

Installation and Operation Manual

GT1600 Industrial Glass Tube Variable Area Flowmeter

BROOKS[®]
INSTRUMENT

Beyond Measure

Essential Instructions Read before proceeding!

Brooks Instrument designs, manufactures and tests its products to meet many national and international standards. These products must be properly installed, operated and maintained to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, operating and maintaining Brooks Instrument products.

- To ensure proper performance, use qualified personnel to install, operate, update, program and maintain the product.
- Read all instructions prior to installing, operating and servicing the product. If this instruction manual is not the correct manual, please see back cover for local sales office contact information. Save this instruction manual for future reference.

▲ WARNING: Do not operate this instrument in excess of the specifications listed in the Instruction and Operation Manual. Failure to heed this warning can result in serious personal injury and / or damage to the equipment.

- If you do not understand any of the instructions, contact your Brooks Instrument representative for clarification.
- Follow all warnings, cautions and instructions marked on and supplied with the product.

▲ WARNING: Prior to installation ensure this instrument has the required approval ratings to meet local and national codes. Failure to heed this warning can result in serious personal injury and / or damage to the equipment.

- Install your equipment as specified in the installation instructions of the appropriate instruction manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- Operation: (1) Slowly initiate flow into the system. Open process valves slowly to avoid flow surges. (2) Check for leaks around the flow meter inlet and outlet connections. If no leaks are present, bring the system up to the operating pressure.
- Please make sure that the process line pressure is removed prior to service. When replacement parts are required, ensure that qualified people use replacement parts specified by Brooks Instrument. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look-alike substitutions may result in fire, electrical hazards or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place to prevent electrical shock and personal injury, except when maintenance is being performed by qualified persons.

▲ WARNING: For liquid flow devices, if the inlet and outlet valves adjacent to the devices are to be closed for any reason, the devices must be completely drained. Failure to do so may result in thermal expansion of the liquid that can rupture the device and may cause personal injury.

European Pressure Equipment Directive (PED)

All pressure equipment with an internal pressure greater than 0.5 bar (g) and a size larger than 25mm or 1" (inch) falls under the Pressure Equipment Directive (PED).

- The Specifications Section of this manual contains instructions related to the PED directive.
- Products described in this manual are in compliance with EN directive 2014/34/EU.
- All Brooks Instrument Flowmeters fall under fluid group 1.
- Products larger than 25mm or 1" (inch) are in compliance with PED category I, II or III.
- Products of 25mm or 1" (inch) or smaller are Sound Engineering Practice (SEP).

European Electromagnetic Compatibility (EMC)

The Brooks Instrument (electric/electronic) equipment bearing the CE mark has been successfully tested to the regulations of the Electro Magnetic Compatibility (EMC directive 2014/30/EU).

Special attention however is required when selecting the signal cable to be used with CE marked equipment.

Quality of the signal cable, cable glands and connectors:

Brooks Instrument supplies high quality cable(s) which meets the specifications for CE certification.

If you provide your own signal cable you should use a cable which is overall completely screened with a 100% shield.

"D" or "Circular" type connectors used should be shielded with a metal shield. If applicable, metal cable glands must be used providing cable screen clamping.

The cable screen should be connected to the metal shell or gland and shielded at both ends over 360 Degrees.

The shield should be terminated to an earth ground.

Card Edge Connectors are standard non-metallic. The cables used must be screened with 100% shield to comply with CE certification.

The shield should be terminated to an earth ground.

For pin configuration : Please refer to the enclosed Instruction Manual.

ESD (Electrostatic Discharge)


▲ CAUTION: This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation or other handling of internal circuit boards or devices.

Handling Procedure:

1. Power to unit must be removed.
2. Personnel must be grounded, via a wrist strap or other safe, suitable means before any printed circuit card or other internal device is installed, removed or adjusted.
3. Printed circuit cards must be transported in a conductive container. Boards must not be removed from protective enclosure until immediately before installation. Removed boards must immediately be placed in protective container for transport, storage or return to factory.

Comments

This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, SMOS, etc.). Experience has proven that even small amounts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, exhibit early failure.

	<p>! WARNING</p>
<p>GLASS TUBE EXPLOSION HAZARD</p>	
<p>Plastic protective sleeve must remain over glass tube. (Meter sizes 7-10 only) Fasten meter window securely. Do not operate above pressure and temperature limits. Avoid pressure and flow surges. Do not service or repair while pressurized. Read and understand instruction manual. Failure to comply could result in serious personal injury or property damage.</p>	

<p>! WARNING</p>
<p>GLASS TUBE EXPLOSION HAZARD</p>
<p>Protective sleeve must remain over glass tube. (Meter sizes 7-10 only) Fasten meter windows securely. Failure to comply could result in serious personal injury or property damage.</p>

Brooks Instrument Serial Number Format(s)

Format 1 - All devices will transition to this format

EXAMPLE: 01B20080023

EXAMPLE: 01 B 2 0 08 0023

01 - Organization

B - Decade (A: 2000 - 2009, B: 2010-2019, ect.)

2 - Year within decade (B2 = 2012)

08 - Week of Year

0 - Warranty Period

0023 - Weekly counter

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Design Features

- Configurable to retro-fit GT10xx, GT130x and Full-View
- 360 degrees rotatable viewing angle
- High quality materials for safety, in- and outdoor durability
- 316 stainless steel frame
- Polycarbonate safety shield
- 316/316L dual certified stainless steel process fittings
- Alarms for high- and low flow (optional for all flow ranges, either at time of order, or as add-on in the field)
- Flanged or threaded connections, available horizontal and vertical
- Panel- and wall mount options
- Easy in-situ maintenance: Clean or replace tube and float without removal from the process piping
- Adjust the scale to compensate for process variation
- Optional integral needle valve

Principle of Operation

The operating parts of the flowmeter consist of a tapered glass tube and a float which operates within the tube. The fluid enters the bottom of the tube, which has the smallest inside diameter (and smallest area), and exits from the top, which has the largest inside diameter (and largest area). The float is free to operate between the largest and smallest areas of the tube. Refer to Figure 1-1.

As the float moves up and down within the tapered tube, the annular area between the float and tube varies (area increases as the float rises). This gives the generic name of "variable area meter" for this measurement principle. As the flow varies, the float will move within the tube until it reaches an equilibrium position, where the tube taper creates an appropriate annular area to balance the forces of gravity and the fluids acting on the float. Refer to Figure 1-2.

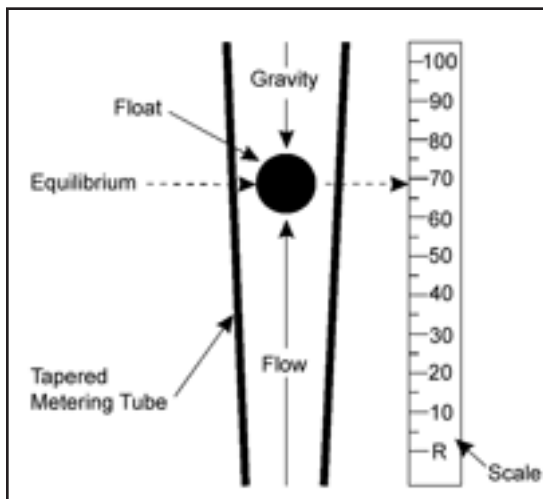


Figure 1-1 Principle of Operation

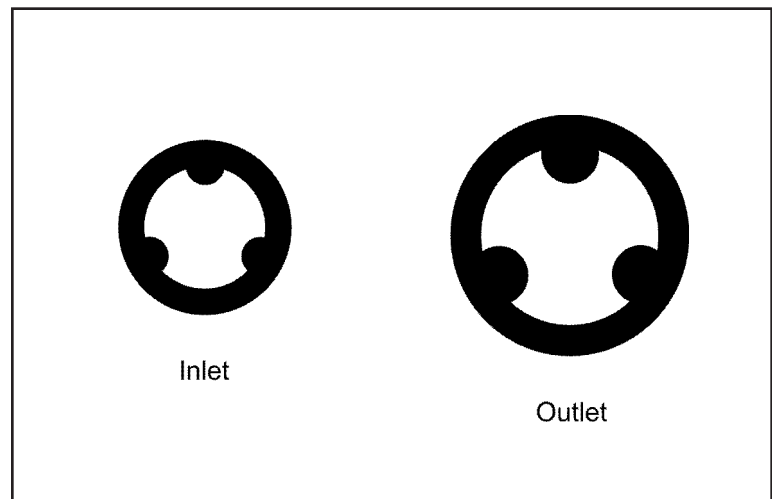


Figure 1-2 Cross-Section - GT1600 Flow Tubes with Rib Guides

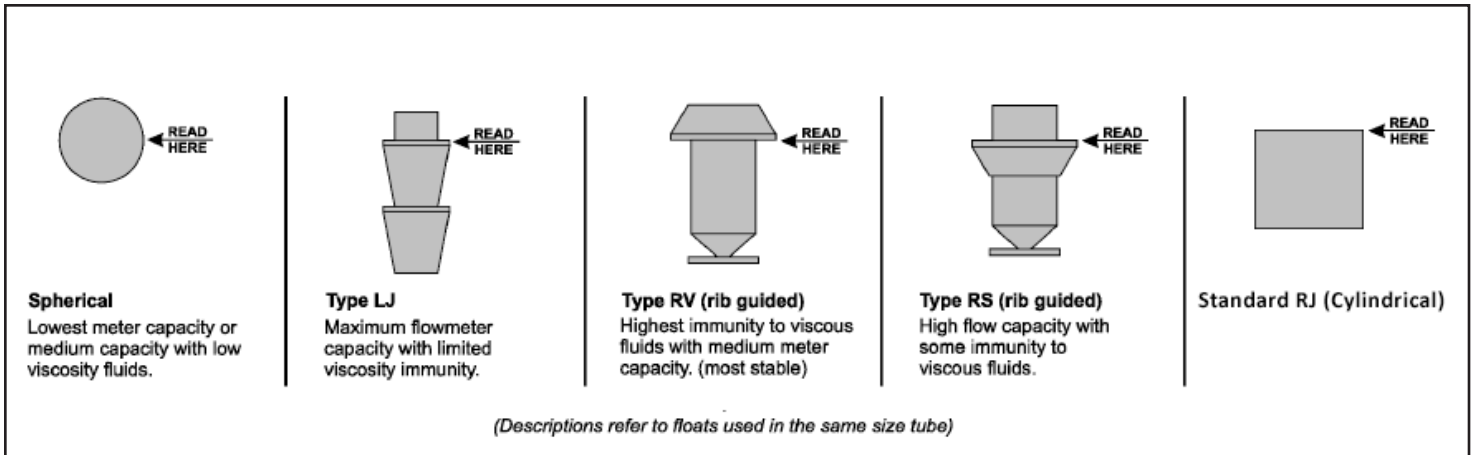


Figure 1-3 GT1600 Floats (Descriptions refer to floats used in the same size tube)

There are four types of floats available for the GT1600 flowmeter. Refer to Figure 1-3.

Guide ribs are formed into the tube to keep the float operating in the center of the tube. The guide ribs do not follow the taper of the tube. They are parallel to the tube centerline so that the proper operating clearance for the float is maintained for its entire range of travel. The increasing annular area of the tube is in the area between the ribs.

Refer to Figure 1-2.

Specifications

⚠ WARNING

Do not operate this instrument in excess of the specifications listed below. Failure to heed this warning can result in serious personal injury and/or damage to the equipment.

⚠ CAUTION

If flow is critical, evaluate the functional safety to help prevent systematic failures from being introduced.

⚠ WARNING

Glass metering tubes are designed for operation up to the maximum operating pressures and temperatures as specified herein. Due to the inherent brittle characteristics of glass and conditions beyond our control, tube breakage could result below specified operating conditions. Do not use glass tube meters with fluids that are toxic, or chemically react with glass such as water above 140°F (60°C), steam, alkalis, fluorine, hydrofluoric acid, or molten metal. Failure to heed warning can result in serious personal injury and/or damage to the equipment.

⚠ CAUTION





It is the user's responsibility to select and approve all materials of construction. Careful attention to metallurgy, engineered materials and elastomeric materials is critical to safe operation.

Table 1-1 Specifications - GT1600

Flow Accuracy	Standard: ±10%, ± 5%, ±2% Full Scale, Class 2.5 acc VDI/VDE				
	Optional: ±1% Full Scale, Class 1.6 acc VDI/VDE				
Repeatability	≤ 0.5% Full Scale				
Capacities and Pressure Drops	See Capacities				
Scales	Transparent scale. Adjustable				
	Nominal Lengths: 75mm, 127mm and 250mm				
	Choice of direct reading units, millimeter or percentage of maximum flow with factor tag.				
Ambient Temperature Limits	-4°F to 125°F -20°C to 52°C				
Operating Fluid Temperature Limits	33 to 250°F 1°C to 121°C				
Mounting options	In-line				
	Panel-mount (see Dimensions)				
	Wall-mount (see Dimensions)				
Process connections	NPT Threaded		Flanged ANSI 150# RF		
	Horizontal IN/OUT		Horizontal IN/OUT		
	Vertical IN/OUT		Vertical IN/OUT		
	Horizontal IN/ Vertical OUT		Horizontal IN/ Vertical OUT		
	Vertical IN/ Horizontal OUT		Vertical IN/ Horizontal OUT		
Pressure Ratings	Maximum Operating Pressure (PSIG bar) at Max Operating Temperature				
	Tube size	Threaded process connections		Flanged process connections	
		psi	bar	psi	bar
	*02	500	34.5	240	16.5
	*06	450	31.0	240	16.5
	07	300	20.7	240	16.5
	08	250	17.0	240	16.5
	09	200	13.8	200	13.8
10	175	12.1	175	12.1	
Materials of construction	Metering Tube (wetted)	Borosilicate glass			
	Process fittings (wetted)	316/316L (dual certified stainless steel)			
	Float (wetted)	Sizes 2&6: Carboloy® or 316/316L (dual certified stainless steel)			
		Sizes 7-10: 316/316L (dual certified stainless steel)			
	Float Stops (wetted)	Teflon®			
	O-rings (wetted)	Viton®, Buna-N, Kalrez®, EPDM			
	Housing	316 stainless steel			
	Window & safety shield	Polycarbonate with UV inhibitor			
Hardware	316 stainless steel				
Alarms	Tube size 02&06	Ring initiator high / low alarm			
	Tube size 07-10	Reed switch high / low alarm			
	Hazardous area approvals	Zone1/Zone2 (CSA/ATEX/IECex) – gas/dust. Protection method Ex-m (no barrier)			
		Div1/Div2 (CSA) – gas/dust. Protection method I.S. / Non-incendive			
Valve	Optional integral needle valve				
Certifications	International Calibration Certificate				
	Material Certification to DIN 3.1				
	Declaration of Compliance 2.1 Oxygen Service				

*Pressure rating for tube sizes 02 & 06 are limited 20.7 bar (300 psi) when an alarm is included for threaded process connections.

Table 1-2 Capacities - GT1600

			Full Scale - Water				Full Scale - Air				Alarm Type							
Flow	Tube	Float	cc/min	l/h	Pressure Drop inch W.C./kPa	V.I.C. cSt	SLPM	In/h	Pressure Drop inch W.C./kPa									
127-Low Flow 	Size 02	R-2-127-AAAAT	316SS	1.9	0.11	0.7/0.17	1.0	0.11	6.7	0.8/0.19	Ring Initiator							
		R-2-127-AAAAT	Carboloy	3.7	0.22	1.1/0.27	1.0	0.2	12	1.2/0.3								
		R-2-127-AAT	Carboloy	7.5	0.45	1.2/0.29	1.0	0.38	23	1.5/0.37								
		R-2-127-DT	316SS	15	0.93	0.9/0.22	1.0	0.68	40	1.0/0.24								
		R-2-127-DT	Carboloy	25	1.5	1.5/0.38	1.0	1	61	1.7/0.42								
		R-2-127-AT	316SS	39	2.3	1.1/0.27	1.0	1.4	86	1.2/0.3								
		R-2-127-AT	Carboloy	59	3.5	1.9/0.47	1.0	2	120	2.1/0.52								
		R-2-127-BT	316SS	110	6.8	1.8/0.45	1.0	3.9	230	2.0/0.21								
	R-2-127-BT	Carboloy	170	10	3.0/0.75	1.0	5.6	340	3.3/0.83									
	R-2-127-CT	Carboloy	270	16	6.1/1.51	1.0	9	540	4.8/1.2									
	Size 06	R-6-127-AT	316SS	410	25	6.1/1.53	1.0	14	850	6.8/1.7								
		R-6-127-AT	Carboloy	620	37	10.5/2.61	1.0	20	1200	11.6/2.9								
		R-6-127-BT	316SS	1000	65	30.1/7.5	1.0	35	2100	33.3/8.3								
		R-6-127-BT	Carboloy	1500	95	57.8/14.4	1.0	49	2900	64.2/16								
250-High Flow 	Size 07	R-7M-25-1FT	7-XV-11A-A	0.48	100	8/2	1.0	1.8	3.1	10/2.5	Reed Switch							
			7-XS-23-A	0.77	170	16/4.0	1.0	3.3	5.6	17/4.2								
	Size 08	R-8M-25-4FT	8-XV-8-A	1.00	240	5/1.5	3.7	4.4	7.5	5/1.3								
			8-XV-14-A	1.40	320	8/2	5.4	5.8	9.9	8/2								
			8-XV-31-A*	2.00	460	16/4	7.0	14	24	17/4.3								
	Size 09	R-9M-25-3FT	9-XS-33-A	3.20	730	4/1	2.3	13	22	8/2								
			9-XV-87-A*	3.90	890	14/3.5	17	28	48	16/4								
			9-XS-87-A*	5.10	1100	18/4.5	3.5	36	62	19/4.8								
	Size 10	R-10M-25-3FT	10-XV-64-A	6.20	1400	12/3	15	25	43	14/3.5								
			10-XS-64-A	7.80	1700	16/4	3.7	32	54	18/4.5								
			10-XS-138-A*	10.00	2400	30/7.5	5.5	80	130	36/9								
			10-XJ-238-A*	21.00	4800	104/26	1.0	150	270	16/4								
	127-High Flow 	Size 07	R-7M-127-1FT	7-XV-11A-A	0.41	93	8/2	1.0	1.8	3.1		10/2.5						
				7-XS-23-A	0.66	150	16/4.0	1.0	2.7	4.6		17/4.2						
Size 08		R-8M-127-4FT	8-XV-8-A	0.99	220	5.0/1.25	3.7	4	6.9	6.0/1.5								
			8-XV-14-A	1.3	310	8.0/2	5.4	5.3	9.1	10/2.5								
			8-XV-31-A*	1.7	400	24/6	7.0	11	20	28/7								
Size 09		R-9M-127-4FT	9-XS-33-A	3.0	690	7.0/1.7	2.3	12	21	8.0/2.0								
			9-XV-87-A*	3.6	830	14/3.5	17	26	44	16/4.0								
			9-XS-87-A*	4.5	1000	17/4.2	3.5	32	55	20/5.0								
Size 10		R-10M-127-3FT	10-XV-64-A	6	1300	9/2.25	15	24	41	10/2.5								
			10-XS-64-A	7.4	1600	12/3	3.7	30	52	13/3.25								
			10-XS-138-A*	9.8	2200	29/7.25	5.5	68	110	33/8.25								
			10-XJ-238-A*	20	4700	104/26	1.0	140	250	16/4								
075-High Flow 		Size 08	R-8M-75-1	8-XV-8-A	0.82	180	8/2	/	3.3	5.6	9/2.25							
				8-RJ-10	1.5	340	9/2.25		6.3	10	11/2.7							
	8-RJ-23			2.4	540	13/3.25	9.9		16	15/3.7								
	8-RJ-30			3.1	710	19/4.8	13		22	22/5.5								
	8-RJ-39			4.7	1000	34/6	/		/	/								
	Size 10	R-10M-75-3	10-RJ-80	12	2700	18/4.5		/			/	/						
			10-RJ-180	21	4900	71/17.6							/	/	/			
			10-RJ-37	/	/	/										24	40	18/4.5
			10-RJ-83													36	62	35/8.7
			10-RJ-90				43		73	71/17.6								

Note (1): Air flow rates in standard units are at 70°F & 14.7 psia

Note (2): Air flow rates in normal units are at 1.013 bar & 20°C

*These codes require a back pressure of 30 psig/2 bar

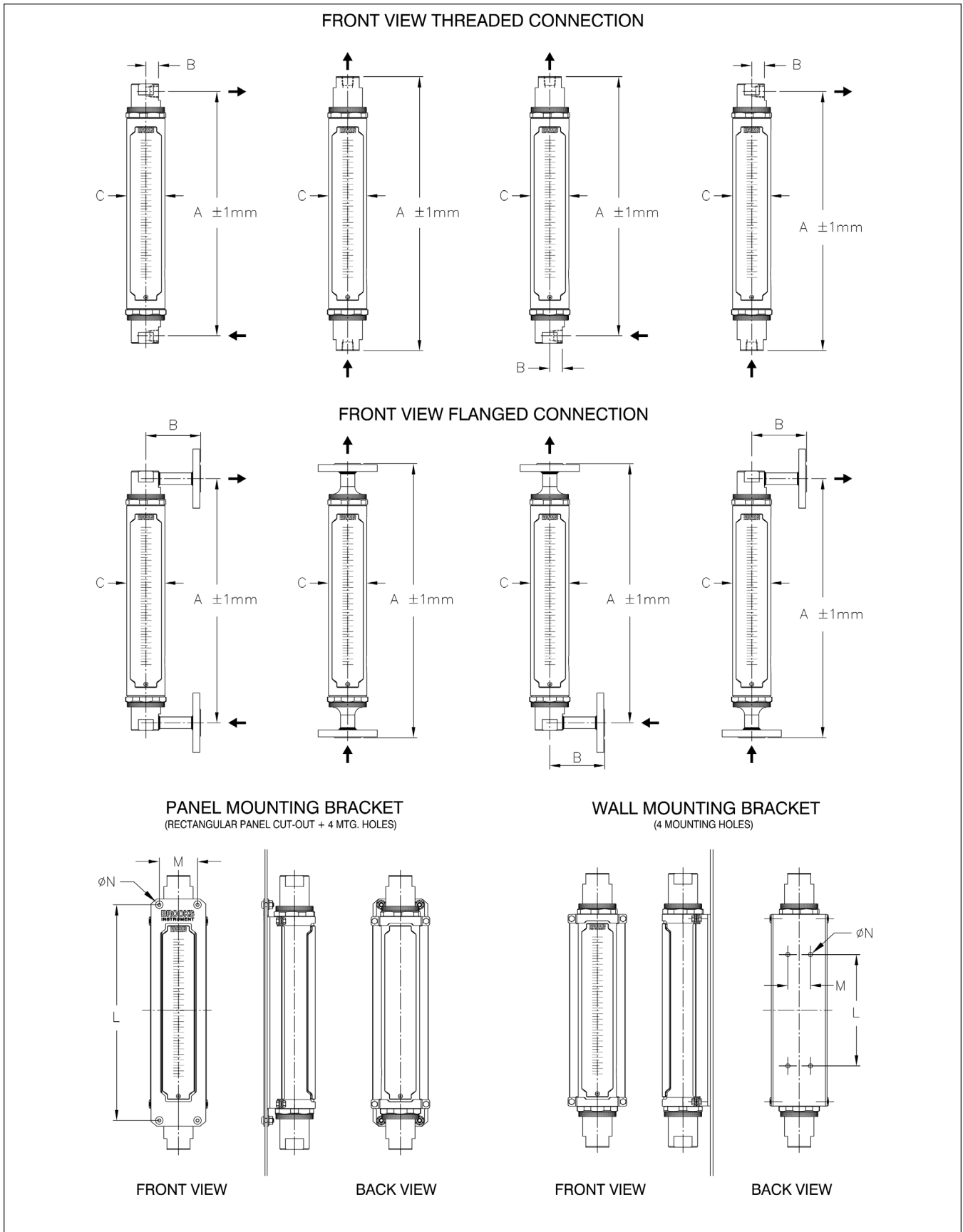



Figure 1-4 Dimensions - GT1600 Series (See Dimensions Tables on following pages)

Table 1-3 Dimensions - GT1600



Meter type	Tube size	Process connection	Orientation H(horizontal) V(ertical)	Notes	Retro-fit	Model	Dimension																	
							A		B		C		L		M		N		P		Q			
							inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm				
	02 06	NPT-F	H-IN / H-OUT	Standard dimensions ⁽³⁾	GT1000	1020	8.59	218.3	0.59	15.0	1.97	50.0	4.00	101.6	1.00	25.4	0.24	6.0	7.24	184	1.48	37.6		
			V-IN / V-OUT			1024	9.84	250.0	-	-														
			H-IN / H-OUT			1026	9.22	234.1	0.59	15.0														
			V-IN / V-OUT			1027	9.22	234.1	0.59	15.0														
			H-IN / H-OUT			Retrofit only ⁽⁴⁾	Full-View	1110	8.59	218.3													0.59	15.0
			V-IN / V-OUT					1114	9.63	244.5													-	-
			H-IN / H-OUT	1140	9.11			231.4	0.59	15.0														
			V-IN / V-OUT	1144	9.11	231.4	0.59	15.0																
			H-IN / H-OUT	Standard dimensions ⁽³⁾	GT1000	1020	8.59	218.3	3.50	88.9														
			V-IN / V-OUT			1024	10.63	270.0	-	-														
			H-IN / V-OUT			1026	9.61	244.1	2.95	75.0														
			V-IN / H-OUT			1027	9.61	244.1	2.95	75.0														
			H-IN / H-OUT			Retrofit only ⁽⁴⁾	Full-View	1140	8.59	218.3													4.00	101.6
			V-IN / V-OUT					1144	14.88	377.8													-	-
H-IN / V-OUT	1146	11.73	298.1	4.00	101.6																			
V-IN / H-OUT	1147	11.73	298.1	4.00	101.6																			

Note (3) - Standard dimension are for new installations

Note (4) - Retro-fit dimensions are for replacement of GT10xx, GT130x and Full-View meters in existing installation. Not for use in new installations.

(Dimensions Table continued on following page)

Table 1-3 Dimensions - GT1600 (continued)

Meter type	Tube size	Process connection	Orientation H(orizontal) V(ertical)	Notes	Retro-fit	Model	Dimension											
							A		B		C		L		M		N	
							inch	mm	inch	mm	inch	mm	inch	mm	inch	mm		
	07 08 09 10	NPT-F	H-IN / H-OUT	Standard dimensions ⁽³⁾			12.31	312.7	0.91	23.0	2.76	70.0						
			V-IN / V-OUT				14.50	368.2	-	-								
			H-IN / V-OUT				13.41	340.5	0.91	23.0								
			V-IN / H-OUT				13.95	354.4	0.91	23.0								
			H-IN / H-OUT #7/8	Retrofit only ⁽⁴⁾			Full-View	1110	11.50	292.1							0.91	23.0
			H-IN / H-OUT #9/10						12.50	317.5							-	-
			V-IN / V-OUT #7/8						12.00	304.8							-	-
			V-IN / V-OUT #9/10						12.25	311.2							-	-
			H-IN / V-OUT #7/8					1116	11.75	298.5							0.91	23.0
			H-IN / V-OUT #9/10						12.38	314.3							-	-
			V-IN / H-OUT #7/8						11.75	298.5							0.91	23.0
			V-IN / H-OUT #9/10						12.38	314.3							-	-
		V-IN / V-OUT	Retrofit only ⁽⁴⁾	GT1306	1306	11.75	298.5	-	-									
		Flanged 150lbs RF	H-IN / H-OUT #7/8	Standard dimensions ⁽³⁾				12.31	312.7	3.94							100.0	
			H-IN / H-OUT #9/10					4.72	120.0	-							-	
			V-IN / V-OUT #7/8					14.50	368.2	-							-	
			V-IN / V-OUT #9/10					-	-	-							-	
			H-IN / V-OUT #7/8							13.41							340.5	3.94
H-IN / V-OUT #9/10	4.72		120.0							-	-							
V-IN / H-OUT #7/8	13.41		340.5							3.94	100.0							
V-IN / H-OUT #9/10	4.72		120.0							-	-							
H-IN / H-OUT #7/8	Retrofit only ⁽⁴⁾		Full-View	1140				11.50	292.1	3.50	88.9							
H-IN / H-OUT #9/10								12.50	317.5	4.00	101.6							
V-IN / V-OUT #7/8								17.88	454.0	-	-							
V-IN / V-OUT #9/10								17.50	444.5	-	-							
H-IN / V-OUT #7/8			1146	14.69	373.0	3.50	88.9											
H-IN / V-OUT #9/10				15.00	381.0	4.00	101.6											
V-IN / H-OUT #7/8				14.69	373.0	3.50	88.9											
V-IN / H-OUT #9/10				15.00	381.0	4.00	101.6											
	08 10	NPT-F	H-IN / H-OUT	Standard dimensions ⁽³⁾			9.02	229.1	0.83	21.0								
			V-IN / V-OUT				11.20	284.6	-	-								
			H-IN / V-OUT				10.11	256.9	0.83	21.0								
			V-IN / H-OUT				10.11	256.9	0.83	21.0								
			V-IN / V-OUT	Retrofit only ⁽⁴⁾			GT1305	1305	7.75	196.9	-	-						
			Flanged 150lbs RF	H-IN / H-OUT #7/8			Standard dimensions ⁽³⁾				9.02	229.1	3.94	100.0				
		H-IN / H-OUT #9/10		4.72							120.0	-	-					
		V-IN / V-OUT #7/8		11.20							284.6	-	-					
		V-IN / V-OUT #9/10		-							-	-	-					
		H-IN / V-OUT #7/8		10.11							256.9	3.94	100.0					
		H-IN / V-OUT #9/10		4.72							120.0	-	-					
		V-IN / H-OUT #7/8									10.11	256.9	3.94	100.0				
V-IN / H-OUT #9/10	4.72	120.0			-	-												

Note (3) - Standard dimension are for new installations

Note (4) - Retro-fit dimensions are for replacement of GT10xx, GT130x and Full-View meters in existing installation. Not for use in new installations.

Table 1-4 Approvals







Declarations	Mark	Meter Options			Standards/Directives/Marking	Status/Certificate	
		Mechanical	Reed Switch	Inductive Alarm			
EU Declaration of Conformity				✓	EMC Directive (2014/30/EU)	Declaration	
			✓	✓	RoHS Directive (2011/65/EU)	Declaration	
			✓	✓	ATEX Directive (2014/34/EU)	Declaration	
		✓			ATEX Directive (2014/34/EU) : Non-Electrical	Declaration	
			✓		EMC Directive (2014/30/EU) The equipment uses a reed switch sensor & is outside the scope of the directive since the inherent nature of the physical characteristics of which is such that: (i) it is incapable of generating or contributing to electromagnetic emissions which exceed a level allowing radio and telecommunication equipment and other equipment to operate as intended; and (ii) it operates without unacceptable degradation in the presence of the electromagnetic disturbance normally consequent upon its intended use.		
		✓	✓	✓	Pressure Equipment Directive (2014/68/EU)	Declaration	
		✓	✓	✓	Canadian Registration Number (CRN)	CRN	
Explosion safety "Constructional safety (c)"	ATEX 	✓			II2G Ex h IIC T6...T4 Gb II2D Ex h IIIC T120°C Db Special conditions for safe use: Refer to IOM	TCF: 203104000-1604	
Explosion safety "encapsulation (m)"	ATEX  IECEX		✓		II 2 G Ex mb IIC T6 Gb II 2 D Ex mb IIIC T85°C Db (Standard Version) II 2 G Ex mb IIC T5 Gb II 2 D Ex mb IIIC T100°C Db (With Junction box Version)	KIWA 18ATEX0013 X	
				✓	Ex mb IIC T6 Gb Ex mb IIIC T85°C Db (Standard Version) Ex mb IIC T5 Gb Ex mb IIIC T100°C Db (With Junction box Version)	IECEX KIWA 18.0008X	
		Standards used for evaluation: EN 60079-0 : 2012+A11: 2013, EN 60079-18 : 2015 IEC 60079-0 : 2011, IEC 60079-18 : 2014					
		Ambient Temperature range: -20 °C to +65 °C (Standard Version) -20 °C to +55 °C (With Junction box Version) Input Power: 30V, 250mA, 3W Special conditions for safe use: Refer to IOM					
Explosion safety "Intrinsic Safety (ia)"			✓		Reed Switch Alarms are classified as "Simple Apparatus" when used in Intrinsically Safe circuits. They comply with the requirements of EN60079-11 clause 5.7 – Simple apparatus. Ambient Temperature ratings: -20° C ≤ Tamb ≤ 65° C Input parameters: Vmax = 30V, Imax = 100mA, Ci = 0µF, Li = 0µH Special conditions for safe use: Refer to IOM		
Explosion safety "Intrinsic Safety (ia)"			✓		IS Class I, II, III, Div 1, Groups A, thru G	UL File E73889 Vol3 Sec 6	
				✓	Inductive Ring Sensor Pepperl + Fuchs Model: RC10-14-N3-Y53478 Pepperl + Fuchs Model: RC15-14-N3-Y53479 <u>Non-Hazardous Locations</u> Power Supply: Nominal Voltage 8V Operating Voltage 5...25V Current consumption: Active area clear : 3mA (at 8V) Ambient Temperature: Active area obscured: 0.5...0.95mA (at 8V) 0°C to 40°C		
Explosion safety "Intrinsic Safety (ia)"	ATEX  		✓		<u>Hazardous Location</u> ATEX II 2 G Ex ia IIC T6...T1 Gb IP67 Refer to ATEX Certificate for: Input parameters, Max Ambient Temperature, Special conditions for use	Pepperl + Fuchs PTB 99 ATEX 2128 X	
			✓		FM Approvals Class I, Division 1, Group A, B, C, Class II, Division 1, Group E, F, G, Class III, Division 1 Class I, Zone 0, Group IIC T6	Pepperl + Fuchs Control Drawing:116-0165G	

Table 1-5 GT1600 Size 2 to 10 Non-Electrical

GT1600 Meter Size 2 to 10

Application	Non-Electrical Equipment for use in Hazardous location
Area Classification	II 2 G / II 2 D
Protection Technique	Constructional safety (c)
Technical Construction File	203104000-1604 (Archived at DEKRA Certification B.V.)
Ambient Temperature	-20°C ≤ Ta ≤ 70°C
Marking	II2G Ex h IIC T6...T4 Gb II2D Ex h IIIC T120°C Db

Installation Notes:

- The product should be installed by suitably trained personnel, in accordance with the applicable code of practice/ installation standards for hazardous areas.
- The flowmeters shall be permanently grounded by means of the process connections in order to allow discharge of electrostatic charges via the connection to ground.

Special conditions for safe use:

- The actual maximum surface temperature of the equipment depends not on the equipment itself, but on operating conditions of the process fluid/gas flowing through the equipment. The equipment by itself does not generate heat. Due to this reason the temperature class is marked as a range. The maximum permitted ambient and process temperature limits can be found in the operating instructions.
- Supply grounding connection by the process connections or earthing terminal.
- Enclosure contains polycarbonate parts. If it is mounted in an area where the use of category 2G or 2D apparatus is required, it must be installed such that ignition source due to propagating brush discharge sparks are excluded.
- The viewing window is made of polycarbonate. Protection from impact should be considered for the viewing

Resistance to Impact:

Metal Enclosure parts	7 Joules
Light-transmitting part (polycarbonate window)	2 Joules
Degree of mechanical risk	low

External Cleaning

- Viewing window of the meter is made of non-conductive component. Care should be taken to ensure that combustible electrostatic charging will not build up during cleaning/maintenance of meter. Do not rub.

Optional Equipment - Alarms & Valves**GT1600 Alarm Contacts Meter Sizes 7 to 10**

The Brooks reed switch alarm is a normally open, latching switch used in conjunction with the GT1600 glass tube flow meter for signaling high and/or low flow or a deviation from a flow setting.

A magnet embedded and sealed in the float actuates the alarm switch. The reed switch is mounted adjacent to the flow tube and is easily adjustable over the entire flow range of the instrument.

The sealed reed switch consists of a biasing magnet and hermetically sealed reed switch, which is insulated to prevent damage from mild shock and normal pipe vibration. The contact rating of the switch is very low (0.5A).

An external relay is recommended for secure operation. Plus the external relay can be configured to operate as a normally open or normally closed state which provides totally flexibility of operation.

Alarm Specifications:**Operating Fluid Temperature Limits**

Reed Switch: Same as meter

Inductive: 185°F (85°C) max.

Reed Switch Limits - Non-hazardous Locations

Maximum Voltage*: 175Vdc, 124Vac

Maximum Current*: 250mA

Maximum Contact Rating: 3 Watts

*(Maximum Switch Specifications)

Alarm Hysteresis

8 mm typical (0.32 in)

GT1600 Alarm Contact (Reed Switch) Meter Size 7 to 10

Application	Electrical Equipment for use in Hazardous location	
Area Classification	II 2 G/ II 2 D	
Protection Technique	encapsulation (m)	
Certificate	IECEX KIWA 18.0008X and KIWA 18ATEX0013 X	
Electrical Data:	Switching Voltage:	max. 30 V
	Switching Current:	max. 250 mA
	Switching Power:	max. 3 W

Meter Options	Standard Version	Junction Box Version
Details	1000 mm cable connection	With junction box and terminal connections
Ambient Temperature:	-20°C ... +65°C	-20°C ... +55°C
Marking	Ex mb IIC T6 Gb Ex mb IIIC T85°C Db	Ex mb IIC T5 Gb Ex mb IIIC T100°C Db

Installation Notes:

- An additional external connection facility for an equipotential bonding conductor is provided on the metallic enclosure.
- Since the reed contact is potential-free, the terminals/wires are not labeled.

Standard Version: The connecting cables of the reed switch alarm either have to be outside the explosive area or if within shall have to be connected with an appropriate connection housing which complies with the Ex-protection-class.

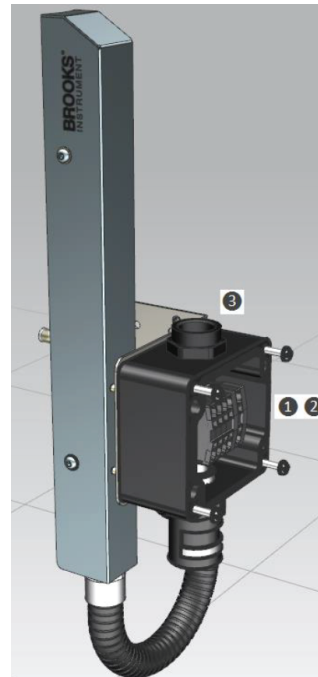
Special conditions for safe use:

- The current through the Reed Switch must be limited to its max switching current using a suitably rated fuse of max 0.5Amps. The fuse must have a breaking capacity in accordance with the prospective short-circuit current of the circuit to properly break the systems highest short circuit current.
- In case device is mounted in an area where the use of EPL Gb/Db (Category 2G/D) or EPL Gc/Dc (Category 3G/D) apparatus is required, the transparent cover must be installed such, that ignition sources due to electrostatic discharge sparks are excluded.
- Standard Version:
All entry devices shall only be installed such that there is a low risk from mechanical impact. The cable of the reed switch shall be protected against damage.
- Junction box Version:
If the M20X1.5- M to ½" NPT –F Adaptor is used it shall be protected from mechanical impact.

Standard Version



Junction box Version



- 1 = Customer connection
- 2 = Potential free
(2 wires for each reed switch)
- 3 = Connection to customer device

GT1600 Alarm Contact (Reed Switch) Meter Size 7 to 10 - (ATEX)

Application	Electrical Equipment for use in Hazardous location
Area Classification	II 2 G
Protection Technique	Intrinsic safety (The electrical equipment operates as a simple device)
Certificate	None (Reference 60079-11, para. 5.7)
Electrical Data:	V _{max} = 30V, I _{max} = 100mA, C _i = 0μF, L _i = 0μH
Ambient Temperature:	-20°C ... +65°C

Electrical Connection:	1: Standard Version - 1000 mm cable connection, one or two wires
	2: Junction Box Version - With junction box and terminal connections

Installation Notes:

- The intrinsically safe equipment may only be connected to separated intrinsically safe circuits.
- An additional external connection facility for an equipotential bonding conductor is provided on the metallic enclosure.

Special conditions for safe use:

- The product should be installed by suitably trained personnel, in accordance with the applicable code of practice.
 - As the product has no source of internal heating, the temperature classification is dependent on the ambient air temperature.
- Since part of flowmeter enclosure is made of plastic materials, if it is mounted in group II, category 1 area, it must be installed such that, ignition sources due to electrostatic discharge sparks are excluded.

GT1600 Alarm Contact (Reed Switch) Meter Size 7 to 10 - C North America

Application	Electrical Equipment for use in Hazardous location
Area Classification	Class I, II, III, Div 1, Groups A, thru G
Protection Technique	Intrinsic safety
Certificate	UL Recognized

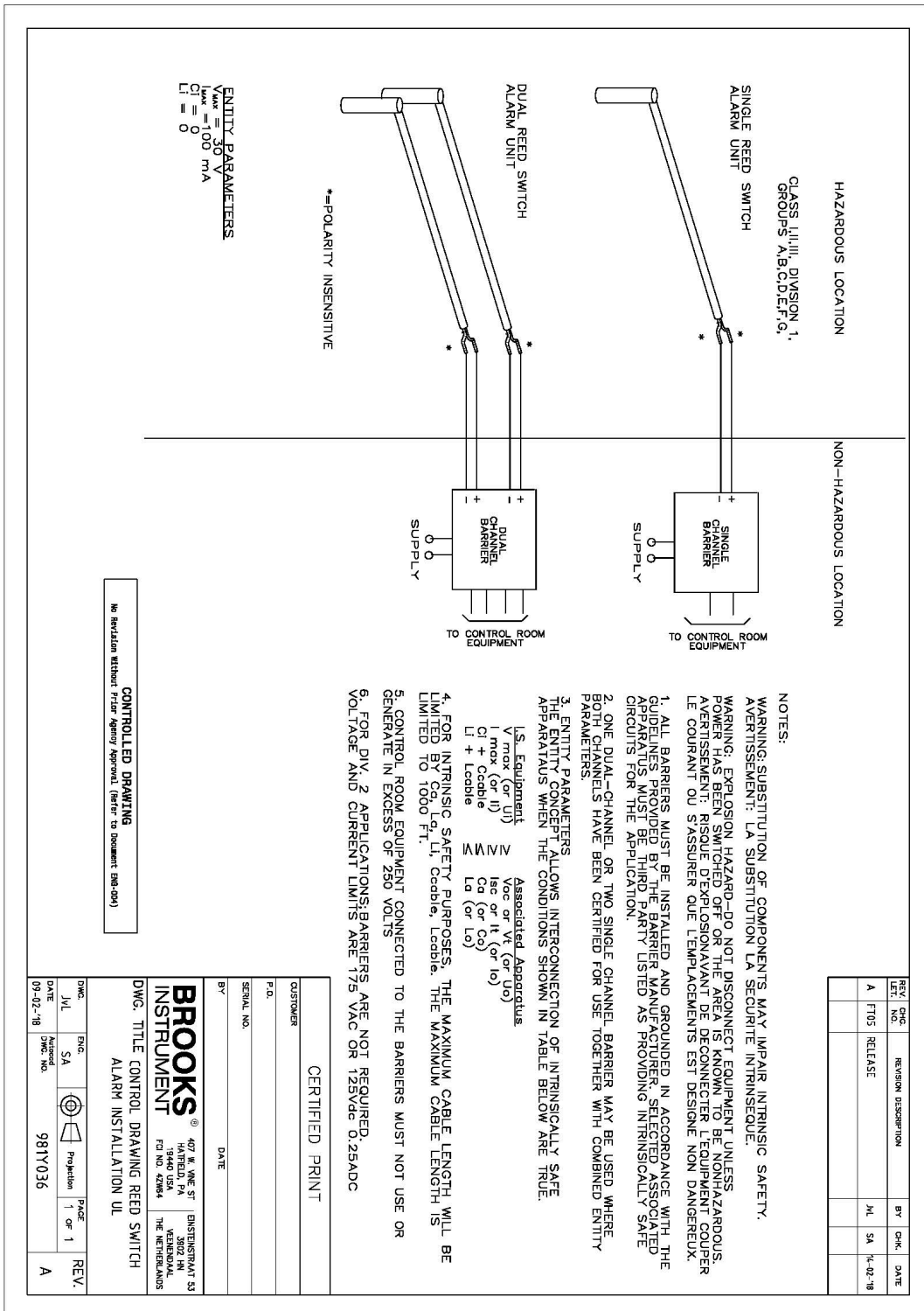


Figure 1-5 Reed Switch Alarm UL Installation

**Inductive Alarms,
Alarm Contacts Meter Sizes 2 and 6**

Inductive coils for high and/or low flow alarm may be mounted to the instrument to create a highly sensitive, stable and accurate device for signaling high or low flows or deviations from a controlled flow. The inductive alarm can only be used in combination with 316 SS or Carboloy® ball floats. The alarm points may be adjusted over the entire flowmeter range and be set so that any two contacts may be made to operate simultaneously. For hazardous area applications Brooks can supply an approved Namur power supply amplifier/relay unit to obtain an intrinsic safe current circuit. (Please refer to Table 1-4).

Table 1-9 Data 10 & 15-14-N3 Inductive Coils

Power Supply	8 volt normal (max. 15>5 Vdc)
Current Consumption	Active area clear: > 3 mA
Current Consumption	Active area obscured: < 1 mA
Self Inductance	70 µH
Self Capacitance	90 nF
Max. Temperature	75°C
Enclosure Type:4	IP67
EMC Directive	EN 60947-5-2 DIN EN 60947-5-6 (Namur)

Operating Fluid Temperature Limits

Reed Switch: Same as meter
Inductive: 167°F (75°C) max.

Alarm Hysteresis

8mm typical (0.32 in).

GT1600 Alarm Contact (Bistable Inductive Switches) Meter Size 2 to 6

Application	Electrical Equipment for use in Hazardous location	
Area Classification	FM: Class I, II, III, Div 1, Groups A, thru G, T6 ATEX : II 2 G	
Protection Technique	Intrinsic safety	
Certificate	Pepperl + Fuchs	Model: RC10-14-N3 or RC15-14-N3
	ATEX : PTB 99 ATEX 2128 X	
	FM Approvals : Control Drawing:116-	
Installation Notes:	Refer to Pepperl + Fuchs ATEX & FM Certificate for: Input parameters, Max Ambient Temperature, Special conditions for use.	

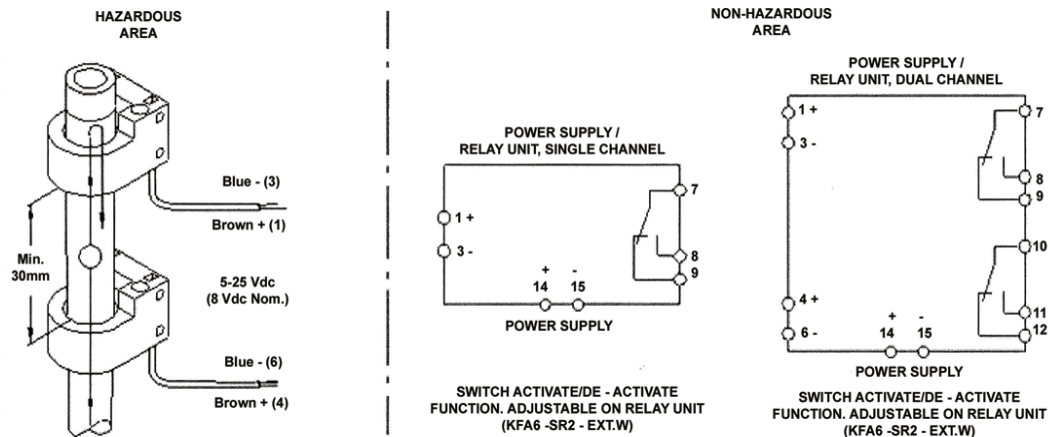


Figure 1-6 Bistable Inductive Switches for GT1600

Alarm Accessories

Remotely mounted, switch isolator/power supplies are required for inductive alarms and recommended for reed switch alarms. One or two single-pole, double-throw (SPDT) relays are available with either 110 or 220 AC volt units.

Optional Needle Valves

For flow rate control, needle valves may be integral to the inlet or outlet side of the instrument. Note, solenoid valves should not be used because this type of valve can cause pressure shocks which can damage the glass tube.

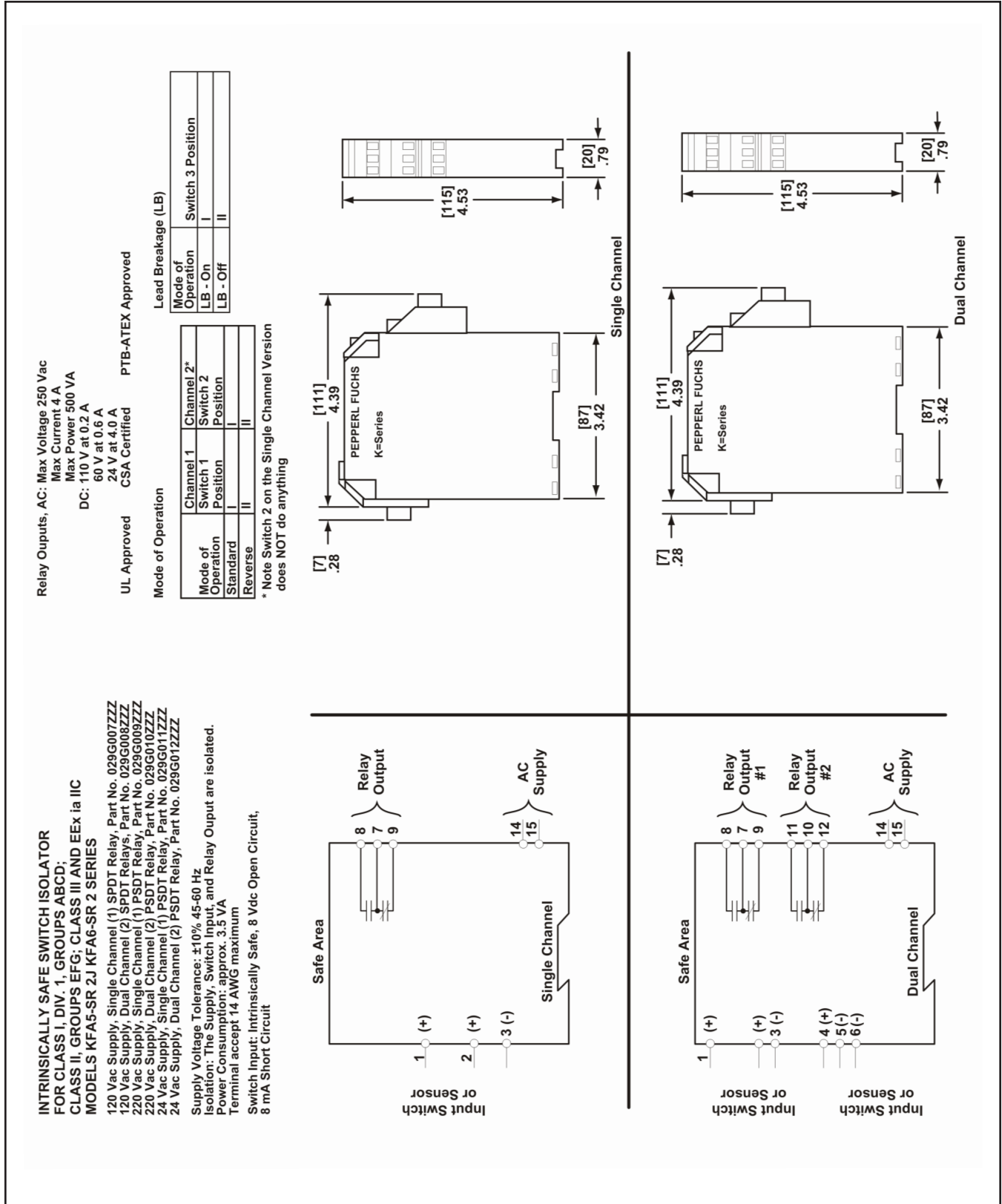


Figure 1-7 Dimensions and Specs, Intrinsically Safe Switch Isolators.

General

This section contains the procedures for the receipt and installation of the instrument. Do not attempt to start the system until the instrument has been permanently installed. It is extremely important that the start-up procedures be followed in the exact sequence presented.

Receipt of Equipment

When the equipment is received, the outside packing case should be checked for damage incurred during shipment. If the packing case is damaged, the local carrier should be notified at once regarding his liability. A report should be submitted to the nearest Brooks Instrument location listed on the Global Service Network page on our website:

BrooksInstrument.com/GlobalSupportCenters

Remove the envelope containing the packing list. Carefully remove the instrument from the packing case. Make sure spare parts are not discarded with the packing materials. Inspect for damaged or missing parts.

Recommended Storage Practice

If intermediate or long-term storage of equipment is required, it is recommended that the equipment be stored in accordance with the following:

- a. Within the original shipping container.
 - b. Stored in a sheltered area, preferably a warm, dry, heated warehouse.
 - c. Ambient temperature of 70° F (21° C) nominal, 109° F (43° C) maximum, 45° F (7° C) minimum.
 - d. Relative humidity 45% nominal, 60% maximum, 25% minimum.
- Upon removal from storage a visual inspection should be conducted to verify the condition of equipment is "as received".

Return Shipment

Prior to returning any instrument to the factory for any reason, visit our website for instructions on how to obtain a Return Materials Authorization Number (RMA #) and complete a Decontamination Statement to accompany it: BrooksInstrument.com/Service. All instruments returned to Brooks also require a Material Safety Data Sheet (MSDS) for the fluid(s) used in the instrument. Failure to provide this information will delay processing of the instrument. Instrument must have been purged in accordance with the following:

⚠ WARNING

Before returning the device, purge thoroughly with a dry inert gas such as Nitrogen before disconnecting process connections. Failure to correctly purge the instrument could result in fire, explosion or death. Corrosion or contamination may occur upon exposure to air.

Transit Precautions

To safeguard against damage during transit, transport the instrument to the installation site in the same container used for transportation from the factory if circumstances permit.

Installation

⚠ NOTICE

Prior to meter installation, remove the plastic shipping tube preventing float movement during shipping.

A. Location

For proper operation of the GT1600 flowmeter it must be mounted within 6 degrees of true vertical, with the inlet connection at the bottom of the meter, and the outlet at the top. The use of a plumb-bob, level or other device to assure vertical positioning is recommended.

B. Piping Arrangement

It is strongly recommended that the typical piping arrangement shown in Figure 2-1, be used when installing the meter. This piping arrangement permits the meter to be isolated from the flow for servicing or cleaning. The design of the GT1600 flowmeter allows the horizontal inlet and outlet end fitting to rotate independently of each other simply by loosening the two clamp bolts for each end fitting at the rear of the meter. Additionally the various end fittings offer horizontal or vertical connections or a combination of both.

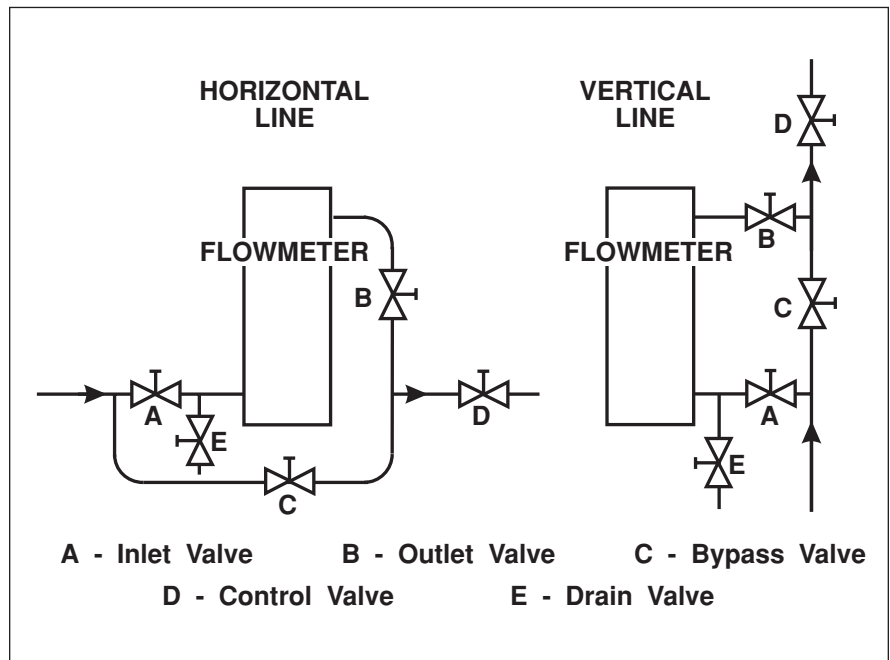



Figure 2-1 Typical Flowmeter Piping Configuration

Pre-Operational Check

Prior to initial start-up and each time the flowmeter is reassembled, the scale alignment should be checked. If the reference line on the tube is aligned with the reference line on the scale, the flowmeter is ready for operation. If the reference lines are not aligned, loosen the screws securing the scale and move it until the marks are in alignment. Then tighten the screws.

	<p>! WARNING</p> <p>GLASS TUBE EXPLOSION HAZARD</p>
<p>Fasten meter windows securely. Do not operate above pressure and temperature limits. Avoid pressure and flow surges. Do not service or repair while pressurized. Read and understand instruction manual. Failure to comply could result in serious personal injury or property damage.</p>	

Operating Instructions

After the flowmeter has been properly installed in the process, it is ready for operation. When initiating flow, slowly open the valve to avoid a flow surge. Bypass is a help in bringing the flow on smoothly. Avoid starting a pump to supply the flowmeter without the use of a valve upstream of the flowmeter.

<p>! WARNING</p> <p>Before operating the flowmeter, ensure all fluid connections have been properly tightened and, where applicable, all electrical connections have been properly terminated.</p>
--

<p>! CAUTION</p> <p>When initiating flow through the flowmeter insure that the process flow begins slowly and evenly, without pressure surges. Surges may drive the float against the outlet float stop, resulting in damage to the tube or float.</p>
--

<p>! CAUTION</p> <p>Any sudden change in system pressure may cause mechanical damage to elastomer materials. Damage can occur when there is a rapid expansion of fluid that has permeated elastomer materials. The user must take the necessary precautions to avoid such conditions.</p>

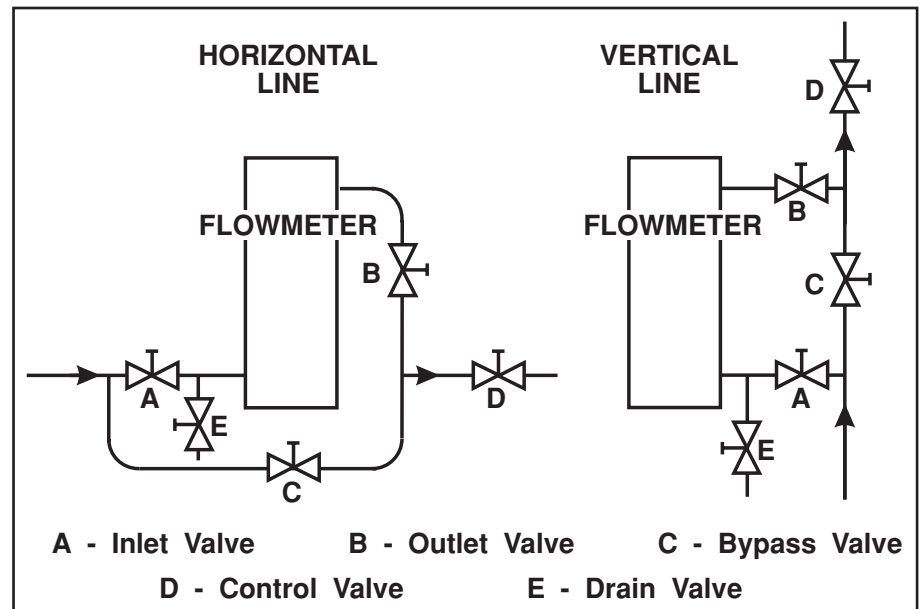


Figure 3-1 Typical Flowmeter Piping Configuration

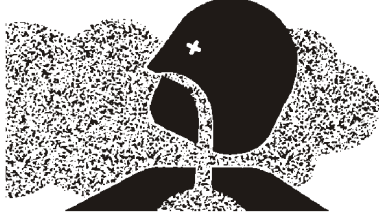
To initiate flow through a flowmeter using bypass piping, refer to Figure 3-1.

1. Close flowmeter inlet valve (A) and outlet valve (B).
2. Fully open bypass valve (C) and slightly open control valve (D).
3. Initiate process flow. When flow has stabilized, fully open outlet valve (B), then slowly open inlet valve (A).
4. Close bypass valve (C).
5. Regulate process flow using control valve (D).
6. If meter is left in bypass configuration, open drain valve (E) to prevent tube damage caused by thermal expansion of the process liquid.

⚠ WARNING

Failure to drain the flowmeter when located in a bypass loop may result in tube breakage caused by chemical expansion of the process liquid.

Overview

	<p>⚠ WARNING</p>
<p>METER/CONTROLLER SEAL COMPATIBILITY</p>	
<p>Products in this manual may contain metal or elastomeric seals, gaskets, O-rings or valve seats. It is the "user's" responsibility to select materials that are compatible with their process and process conditions. Using materials that are not compatible with the process or process conditions could result in the Meter or Controller leaking process fluid outside the pressure boundary of the device, resulting in personnel injury or death.</p> <p>It is recommended that the user check the Meter or Controller on a regular schedule to ensure that it is leak free as both metal and elastomeric seals, gaskets, O-rings and valve seats may change with age, exposure to process fluid, temperature, and /or pressure.</p>	
<p>⚠ WARNING</p>	
<p>If it becomes necessary to remove the instrument from the system power to the device is disconnected at the power supply.</p>	
<p>⚠ WARNING</p>	
<p>If it becomes necessary to remove the flowmeter from the system after exposure to toxic, pyrophoric, flammable or corrosive gas, purge the flowmeter thoroughly with a dry inert gas such as Nitrogen before disconnecting the gas connections. Failure to correctly purge the flowmeter could result in fire, explosion or death. Corrosion or contamination of the flowmeter upon exposure to air, may also occur.</p>	
<p>⚠ CAUTION</p>	
<p>It is important that this device only be serviced by properly trained and qualified personnel.</p>	

Cleaning

The following procedure may be used for cleaning the tube, float and end fittings.

⚠ NOTICE

Anytime the tube is removed for service, new O-rings should be installed in both the inlet and outlet end fittings.

1. Remove the four screws securing the front window to the meter, then remove the front shield.
2. Slide out the plastic tube retainer holding the tube in position. Do not remove the two screws securing it.

⚠ CAUTION

Do not allow the float to fall out of the metering tube. A damaged float will affect the accuracy of the meter. Be careful not to break the tube by pulling on it at an extreme angle or applying excessive force.

3. Slide the metering tube up behind the plastic tube retainer until it clears the lower end fitting. When the tube is clear of the end fitting pull out on it until you can remove it from the upper end fitting. Hold the inlet (lower) float stop in position when removing the tube.
4. Remove the outlet float stop, float and inlet float stop from the metering tube.
5. Clean the metering tube, float stops, float and end fittings with a suitable solvent.
6. Install the inlet float stop into the metering tube. Refer to Figure 1-3 for the correct orientation of the float. Slide the float into the metering tube from the outlet end. Replace the outlet float stop in the metering tube.
7. Slide the metering tube onto the upper end fitting. Insure that the plastic tube retainer is pulled all the way out.
8. Push the metering tube in and down to seat it on the lower end fitting.
9. Push the plastic tube retainer all the way in to hold the tube in position.

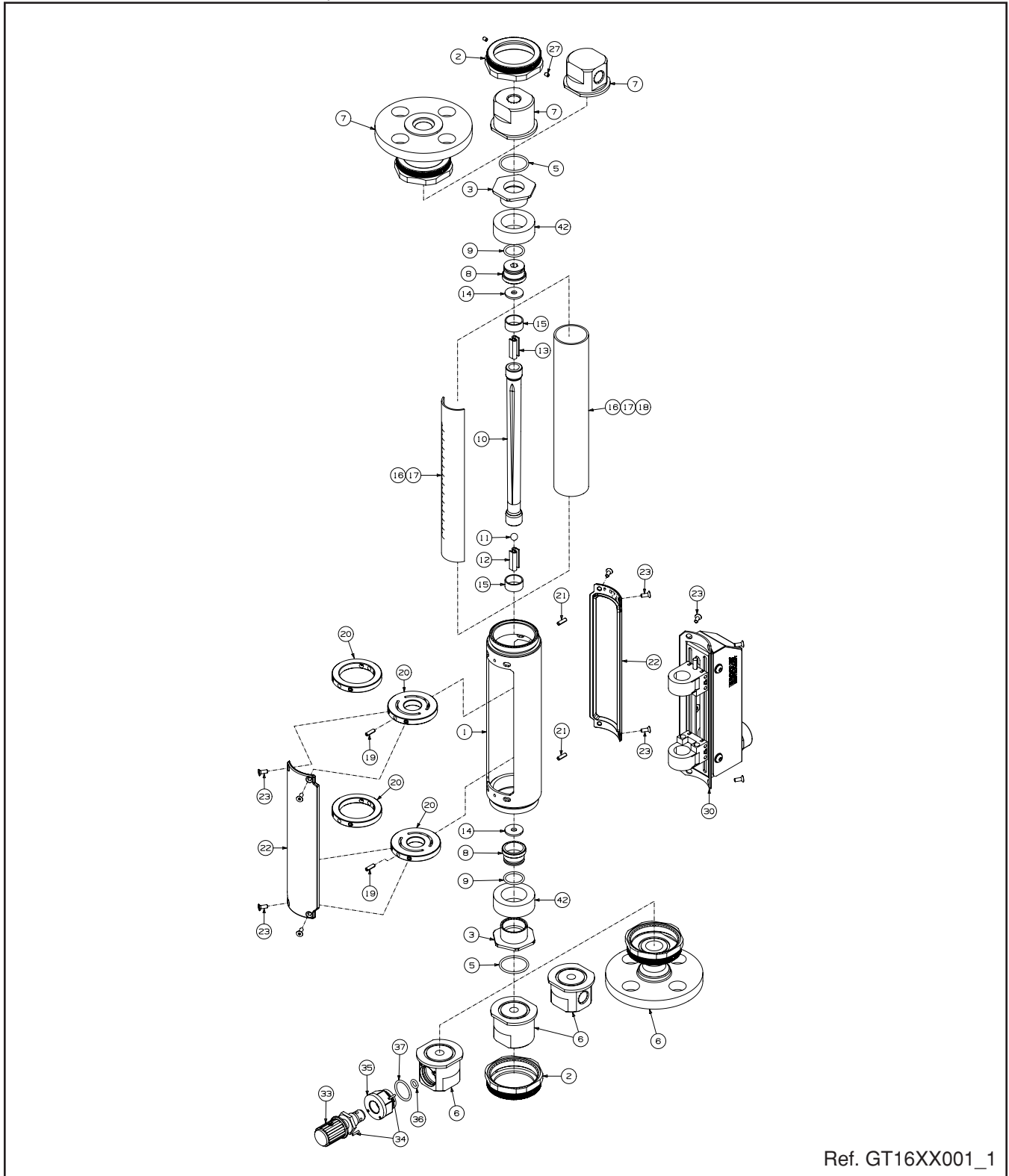
Note: Before installing the front window you may wish to clean the inside surface with a commercial glass cleaner or mild soap and water. DO NOT ATTEMPT TO CLEAN IT WITH A DRY CLOTH, AS THIS MAY SCRATCH THE SURFACE.

10. Install the front window on the meter and secure with four screws tightened to 35 inch-pounds (4 Newton Meters).

⚠ WARNING

Pressure test the meter before returning it to service. Hydrostatic pressure testing should be performed by qualified personnel or serious injury and/or damage to the equipment can result.

See Figures 5-1 and 5-2, and Table 5-1 for parts assembly drawings and parts list.



Ref. GT16XX001_1

Figure 5-1 GT1600, Sizes 2 - 6 Parts Assembly Drawing

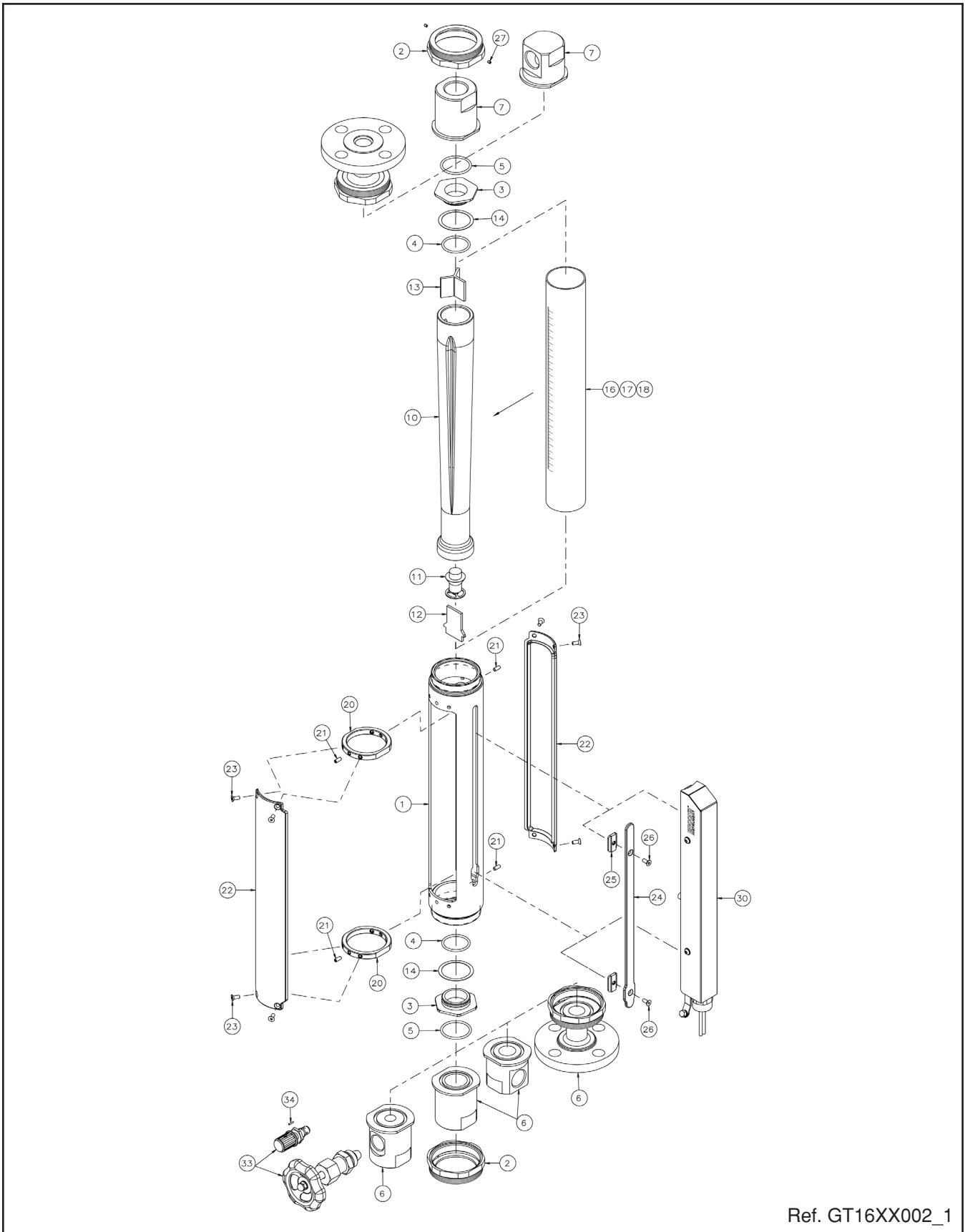


Figure 5-2 GT1600, Sizes 7 - 10 Parts Assembly Drawing

Table 5-1 Parts Assembly Item Identification

Item#	Description
1	TUBE HOUSING ASSEMBLY
2	COUPLING NUT HOUSING
3	IN/OUTLET TUBE-FITTING INSERT
4	O-RING INSERT TO TUBE
5	O-RING INSERT TO FITTING
6	INLET END FITTINGS
7	OUTLET END FITTINGS
8	SEAL SPINDLE (SZ 2-6)
9	O-RING FOR SEAL SPINDLE (SZ 2-6)
10	GLASS METERING TUBE
11	FLOAT
12	INLET FLOAT STOP
13	OUTLET FLOAT STOP
14	TUBE SEAT GASKET/PACKING
15	CENTERING RING TUBE GASKET (SZ 2-6)
16	SLEEVE
17	LABEL CLEAR SCALE
18	SCREW CENTERING RING FRONT
19	RESERVED FOR LABEL WHITE BACKING
20	CENTERING RING
21	SCREW CENTERING RING BACK
22	WINDOW ASSEMBLY
23	SCREW WINDOW
24	SIDE STRIP W/O ALARM (SZ 7-10)
25	RETAINER SIDE STRIP W/O ALARM (SZ 7-10)
26	SCREW SIDE STRIP W/O ALARM (SZ 7-10)
27	SCREW DRAIN HOLES (TOP ONLY)
30	ALARM SWITCH ASSY
33	CARTRIDGE VALVE / VALVE SPINDLE
34	ROLL PIN FOR VALVE
35	VALVE BUSHING (SZ 2-6)
36	O-RING TOP BUSHING (SZ 2-6)
37	O-RING OUTSIDE BUSHING (SZ 2-6)
38	LABEL SET
40	FLANGE PROTECTORS / END CAPS
41	LOCTITE
42	FOAM FILTER
43	CONTAINER, INNER PACKING (PACKAGING)

LIMITED WARRANTY

Visit www.BrooksInstrument.com for the terms and conditions of our limited warranty.

BROOKS SERVICE AND SUPPORT

Brooks is committed to assuring all of our customers receive the ideal flow solution for their application, along with outstanding service and support to back it up. We operate first class repair facilities located around the world to provide rapid response and support. Each location utilizes primary standard calibration equipment to ensure accuracy and reliability for repairs and recalibration. The primary standard calibration equipment to calibrate our flow products is certified by our local Weights and Measures Authorities and traceable to the relevant International Standards.

Visit www.BrooksInstrument.com to locate the service location nearest to you.

START-UP SERVICE AND IN-SITU CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required.

For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

SEMINARS AND TRAINING

Brooks Instrument can provide seminars and dedicated training to engineers, end users and maintenance persons. Please contact your nearest sales representative for more details.

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X-VA-GT1600-eng/541B220AAG/2023-01

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Beyond Measure