

Variable Area Flowmeter, Glass Tube

Models A3500 & A3600

Specification DataFile

- **Removable metering tube**
 - for range changing or cleaning without removing meter from line

- **External retaining spring and equal area ends on tube**
 - prevents the tube moving under pressure, vacuum, overrange or backflow when O-ring seals are used

- **Rotatable end fittings**
 - increases flexibility of installation

- **180° visibility of tube and float with standard enclosure and mounting**
 - provides wide viewing angle for all installations

- **Operator protection shield in polycarbonate available**
 - for increased safety where required



*Provides accurate visual indication
of flow on a linear scale*

Overview

The ABB Extruded-body Flowrator Meter is a glass tube variable-area flowmeter providing visual indication of flow rate over a 12¹/₂ : 1 range on a linear scale. The Model 10A3500 utilizes O-ring seals and Model 10A3600 a packing-gland type seal.

With either type of seal the glass metering tube can be removed easily for range change or cleaning, without disassembling other meter parts or removing the meter from the line. Both types have the same external dimensions and are interchangeable with regard to piping assembly.

The meter is available in tube sizes from 1/2 to 2 in. bore for liquid or gas service.

Specification

Accuracy

Standard ±2% max. flow – tube size 1/2 to 2 in.

Optional ±1% max. flow – tube size 1/2 to 2 in.

Repeatability

≤ 0.25% of full scale

Range

12¹/₂ : 1

Mounting

Standard – Line mounting

Optional – Panel mounting (flush or surface)
Laboratory stand

Scale Type and Location

Tube Sizes in.	Nominal Length in. (mm)	Scale Type and Location
1/2, 3/4, 1 1/2	10 (250)	1) Percent on tube (except Capacity Table 1) 2) Percent on clip-on scale (Capacity Table 1) 3) Blank tube with ref. mark and clip-on scale (Capacity Tables 1 & 2)
1, 2	9 (225)	

...Specification

Materials of Construction

Tube

Bead-guided borosilicate glass
used in tube sizes 1/2 to 2 in.

USV, SV, NSV Floats

Standard – Stainless steel

Optional – Hastelloy C, Monel

O-Rings

Standard – Buna N

Optional – EPR, Viton (Model A3600 only)

Packing

Standard – Neoprene

Optional – Moulded PTFE liner

Fittings

Standard – Brass, Stainless steel

Optional – Steel, Hastelloy C, Monel
(Model A3600 only)

Inlet float stop

PTFE, Polypropylene

Outlet float stop

PTFE, Polypropylene

Tube rest gaskets

Standard – Durabla

Optional – PTFE

Glands

Stainless steel

Compression screws

Stainless steel

Meter body

Rigid extruded aluminium with protection coating and matt black epoxy finish

Tube retainer spring

Armco 17-7 pH stainless steel,
external to fluid stream in O-ring meters

Tube cover

Lucite

Optional Operator protection

Polycarbonate shield (see Note 3 under
Tube Design Pressure opposite)

Operational limits

Service

Glass tube meters are not recommended for service with alkalis above 40°C, fluorine and hydrofluoric acid concentrations of greater than 20%, water above 90°C, steam, slurries, or molten metal

Temperature ratings

Minimum recommended temperature is 0°C.

Maximum recommended temperature is 120°C

Tube pressure ratings

In flanged meters the ANSI rating of the flange should be used if this is lower than the glass tube rating

Tube Design Pressure

Tube Size	Max. Design Pressure in bar @ 40°C	
1/2	21	Tempered Borosilicate Glass
3/4	14	
1	14	
1 1/2	9	
2	9	

Notes.

- Sizes 1/2 and 3/4 in. – max. pressure rating does not decrease with increasing temperature.
- Sizes 1, 1 1/2 and 2 in. – decrease pressure rating by 1% per 2°C increase in operating temperature above 90°C.
- All gas applications at pressures exceeding 1 bar g and all flashing liquid applications should be handled by using either all-metal meters or glass tube meters with an externally installed personnel protection shield. This precaution is recommended because of the danger of accidental breakage of the glass tube under pressure.

Weight and Connection Types and Sizes

Connection Type		Tube Size		
		1/2 in.	3/4 in. & 1 in.	1 1/2 in. & 2 in.
Screwed	Weight (kg)	1.8	5	15
	Thread Size (in. BSP)	1/2	3/4	1 1/2
Flanged	Weight (kg)	4.5	8.6	19.5
	Nom. Flange Size	1/2	1	1 1/2

Note.

Flange connections match BS10 Table 'E', DIN (BS 4504) or ANSI (BS 1560)

Screwed connections are BSP 'Tr'

Measuring Range Table 1 – Low Pressure Drop Floats, Beaded Tubes (not suitable for use with alarm sensors)

Tube Size in.	Max. Flow Rate		Tube No.	Float No.	Pressure Drop mbar (1)	V.I.C. Factor (2)	Minimum Required Pressure for Gas Service bar (3)	Tube/Float Combination
	L/h Water SG 1.0	Nm ³ /h Air @ 0°C and 1013 mbar						
1/2	45.0	1.31	FP-1/2-17-G-10	1/2-GUSVT-410	1.3	2.2	0.25	B1A
	50.5	1.47	FP-1/2-17-G-10	1/2-GUSVT-413	2.3	2.3	0.32	B1B
	54.1	1.61	FP-1/2-21-G-10	1/2-GUSVT-410	1.3	2.2	0.25	B1C
	60.7	1.81	FP-1/2-21-G-10	1/2-GUSVT-413	2.3	2.3	0.32	B1D
	73.6	2.19	FP-1/2-27-G-10	1/2-GUSVT-410	1.4	2.2	0.25	B1E
	82.7	2.46	FP-1/2-27-G-10	1/2-GUSVT-413	2.7	2.3	0.32	B1F
	110.3	3.27	FP-1/2-27-G-10	1/2-GUSVT-412	4.9	2.7	0.57	B1G
	134.9	4.02	FP-1/2-27-G-10	1/2-GUSVT-414	7.8	3.3	0.84	B1H
	3/4	143.8	4.29	FP-3/4-21-G-10	3/4-GUSVT-510	1.5	3.3	0.21
169.7		5.06	FP-3/4-21-G-10	3/4-GUSVT-511	2.0	3.6	0.30	B2B
195.3		5.79	FP-3/4-27-G-10	3/4-GUSVT-510	1.8	3.3	0.10	B2C
230.6		6.84	FP-3/4-27-G-10	3/4-GUSVT-511	2.4	3.6	0.15	B2D
1	273.7	8.15	FP-1-27-G-10	1-GUSVT-611	3.2	4.0	0.07	B3A
	318.0	9.47	FP-1-27-G-10	1-GUSVT-613	3.3	4.6	0.10	B3B
	379.3	11.29	FP-1-35-G-10	1-GUSVT-611	4.6	4.0	0.05	B3C
	440.7	13.12	FP-1-35-G-10	1-GUSVT-613	5.0	4.6	0.07	B3D
	585.9	17.51	FP-1-27-G-10	1-GUSVT-610	13.6	8.6	0.31	B3E
	817.6	24.29	FP-1-35-G-10	1-GUSVT-610	19.8	8.6	0.24	B3F
1 1/2	556.4	16.86	FP-1 1/2-21-G-10	1 1/2-GUSVT-813	2.3	6.5	0.07	B4A
	583.6	17.68	FP-1 1/2-21-G-10	1 1/2-GUSVT-812	2.5	6.7	0.08	B4B
	756.2	22.54	FP-1 1/2-27-G-10	1 1/2-GUSVT-813	3.1	6.5	0.07	B4C
	793.2	23.69	FP-1 1/2-27-G-10	1 1/2-GUSVT-812	3.4	6.7	0.08	B4D
	848.7	25.71	FP-1 1/2-21-G-10	1 1/2-GUSVT-816	4.9	9.8	0.17	B4E
	1153.5	34.45	FP-1 1/2-27-G-10	1 1/2-GUSVT-816	5.5	9.8	0.17	B4F
	1476.2	44.19	FP-1 1/2-21-G-10	1 1/2-GUSVT-814	14.3	16.2	0.47	B4G
2	1258.1	37.48	FP-2-27-G-10	2-GUSVT-913	4.1	8.9	0.07	B5A
	1640.7	48.88	FP-2-27-G-10	2-GUSVT-915	3.6	11.6	0.12	B5B
	1921.0	57.04	FP-2-27-G-10	2-GUSVT-916	4.9	13.6	0.17	B5C
	3122.6	92.80	FP-2-27-G-10	2-GUSVT-914	22.4	22.0	0.43	B5D

Notes.

All Low Pressure Drop tubes are blank with a reference mark and are supplied complete with a clip-on scale plate graduated either in percent of maximum flow or customers' specified flow units.

- Pressure drop in mbar is total pressure loss across the meter at 100% flowrate.
- Meter is unaffected by viscosity when the value of $\text{cps}/\sqrt{\rho}$ (using operating density in g/cc and viscosity in centipoise) is less than the Viscosity Immunity Ceiling (V.I.C.). V.I.C. is applicable to liquids only: all gas flows fall below V.I.C.
V.I.C. = (factor) $\times \sqrt{\rho}$
- Meters not recommended for gas service where pressure is below minimum shown. A flow throttling valve close-coupled to the meter outlet is recommended for all gas applications.

...Specification

Measuring Range Table 2 – Beaded Tubes – Suitable for use with 55AX1000 Alarm Sensor (except *)

Tube Size in.	Max. Flow Rate		Tube No.	Float No.	Pressure Drop mbar (1)	V.I.C. Factor (2)	Minimum Required Pressure for Gas Service bar (3)	Tube/Float Combination
	L/h Water SG 1.0	Nm ³ /h Air @ 0°C and 1013 mbar						
1/2	109.0	3.14	FP-1/2-17-G-10	1/2-GSVT-45-A*	8.71	5.1	1.23	A1A
	136.3	4.04	FP-1/2-21-G-10	1/2-GSVT-45-A*	11.45	5.1	0.79	A1B
	152.2	4.52	FP-1/2-17-G-10	1/2-GSVT-44-A	15.93	7.1	2.30	A1C
	156.7	4.66	FP-1/2-17-G-10	1/2-GSVT-48-A	18.17	7.6	2.69	A1D
	167.2	4.97	FP-1/2-21-G-10	1/2-GNSVT-45-A*	14.93	1.0	0.79	A1E
	184.0	5.48	FP-1/2-27-G-10	1/2-GSVT-45-A*	16.93	5.1	0.58	A1F
	188.5	5.60	FP-1/2-21-G-10	1/2-GSVT-44-A	19.17	7.1	2.33	A1G
	200.0	5.93	FP-1/2-21-G-10	1/2-GSVT-48-A	19.91	7.6	1.70	A1H
	231.6	6.87	FP-1/2-27-G-10	1/2-GNSVT-45-A*	19.91	1.0	0.58	A1I
	254.4	7.53	FP-1/2-27-G-10	1/2-GSVT-44-A	30.61	7.1	1.12	A1J
	270.3	8.02	FP-1/2-27-G-10	1/2-GSVT-48-A	34.10	7.6	1.28	A1K
	327.0	9.71	FP-1/2-27-G-10	1/2-GSVT-48-A	37.50	1.1	1.30	A1L
	354.3	10.53	FP-1/2-35-G-10	1/2-GSVT-44-A	36.84	7.1	1.14	A1M
	377.0	11.21	FP-1/2-35-G-10	1/2-GSVT-48-A	42.81	7.6	1.30	A1N
	417.9	12.44	FP-1/2-27-G-10	1/2-GNSVT-43	25.80	1.3	1.90	A1O
	454.2	13.49	FP-1/2-35-G-10	1/2-GNSVT-48-A	47.29	1.1	0.61	A1P
3/4	445.1	13.23	FP-3/4-21-G-10	3/4-GSVGT-54	13.19	10.4	0.96	A2A
	565.5	16.69	FP-3/4-21-G-10	3/4-GNSVGT-54	16.93	1.6	0.96	A2B
	613.2	18.17	FP-3/4-27-G-10	3/4-GSVGT-54	19.17	10.4	0.96	A2C
	806.2	23.89	FP-3/4-27-G-10	3/4-GNSVGT-54	28.62	1.6	0.66	A2D
	833.5	24.72	FP-3/4-27-G-10	3/4-GSVGT-59	34.10	14.1	1.37	A2E
	1090.1	32.41	FP-3/4-27-G-10	3/4-GNSVGT-59	51.02	2.1	1.37	A2F
1	965.2	28.64	FP-1-27-G-10	1-GSVGT-64	32.11	14.8	0.79	A3A
	1060.6	31.58	FP-1-27-G-10	1-GSVGT-60	45.31	15.7	0.98	A3B
	1094.6	32.57	FP-1-27-G-10	1-GSVGT-68	46.54	16.9	1.08	A3C
	1278.6	37.97	FP-1-27-G-10	1-GNSVGT-64	51.52	2.2	0.79	A3D
	1326.6	40.42	FP-1-35-G-10	1-GSVGT-64	61.23	14.8	0.48	A3E
	1467.1	43.53	FP-1-27-G-10	1-GNSVGT-68	80.91	2.5	1.08	A3F
	1498.9	44.51	FP-1-35-G-10	1-GSVGT-60	81.41	15.7	0.63	A3G
	1544.3	45.82	FP-1-35-G-10	1-GNSVGT-68	92.10	16.9	0.61	A3H
	1780.5	53.04	FP-1-35-G-10	1-GNSVGT-64	93.84	2.2	0.48	A3I
	1816.8	54.00	FP-1-35-G-10	1-GSVGT-61	130.67	20.0	0.94	A3J
	2043.9	60.57	FP-1-35-G-10	1-GNSVGT-68	156.31	2.5	0.61	A3K
	2157.5	64.17	FP-1-35-G-10	1-GSVGT-69	162.53	8.5	0.92	A3L
2498.1	74.15	FP-1-35-G-10	1-GNSVGT-69	278.77	1.5	0.92	A3M	
1 1/2	2123.4	53.17	FP-1 1/2-21-G-10	1 1/2-GSVGT-87	18.92	27.6	1.37	A4A
	2348.2	59.71	FP-1 1/2-21-G-10	1 1/2-GSVGT-86	20.17	31.0	1.65	A4B
	2872.8	85.42	FP-1 1/2-21-G-10	1 1/2-GNSVGT-87	23.15	4.2	1.37	A4C
	2997.7	89.05	FP-1 1/2-27-G-10	1 1/2-GSVGT-87	23.65	27.6	1.06	A4D
	3315.7	98.22	FP-1 1/2-27-G-10	1 1/2-GSVGT-86	33.60	31.0	1.52	A4E
	3997.0	117.86	FP-1 1/2-27-G-10	1 1/2-GNSVGT-87	31.86	4.2	1.06	A4F
4224.1	125.22	FP-1 1/2-27-G-10	1 1/2-GNSVGT-86	37.83	4.8	1.52	A4G	
2	4769.1	141.72	FP-2-27-G-10	2-GSVGT-910	41.07	35.0	0.84	A5A
	5450.4	162.03	FP-2-27-G-10	2-GSVGT-97	59.74	26.5	1.13	A5B
	6813.0	202.62	FP-2-27-G-10	2-GSVGT-98	84.63	18.5	1.46	A5C
	8198.3	243.90	FP-2-27-G-10	2-GNSVGT-98	112.00	3.3	1.46	A5D

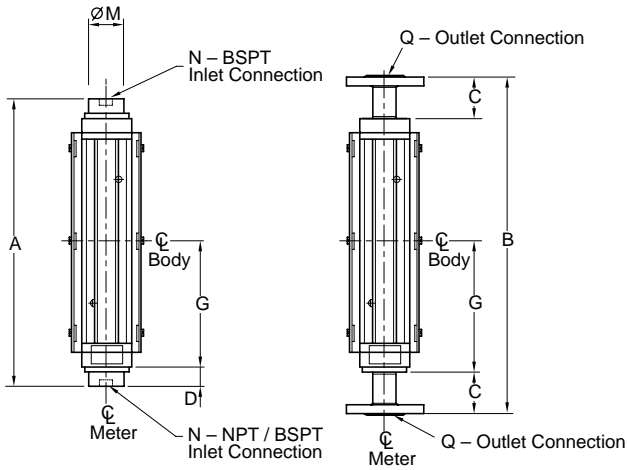
Notes.

- (1) Pressure drop in mbar is total pressure loss across the meter at 100% flowrate
- (2) Meter is unaffected by viscosity when the value of $\text{cps}/\sqrt{\rho}$ (using operating density in g/cc and viscosity in centipoise) is less than the Viscosity Immunity Ceiling (V.I.C.). V.I.C. is applicable to liquids only: all gas flows fall below V.I.C.
V.I.C. = (factor) $\times \sqrt{\rho}$
- (3) Meters not recommended for gas service where pressure is below minimum shown. For such applications see Measuring Range Table 1 – Low Pressure Drop Floats, Beaded Tubes. A flow throttling valve close-coupled to the meter outlet is recommended for all gas applications.

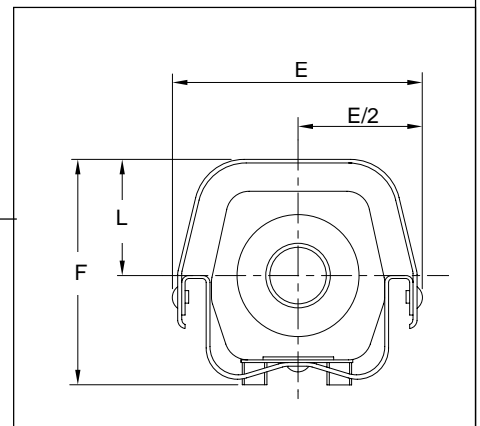
Overall Dimensions

With Operator Protection Shield

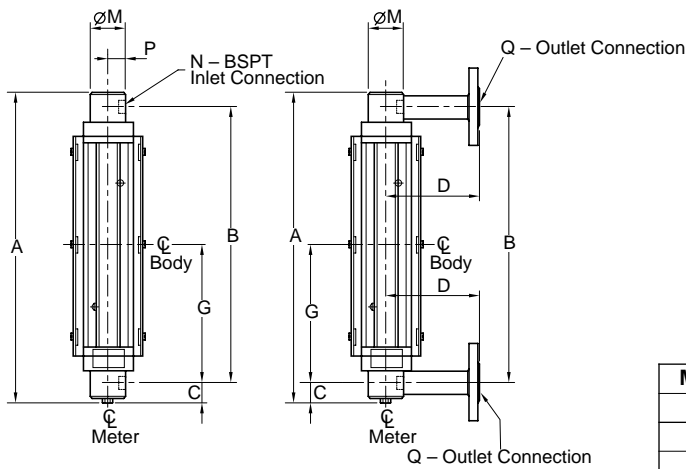
Vertical Connections



Meter Tube Size	1/2		3/4 to 1		1 1/2 to 2	
	in.	mm	in.	mm	in.	mm
A	16 ⁵ / ₈	422	17 ⁷ / ₈	454	20 ¹ / ₈	511
B	20 ³ / ₈	519	21 ³ / ₈	543	24 ¹ / ₂	622
C	2 ¹ / ₂	64	2 ³ / ₄	70	3 ¹ / ₄	83
D	5/8	16	1 ⁵ / ₁₆	24	1 ¹ / ₁₆	27
E	3 ⁷ / ₁₆	87	4 ⁹ / ₁₆	116	7	178
F	3	76	4 ¹ / ₄	108	6 ³ / ₈	162
G	7 ¹¹ / ₁₆	195	8	203	9	229
L	1 ⁷ / ₁₆	37	2 ¹ / ₁₆	52	3 ¹ / ₄	83
M	1 ¹ / ₂	38	2 ¹ / ₄	57	3 ³ / ₄	95
N	1/2	13	3/4	19	1 ¹ / ₂	38
Q	1/2	13	1	25	1 ¹ / ₂	38



Horizontal Connections



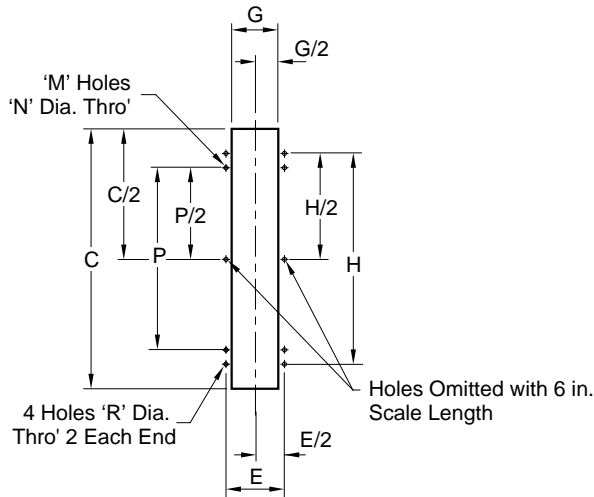
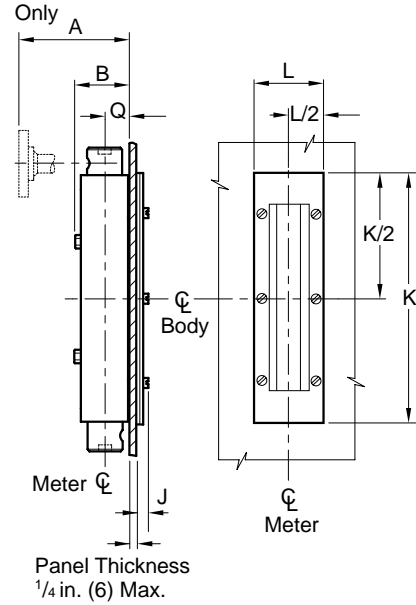
Meter Tube Size	1/2		3/4 to 1		1 1/2 to 2	
	in.	mm	in.	mm	in.	mm
A	18 ¹ / ₄	464	19 ³ / ₄	502	23 ³ / ₄	603
B	16 ¹ / ₂	419	17 ¹ / ₂	445	20 ¹ / ₂	521
C	1	25	1 ¹ / ₄	32	1 ⁷ / ₈	48
D	3 ¹ / ₂	89	4	102	5	127
E	3 ⁷ / ₁₆	87	4 ⁹ / ₁₆	116	7	178
F	3	76	4 ¹ / ₄	108	6 ³ / ₈	162
G	8 ¹ / ₄	210	8 ³ / ₄	222	10 ¹ / ₄	260
L	1 ⁷ / ₁₆	37	2 ¹ / ₁₆	52	3 ¹ / ₄	83
M	1 ¹ / ₂	38	2 ¹ / ₄	57	3 ³ / ₄	95
N	1/2	13	3/4	19	1 ¹ / ₂	38
Q	1/2	13	1	25	1 ¹ / ₂	38
P	2 ¹ / ₃₂	17	1	25	1 ¹¹ / ₁₆	43

Overall Dimensions

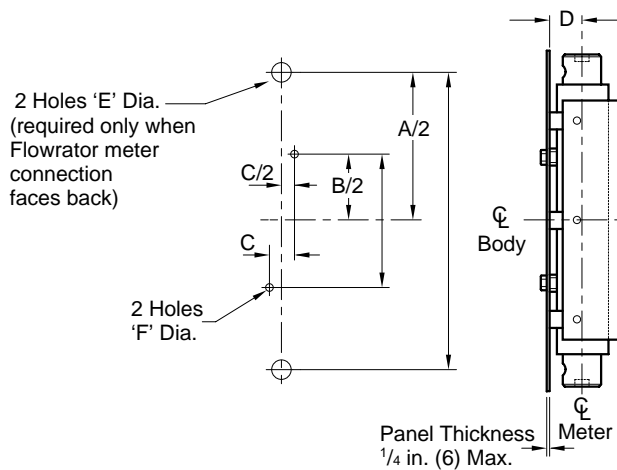
Rear Panel Mounting (including polycarbonate shield)

Meter Tube Size	1/2		3/4 to 1		1 1/2 to 2	
	in.	mm	in.	mm	in.	mm
A	4 5/8	117	5 9/16	141	7 5/16	186
B	2 3/8	60	3 3/8	86	5	127
C	15 3/8	391	15 5/8	397	17 1/4	438
E	3 7/16	87	3 7/16	87	5 3/16	132
G	2 3/4	70	2 3/4	70	4 7/16	113
H	12 5/8	321	12 5/8	321	13 1/2	343
J	5/16	8	5/16	8	5/15	8
K	16 3/16	411	16 3/16	411	17 3/4	451
L	4 3/8	111	4 3/8	111	6 1/2	165
M	6 holes	—	6 holes	—	6 holes	—
N	1/4	6.4	1/4	6.4	5/16	8
P	10 7/8	276	10 7/8	276	11 1/2	292
Q	1 1/8	29	1 9/16	40	2 5/16	59
R	1/4	6.4	1/4	6.4	1/4	6.4

Flanged Connection Only



Front Panel Mounting – for Polycarbonate Shield Type Only



Dimension	A		B		C		D		E dia.		F dia.	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
1/2	16 1/2	419	9 3/8	238	1	25	1 3/8	35	1 1/8	29	5/16	8
3/4 to 1	17 1/2	445	7 7/8	200	1 1/2	38	1 15/16	49	1 3/16	30	3/8	10
1 1/2 to 2	20 1/2	521	8 1/2	216	2	51	3	76	2 1/8	54	7/16	11

Ordering Information

Variable Area Flowmeter, Glass Tube	A3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
O-ring Seal		5																
Packing Gland Seal		6																
Shield Type	Polycarbonate		5															
	Acrylic		6															
Connection Orientation (Inlet/Outlet)	Vertical/Horizontal					1												
	Horizontal/Vertical					2												
	Horizontal/Horizontal					3												
	Vertical/Vertical					4												
Connection Type	BSPT																	
	BS1560 Class 150																	A
	BS1560 Class 300																	B
	BS4504 PN10-40																	C
	BS10 Table E																	D
	Special																	E
																		Z
Tube/Float	Tube length	10 in.																1
	Float type	Standard																A
		Low pressure																B
		Special																Z
	Tube diameter	1/2 in.																1
		3/4 in.																2
		1 in.																3
		1 1/2 in.																4
		2 in.																5
	Tube/Float	(selected from page 3 or 4 RH column – last letter)																X
	No tube or float																	Z
Scale Type	Without																	0
	Direct reading on tube																	1
	% on tube																	2
	Reference mark + clip-on scale																	3
	% tube + clip-on scale																	4
	Special																	9
Flow Calibration	Without																	0
	With																	1
Materials	Brass/Viton*																	A
	Brass/Buna*																	B
	Brass/EPR*																	C
	Stainless steel/Viton*																	I
	Stainless steel/Buna*																	J
	Stainless steel/EPR*																	K
	Special*																	Z
	Stainless steel†																	A
	Brass†																	I
Float Stop Material	PTFE*																	0
	Polypropylene*																	1
Packing	PTFE†																	0
	Standard†																	1
Alarm	Without																	A
	Min. alarm																	B
	Max. alarm																	C
	Min. & max. alarms																	D
Mounting	In-line																	A
	Rear panel																	B
	Front panel																	C
	Laboratory stand																	D
Design Level																		A

* Model A35 only † Model A36 only

Accessories

Laboratory Stand

Available in all sizes for portable bench or table-top use.

External Clip-on Scale

Graduated-flow scale mounted adjacent to metering tube, aligned with reference mark.

Surface (Front) Panel Mounting

Nuts, bolts and lock washers for mounting meter against front of panel by means of mounting holes provided on every meter body.

Flush (Rear) Panel Mounting

Brackets, bezel and hardware for mounting meter behind panel – incorporates polycarbonate window.

Ordering Requirements

To eliminate delays in the processing of orders and to ensure prompt delivery please specify:

- a) **Model number**
- b) **Operating conditions**
 - Fluid measured
 - Maximum flow rate
 - Fluid density
- c) **Fluid viscosity**
- d) **Allowable pressure drop**
- e) **Operating and maximum temperature**
- f) **Operating and maximum pressure**



The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice.

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