
7975-5	100-1400 lpm
7975-6	400-3400 lpm

Option: Inlet needle valve - add suffix "V" to model number,i.e. 7975V-1.



## Very Large Flow Acrylic Flowmeters Series 7976 & 7977

The Series 7976 and 7977 acrylic flowmeters are useful in a wide varied of of applications involving non-corrosive gases where flow rates exceed those of traditional laboratory models. All units have direct reading scales in either liters/minute or cubic feet/minute of air. Correction factors for other gases can be provided.

### Features

- Easy to read scales
- Air ranges from 10 SUM to 400 SUM (300 to 1 1000 LPM).
- Durable one-piece clear acrylic construction
- Stable, easy to read stainless steel floats
- In-line design - Inlet and outlet 180° to each other

### MATERIALS OF CONSTRUCTION

Body: clear acrylic  
Fittings: PVC standard  
(stainless steel optional)  
Seals: Viton

### SPECIFICATIONS

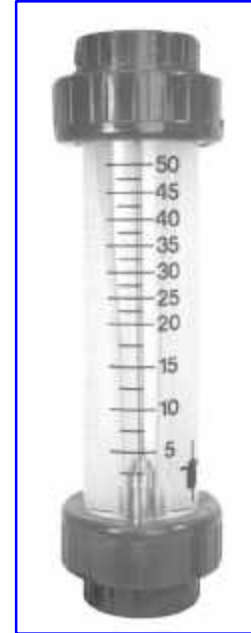
Max. Operating Pressure: 100 psig  
Operating Temp. Range: 00 to +1500° F  
Body Inlet and Outlet: 7976 - 1 1/2" NPT female  
7977 - 2" NPT female  
Accuracy: ± 5%

Model Number	Flow Range
7976-1	10-110 SCFM
7976-2	15-160SCFM
7976-3	20-200 SCFM
7976-4	300-3000 lpm
7976-5	450-4500 lpm
7976-6*	500-5500 lpm

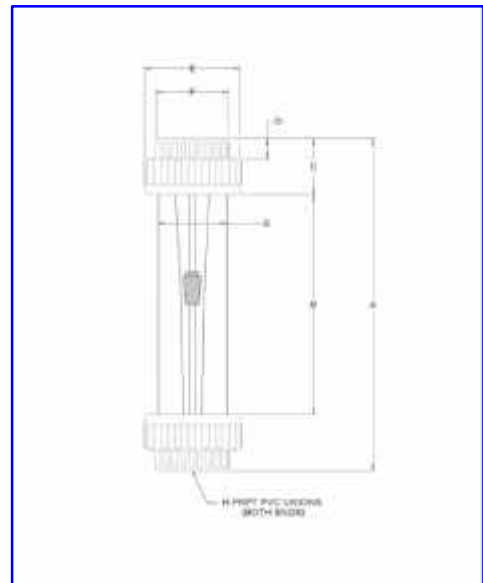
Option: For stainless steel fittings add suffix "S" model number, i.e. 7976S-2.

Model Number	Flow Range
7977-1	25-250 SCFM
7977-2	30-330SCFM
7977-3	40-400 SCFM
7977-4	300-3000 lpm
7977-5	450-4500 lpm
7977-6	500-5500 lpm

Option: For stainless steel fittings add suffix "S" to model number, i.e. 7977S-1.



Series 7976



	A	B	D	E	F	G	H
7976	133/8	91/8	7/8	3 1/2	21/2	21/2	11/2" FNPT
7977	13 5/8	8 11/16	11/8	41/8	3	29/10	2" FNPT