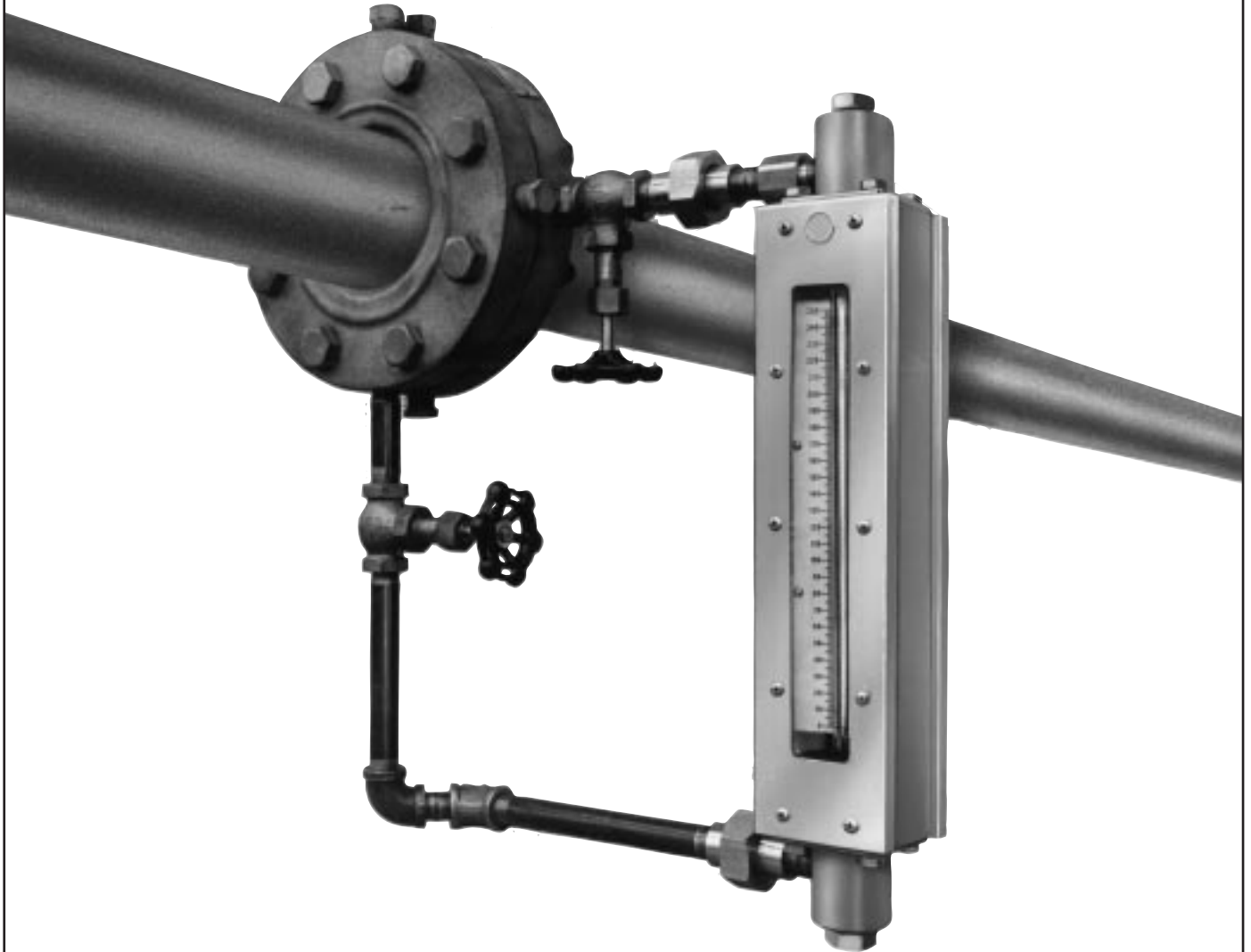




BYPASS ROTAMETERS

FOR MEASURING RATE OF FLOW IN LARGE PIPELINES



BYPASS ROTOMETERS

SK bypass Rotameter systems are designed for the accurate measurement of fluid rate of flow in pipelines 1½ inches in diameter or larger. They accomplish this by providing a bypass flow that is directly proportional to the main flow. Since Rotameters measure bypass flow, not static differential, flow ranges up to 10 to 1 are possible with these instruments. This provides a decided advantage over other types of flow measuring devices.

SYSTEM — A complete bypass Rotameter installation consists of the following: orifice flanges with orifice plate for insertion into the main pipeline; bypass piping with valves and fittings; a range orifice for insertion into the bypass pipeline; and whatever type Rotameter is considered best suited to a particular

application.

INSTALLATION — Bypass Rotameters can be installed to measure horizontal flow (Fig. 1) or vertical flow, up (Fig. 2) or down (Fig. 3). Orifices are installed in accordance with ASME or AGA standards. For proper operation, a straight run of pipe is required on both sides of the orifice or, when space is limited, straightening vanes must be used as indicated in Table F.

ORDERING — When ordering, the customer should specify actual I.D. of the main pipeline and the type of arrangement required for the flow. If other than 300# flange taps will be used, the type should be specified.

Note: The viscosity limit for bypass rotameters is 3.0 centipoise.

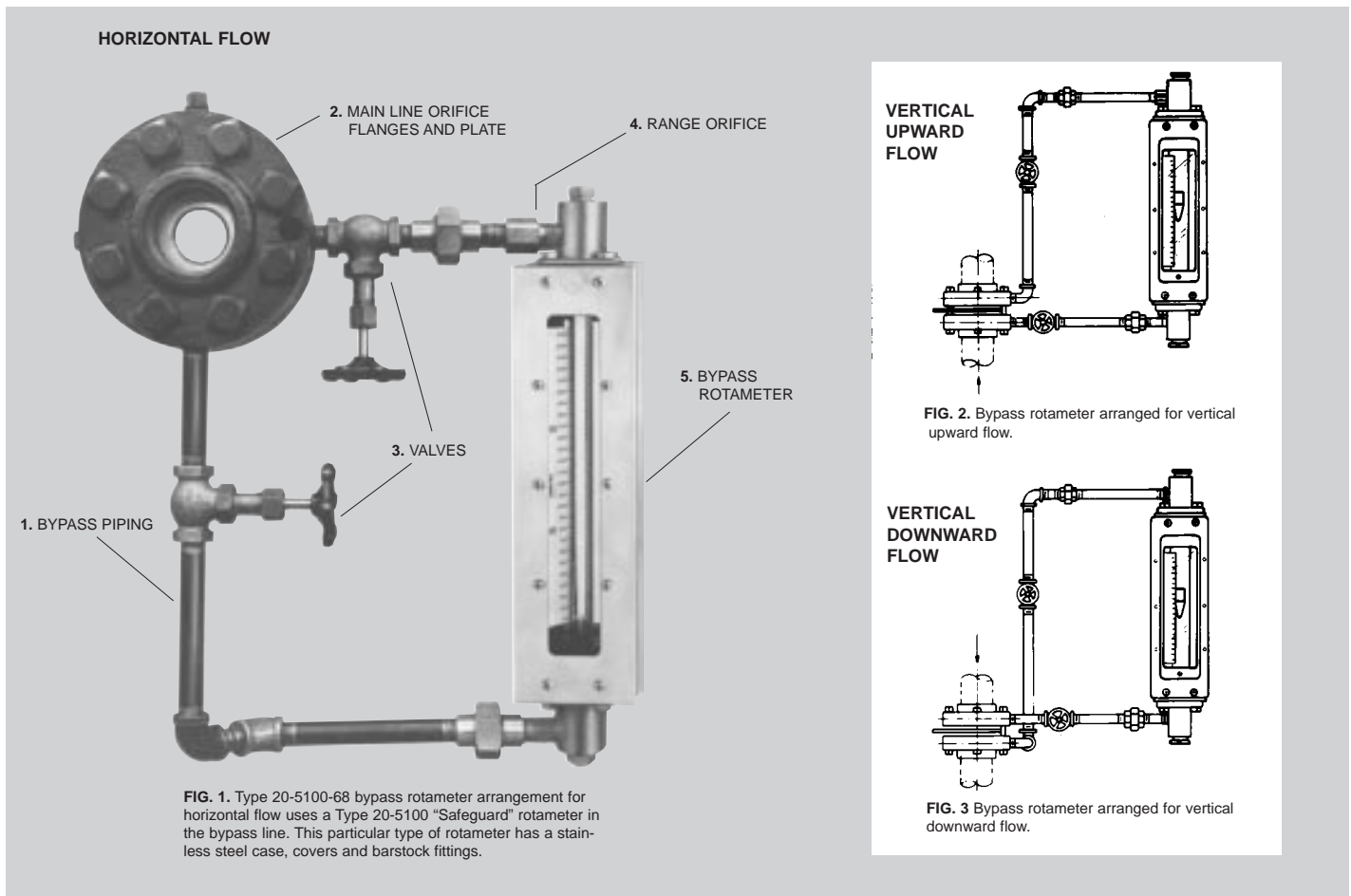


FIG. 1. Type 20-5100-68 bypass rotameter arrangement for horizontal flow uses a Type 20-5100 "Safeguard" rotameter in the bypass line. This particular type of rotameter has a stainless steel case, covers and barstock fittings.

FIG. 2. Bypass rotameter arranged for vertical upward flow.

FIG. 3. Bypass rotameter arranged for vertical downward flow.

1. BYPASS PIPING — The bypass pipeline connection to the inlet of rotameter is located upstream. The bypass connection from the outlet of the rotameter is located downstream from the orifice. As a result of the specific difference in pressure between the upstream side of the orifice and the downstream side, a *fixed ratio* of fluid is diverted from the main line and flows through the bypass piping.

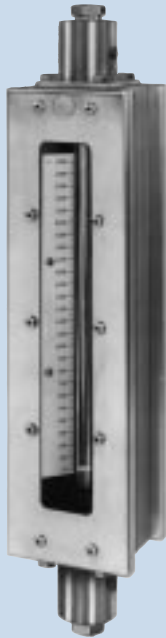
2. MAIN LINE ORIFICE FLANGES AND PLATE — This orifice provides a pressure differential.

3. VALVES — Ball or gate valves in the bypass pipeline permit the rotameter to be isolated for cleaning or removing the unit when necessary to replace parts.

4. RANGE ORIFICE — A small range orifice in the bypass piping limits the flow to within the range of the rotameter and helps match the differential pressure of the main line orifice.

5. BYPASS ROTAMETER — Since the bypass flow is directly proportional to the main flow, the rotameter in the bypass line is matched to read the main flow directly. Measurement is accurate and on a linear scale. Various types of indicating and alarm rotameters can be used in bypass arrangements. Because the bypass rotameter and its piping must match the main line differential pressure, any deviation in the standard bypass piping can affect the standard $\pm 2\%$ full scale accuracy.

Glass Tube



SERIES 20-5000

“Safeguard” Rotameter. This general purpose, glass tube Rotameter has stainless steel case and covers and barstock end fittings. Standard units have 10 inch (250 mm) tube. Special models of this type and other “Safeguard” types are also available.
Refer to Bulletin 20-5000.

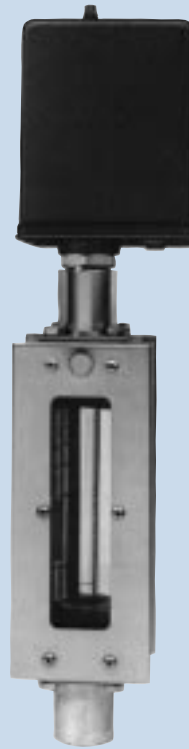
Metal Tube



SERIES 20-9550-8510

Metal-tube Rotameter. A rugged instrument, designed for use with hazardous fluids or fluids under pressures up to 2500 psig at temperatures to 400°F. An extension rod extends from the float up into the measuring head. An encapsulated magnet in the top of the extension rod causes a follower to move up or down as flow increases or decreases. The location of the follower in relation to a scale indicates rate of flow.
Refer to Bulletin 19.

Glass Tube Alarm



SERIES 20-5150-2110

Magnetic alarm Rotameter. This is a glass-tube “Safeguard” Rotameter with a magnetic alarm system mounted above the Rotameter in a weathertight housing. The alarm system is vibration resistant and reset is automatic. Both high and low flow alarm switches are available. “Explosion-proof” housing* is also available for use when conditions make this type applicable.
Refer to Bulletin 18A.

Metal Tube Alarm



SERIES 20-9550-2210

Magnetic alarm Rotameter. This unit consists of a metal-tube Rotameter, a magnetic indicating follower, and an alarm system in a weathertight housing. It is available with high and low flow alarms. A similar instrument, the Series 20-9550-2211 has the indicator and switches enclosed in an “explosion-proof”* housing.
Refer to Bulletin 18A.

*Design meets “explosion-proof” requirements of N.E.C. Class 1, Div. 1, Group D.

HOW TO SELECT THE PROPER SIZE SK ROTOMETER FOR BYPASS INSTALLATION

STEP 1 - Determine the Sizing Flow.

For Liquids Having a Viscosity Similar to Water:

$$\text{Sizing Flow (GPM)} = \text{GPM Liquid} \sqrt{\text{Liquid Specific Gravity}}$$

For Gases Other Than Steam:

$$\text{Sizing Flow (SCFM)} = \text{SCFM Gas} \times f_2 \times f_3 \times f_1 \quad (\text{From Table A})$$

For Saturated or Superheated Steam:

$$\text{Sizing Flow (PPH)} = \text{PPH Steam} \times f_p \times f_s \quad (\text{From Table B})$$

Using Sizing Flow, determined from above, refer to Table C and select the smallest pressure differential necessary to give this flow in the required pipe size.

STEP 2 - Confirm the flow range for the type of rotameter selected.

1. Refer to Table D and determine the flow range that the above pressure differential will give with the type of rotameter to be used.
2. If a larger flow range is required, select a larger pressure differential, although this will result in a larger permanent pressure loss.

STEP 3 - Determine permanent pressure loss as follows:

1. Calculate Flow Ratio

a. For Liquids:

$$\text{Flow Ratio} = \frac{\text{Sizing Flow GPM}}{\text{Maximum GPM (Table C)}}$$

b. For Gases Other than Steam:

$$\text{Flow Ratio} = \frac{\text{Sizing Flow SCFM}}{\text{Maximum SCFM (Table C)}}$$

c. For Saturated or Superheated Steam:

$$\text{Flow Ratio} = \frac{\text{Sizing Flow PPH}}{\text{Maximum PPH (Table C)}}$$

2. Refer to Table E for Diameter Ratio (β) and Permanent Loss in % differential pressure.
3. Determine Permanent Pressure Loss in inches of water:
Permanent Pressure Loss in Inches of Water = Differential Pressure x Percent Loss.
If this is more than can be tolerated, it may be necessary to go to a larger pipe size and select a smaller differential.

STEP 4 - Determine minimum straight length of pipe required using Diameter Ratio (β) from Table E, refer to the piping requirements on Table F to determine the minimum straight length of pipe required.

TABLE A. Factors For Sizing Flow in scfm For Gases

PRESSURE f_1		TEMPERATURE f_2		SPECIFIC GRAVITY f_3	
psig	FACTOR	°F	FACTOR	SP.GR.	FACTOR
2	1.07	0	.93	0.1	.32
5	1.00			0.2	.45
10	.86	100	1.03	0.3	.55
20	.71	150	1.07	0.4	.63
30	.65	200	1.12	0.5	.71
40	.58	250	1.16	0.6	.77
60	.48			0.8	.89
80	.42			1.0	1.00
100	.38	300	1.20	1.2	1.10
140	.32			1.4	1.18
180	.28	400	1.27	1.6	1.26
220	.26	500	1.35	1.8	1.34
240	.25	600	1.41	2.0	1.41
				2.5	1.58

NOTE: Do not use a 200" differential with less than 5 psig upstream pressure or a 400" differential with less than 30 psig upstream pressure.

TABLE B. Factors For Sizing Flow In pph For Steam

PRESSURE f_p				SUPERHEAT f_s	
psig	FACTOR	psig	FACTOR	°F	FACTOR
5	1.00	400	.20	0	1.00
10	.88	500	.18	25	1.03
15	.79	600	.17	50	1.04
20	.72	700	.16	100	1.08
40	.60	800	.14	150	1.12
60	.50	1000	.13	200	1.15
80	.44	1200	.12	250	1.19
100	.40	1400	.11	300	1.22
150	.33	1600	.10	400	1.27
200	.29	1800	.09	500	1.32
300	.24	2000	.08		

NOTE: Condensate in the bypass line will cause erroneous readings so that dry steam must be maintained throughout the system for proper operation.

TABLE C. Sizing Flow Capacity Data For SK Bypass Rotameters

MAIN LINE PIPE SIZE SCHD. 40	SIZING GPM (LIQUID)					SIZING SCFM (AIR)						SIZING PPH (STEAM)				
	DIFFERENTIAL, INCHES WATER					DIFFERENTIAL, INCHES WATER						DIFFERENTIAL, INCHES WATER				
	50	100	150	200	400	25	50	100	150	200	400	50	100	150	200	400
1 1/2"	37	53	64	74	100	103	145	206	250	290	430	460	640	810	920	1270
2"	60	85	100	120	170	170	240	340	420	480	710	760	1060	1330	1520	2100
2 1/2"	84	120	150	170	240	250	350	500	600	680	1000	1100	1540	1900	2200	3100
3"	130	180	230	260	370	380	540	750	930	1080	1580	1700	2400	2900	3400	4800
4"	260	380	460	530	750	770	1100	1540	1900	2200	3200	3500	5000	6000	6400	9900
5"	420	600	720	830	1200	1200	1700	2400	3000	3400	5000	5300	7600	9500	11,000	15,200
6"	600	850	1000	1200	1700	1800	2500	3500	4300	5000	7200	8000	11,000	13,700	15,600	22,000
8"	1000	1500	1800	2100	2900	3100	4300	6100	7500	8600	12,600	13,700	19,500	24,000	28,000	38,000
10"	1600	2300	2800	3300	4600	4900	6800	9700	12,000	13,600	20,000	21,000	30,000	37,000	43,000	61,000
12"	2300	3300	4100	4700	6600	6800	9700	13,600	16,500	19,000	28,000	30,000	43,000	52,000	61,000	88,000
14"	2800	4000	4800	5600	7900											
16"	3500	5200	6300	7300	10,300											
18"	4600	6500	8000	9300	13,000											
20"	5700	8100	10,000	12,000	16,000											
24"	8300	12,000	14,000	17,000	24,000											

Notes:

1. Capacities listed are maximum for each differential, but lesser flows as a maximum can be specified.

2. If any other schedule is used, multiply values in table by: $\left(\frac{\text{Actual Pipe I.D.}}{\text{Sched. 40 Pipe I.D.}} \right)^2$

TABLE D. Flow Range Data For Various Types of SK Rotameters

ROTAMETER		TUBE SIZE	CONN. SIZE	FLOW RANGE					
TUBE	TYPE			DIFFERENTIAL PRESSURE, INCHES OF WATER					
				25	50	100	150	200	400
GLASS TUBE	INDICATING	1/2"-37-G-10	1/2"	5:1	7.1:1	10:1	10:1	10:1	10:1
	ALARM	1"-20-G-5*	1/2"	-	3.3:1	4.7:1	5.8:1	6.7:1	9.4:1
		1"-27-G-5	1"	-	4.4:1	5.8:1	7.1:1	8.2:1	10:1
METAL TUBE	INDICATING ALARM TRANSMITTER†	1"-28-M-5	1"	—	3.3:1	4.7:1	5.8:1	6.7:1	9.4:1

Notes: All data applies to stainless steel float material except tubes marked* with PVC magnet encapsulation.
 For gas flow multiply flow ranges in above table by 0.935.
 †Transmitter available only for differential pressures of 400 in. H₂O.

TABLE E. Diameter Ratio (β) And Permanent Loss Factors

FLOW RATIO	PIPE SIZE 3" & LESS		PIPE SIZE 4" & GREATER	
	DIA. RATIO β	PERM. LOSS % DIFF.	DIA. RATIO β	PERM. LOSS % DIFF.
.05	.17	97	.18	97
.10	.24	94	.26	93
.15	.29	92	.32	90
.20	.33	89	.37	87
.25	.37	84	.41	81
.30	.41	81	.45	77
.40	.47	76	.51	71

FLOW RATIO	PIPE SIZE 3" & LESS		PIPE SIZE 4" & GREATER	
	DIA. RATIO β	PERM. LOSS % DIFF.	DIA. RATIO β	PERM. LOSS % DIFF.
.50	.52	70	.57	66
.60	.57	66	.61	60
.70	.61	60	.65	56
.80	.64	57	.69	51
.90	.67	55	.72	48
1.00	.70	50	.75	44

DIAMETER RATIO β	ELBOW OR TEE		TWO ELLS OR BENDS IN SAME PLANE		TWO ELLS OR BENDS IN DIFFERENT PLANES		GLOBE OR REGULATING VALVE ²		REDUCER OR EXPANDER	
	WITH STRAIGHT VANES	WITHOUT	WITH STRAIGHT VANES	WITHOUT	WITH STRAIGHT VANES	WITHOUT	WITH STRAIGHT VANES	WITHOUT	WITH STRAIGHT VANES	WITHOUT
.3		6		8		16		9		8
.4		6		9		18		10		9
.5	7	7	10	10	10	20	10	11	10	10
.6	8	8	11	13	11	24	11	13	11	11
.7	11	12	12	18	12	30	12	16	13	13
.8	14	20	13	25	13	40	13	20	16	16

¹The straight lengths of pipe (L) required after the orifice (in pipe diameters) are three pipe diameters for diameter ratios less than 0.7 and four pipe diameters for diameter ratios greater than 0.7.

²Any control valve should be located after the orifice.

Specifications contained herein are subject to change without notice. Since it is impossible to anticipate or control the many different conditions under which this information and our products may be used, McCrometer cannot guarantee the applicability and accuracy of the information, or the suitability of our products in any given situation.

SK FLOWMETERS SERVE MANY FUNCTIONS

"SAFEGUARD" ROTAMETERS



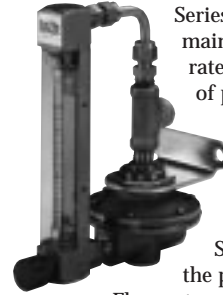
Series 20-5100 Rotameters (threaded connections) and 20-5200 (flanged connections) have "Universal" end fittings which permit instant change in the field between vertical and horizontal piping orientations. Capacities from 120 cc/min to 92 gpm; accuracy of $\pm 2\%$ F.S. standard, $\pm 1\%$ with special calibration.
Request Bulletin 20-5000.

600 mm LABORATORY ROTAMETERS

Series 20-5120 Rotameters are designed for measuring rate of flow of liquids and gases where a high degree of accuracy is required. The 600 mm scale length can be direct reading in flow units. Metering tube is either Linear or Log.
Request Bulletin 20-1900.



PURGE ROTAMETER WITH DIFFERENTIAL REGULATOR



Series 20-3200 meters maintain constant flow rate settings regardless of pressure fluctuations in the piping. Available in brass or stainless steel, they can be mounted on most SK purgemeters of the proper flow sizing.

Flow rates are 1 to 120 scfh air. Ideal for furnace and liquid level "Bubbler" applications. *Request Bulletin 20-5000*

FLO-THRU INDICATING/TRANSMITTING/ALARM ROTAMETERS

Series 9300 metal tube Rotameters measure rates of flow (up to 100 gpm) at pressures up to 1500 psig at 400°F. Output signal on 9300-ET transmitter is 4 to 20 mA. Model 9300-EA alarm meter has two SPDT 10 amp, 120 VAC relays for high and low flow indications.
Request Bulletin on 20-9300 Series.



METAL TUBE ROTAMETERS

Series 20-9550-8510 Metal-tube Rotameter. A rugged instrument, designed for use with hazardous fluids or fluids under pressures up to 2500 psig at temperatures to 400°F. An extension rod extends from the float up into the measuring head. An encapsulated magnet in the top of the extension rod causes a follower to move up or down as flow increases or decreases. The location of the follower in relation to a scale indicates rate of flow.
Request Bulletin 19.

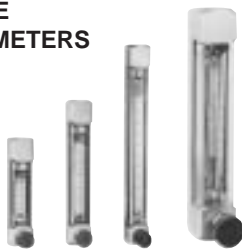


ALARM ROTAMETERS

Series 20-9650 alarm rotameters feature a magnetic follower and alarm system which can activate audible and visual alarms or an automatic shutoff in case of abnormally high or low flows. Both weather-tight (pictured) and explosion-proof (Class 1, Group D, Div. I Service) housings are available.
Request Bulletin 18A.



PURGE ROTAMETERS



Series 7000 Rotameters feature stainless steel construction. Series 20-7010 has a 1 1/2 in. scale and is used for flows up to 12 gph. Series 20-7030 has a 3 in. scale and is used for flows up to 20 gph. Series 20-7050 Rotameters provide flow ranges up to 28 gph water. For higher flow (up to 46 gpm), use Series 20-7055.
Request Bulletin 20-7000 and 20-7055.

BALL FLOW INDICATORS

For simple, inexpensive indication of flow, McCrometer offers a complete line of sight flow indicators including ball, rotary and flapper types. Series 20-6100 ball flow indicators are available in capacity ranges from 2 to 190 gpm.
Request Bulletin 20-6100.



HIGH-PRESSURE PURGE ROTAMETERS

Series 20-9500 metal tube purge rotameters are used for measuring low flows of fluids and gases at high pressures. This unit operates on the same principle as the standard metal tube meter and has a weathertight extension housing which can be rotated 360°. This rotameter is designed for flow capacities up to 6.6 gpm and can handle pressures up to 1500 psig at 200°F.
Request Bulletin 20-9500.

