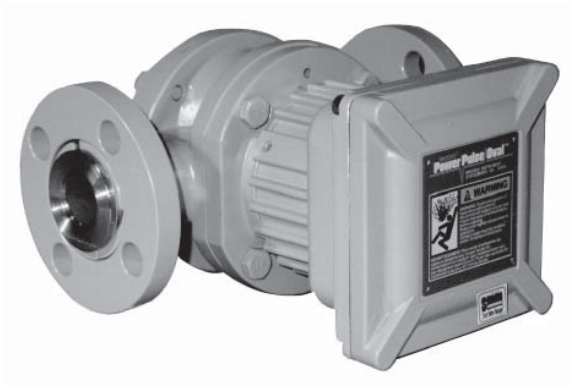
BRODIE International

9800 Series
Power Pulse Oval Flowmeter

Description



The Brodie 9800 Series Oval flowmeters are highly accurate, positive displacement meters with electronic output or registration. They are used in chemical, hydrocarbon food and beverage applications. Utilizing precision matched oval gears for exact liquid measurement, these highly accurate meters can handle a wide range of viscosities and maintain precision accuracy even when handling low viscosity products at low flow rates. A significant feature of the oval is the ability to handle high viscosity products with very low pressure drop across the meter. The 9800 Series has a compact, 3-piece design which uses both front and rear flanges instead of the closed end body configuration found in traditional oval flowmeters. They are available in sizes 1/2" through 3".

Electronic registration is provided through the Brodie BERT-E electronic register. This microprocessor based instrument is used for flowrate indication and totalization. It is capable of transmitting a factored analog current output signal (4-20 mA) used to drive standard process instrumentation. Pulse output is also available.

The 9800 Series oval is available in three basic configurations:

1. The basic Power Pulse Oval
2. Power Pulse Oval with integral BERT-E
3. Power Pulse Oval with remote BERT-E

Principle of Operation

The Power Pulse Oval meter accurately measures liquid flow by using a slight pressure differential to rotate a pair of oval gears located within the measuring chamber. Each complete rotation of the gears (rotors) displaces a fixed amount of liquid from the inlet to the outlet of the meter in a continuous flow pattern. When in the position as shown in Figure 1, Position 1, all of the driving torque resulting from differential pressure is applied to Gear A. Gear B has zero driving torque since equal areas of gear surface on opposite sides of the axis of rotation are exposed to higher inlet pressure. As the gears begin to rotate (Position 2), the torque applied to Gear A decreases but Gear B now has driving torque due to increased area exposed to the high pressure. At Position 3, all of the driving torque is exerted on Gear B and Gear A has decreased to zero. This alternate driving action provides a smooth rotation of almost constant torque without dead spots.

Because slippage between the gears and the wall is minimal, the meter is essentially unaffected by the viscosity and lubricity of the liquids being metered.

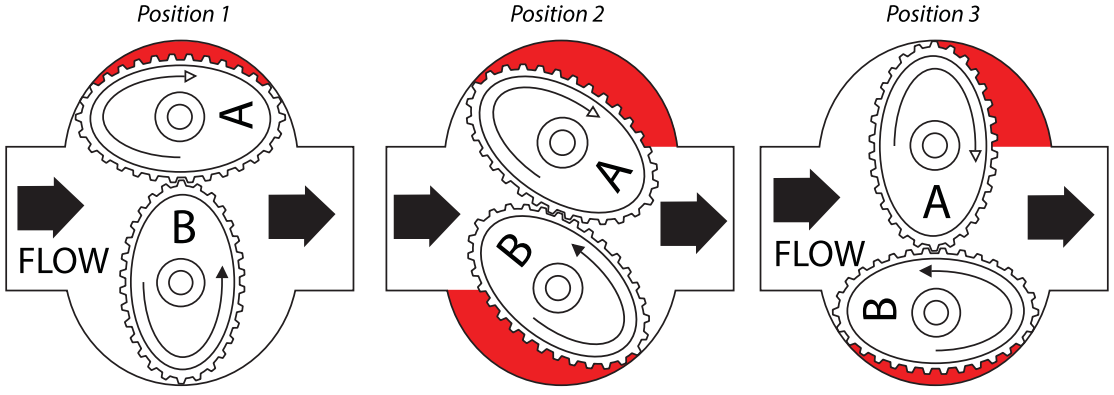


Figure 1: Principle of Operation

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.

Viscosity
Basic viscosity classifications include:
Standard viscosity class from 0.2 to 300 centipoise
High Viscosity class above 300 centipoise

Materials of Construction
Body: Stainless steel
Rotors: Stainless steel
Shafts: Stainless steel (Std.), chrome plated (Opt.)
Rotor Bearings: Carbon (Std.) or for corrosive/abrasive product, Waukesha (Opt.) or carbon/ceramic (Opt.)
O-rings: Viton® (Std.); Teflon®, EPR, silicon (Opt.). Refer to Model Code Table.

Capacities
Refer to Table 1

Performance
Accuracy: ±0.25% on viscosities of 5 centipoise and above. ±0.5% on viscosities from 0.2 to 5 centipoise
Repeatability: ±0.05% or better
Accuracy vs. Pressure Drop: Refer to Table 2

Maximum Working Temperature (Limited by Electronics)
Process Operating Temperature:
Class A: -40°F to 230°F (-40°C to 110°C)
Class C: 230°F to 400°F (110°C to 204°C)
Ambient Operating Temperature:
-40°F to 140°F (-40°C to 60°C)
Storage:
-58°F to 175°F (-50°C to 79°C)

Maximum Working Pressure at 100°F (38°C)
Stainless steel, Class 150 ANSI Flg.: 275 psi (1895 kPa)
Carbon steel, Class 150 ANSI Flg.: 285 psi (1964 kPa)
Stainless steel, Class 300 ANSI Flg.: 720 psi (4960 kPa)
Carbon steel, Class 300 ANSI Flg.: 740 psi (5099 kPa)

Process Connections
Standard: 1/2” to 3” Class 150 ANSI flange
Optional: 1/2” to 3” Class 300 ANSI Flange, DIN, Tri-Clover

Power
Input Supply Voltage: 10-30 Vdc, 130 mA max.

Output Signals
Powered Pulse
Amplitude: 4 Vpp
Pulse Width: Approximately 20 microseconds

Preamp
Type: Square Wave
Frequency Range: 0-5 kHz.
Amplitude: 5 V or Supply Voltage (jumper selectable)
Duty Cycle: 50/50, ± 20%
Loading: 1 kohm internal pull-up
125 mA sink current
0.5 W, max.
Type: Open Collector Output
Frequency Range: 0-5 kHz.
Duty Cycle: 50/50, ± 20%
Maximum Voltage: 30 Vdc
Maximum Current: 125 mA

Dimensions: Refer to Figure 2

Ordering Information (Refer to Table 6)

To order please specify:
1. Model number
2. Product
3. Viscosity
4. Maximum operating temperature
5. Maximum operating pressure
6. Units of registration
7. Operating Flow Ranges (Minimum, maximum and normal)
8. Output options required

Table 1: Pulse Resolution

Meter Size	Bore (Inches)	Flowmeter K-Factor (pulses/gallon)
9852	1/2	390.0
9853	1	217.6
9855	1	108.4
9856	1-1/2	50.4
9857	2	76*
9859	3	29*

**K-factory with preamp; K-Factor without preamp is 50%.*

Table 2: Specifications Strainer

Connection Size	Model Number	Mesh	Micron
1/2” & 1”	9852, 9853	80	150
1” & 1-1/2”	9855, 9856	60	250
2” & 3”	9857, 9859	40	350

Table 3: Operating Range, Water and Petroleum Products, Volume

Line Size	Model	Units	Cold Water	Hot Water 140 to 230 DF	LPG 0.2 cP	Gasoline 0.3 to 0.7 cP	Kerosene 0.78 to 1.8 cP	Light Oil 2 to 4 cP	Heavy Oil 5 to 300 cP
1/2"	9402	m3/hr	0.3 to 1.5	0.4 to 1	0.7 to 1.8	0.4 to 1.8	0.3 to 1.8	0.15 to 2	0.08 to 2
	9852	gpm	1.3 to 6.6	1.8 to 4.4	3.1 to 7.9	1.8 to 7.9	1.3 to 7.9	0.7 to 8.8	0.4 to 8.8
	9952	lpm	5.0 to 25.0	6.7 to 16.7	11.7 to 30.0	6.7 to 30.0	5.0 to 30.0	2.5 to 33.3	1.3 to 33.3
1"	9453	m3/hr	0.55 to 3	0.7 to 2	1.1 to 3.6	0.7 to 3.6	0.55 to 3.6	0.28 to 4	0.15 to 4
	9853	gpm	2.4 to 13.2	3.1 to 8.8	4.8 to 15.9	3.1 to 15.9	2.4 to 15.9	1.2 to 17.6	0.7 to 17.6
	9953	lpm	9.2 to 50.0	11.7 to 33.3	18.3 to 60.0	11.7 to 60.0	9.2 to 60.0	4.7 to 66.7	2.5 to 66.7
1"	9455	m3/hr	1 to 7	1.2 to 5	1.8 to 8.5	1.2 to 8.5	1 to 8.5	0.4 to 10	0.26 to 10
	9855	gpm	4.4 to 30.8	5.3 to 22.0	7.9 to 37.4	5.3 to 37.4	4.4 to 37.4	1.8 to 44.0	1.1 to 44.0
	9955	lpm	16.7 to 116.7	20.0 to 83.3	30.0 to 141.7	20.0 to 141.7	16.7 to 141.7	6.7 to 166.7	4.3 to 166.7
1-1/2"	9456	m3/hr	2 to 14	2.5 to 10	3.5 to 17	2.5 to 17	2 to 17	0.9 to 20	0.6 to 20
	9856	gpm	8.8 to 61.6	11.0 to 44.0	15.4 to 74.9	11.0 to 74.9	8.8 to 74.9	4.0 to 88.1	2.6 to 88.1
	9956	lpm	33.3 to 233.4	41.7 to 166.7	58.3 to 283.4	41.7 to 283.4	33.3 to 283.4	15.0 to 333.4	10.0 to 333.4
2"	9457	m3/hr	4 to 30	5 to 20	8 to 35	8 to 35	4 to 35	2 to 40	1.2 to 40
	9857	gpm	17.6 to 132.1	22.0 to 88.1	35.2 to 154.1	35.2 to 154.1	17.6 to 154.1	8.8 to 176.1	5.3 to 176.1
	9957	lpm	66.7 to 500.0	83.3 to 333.4	133.3 to 583.4	133.3 to 583.4	66.7 to 583.4	33.3 to 666.7	20.0 to 666.7
3"	9459	m3/hr	8 to 60	10 to 40	15 to 70	10 to 70	8 to 70	6 to 90	4 to 90
	9859	gpm	35.2 to 264.2	44.0 to 176.1	66.1 to 308.2	44.0 to 308.2	35.2 to 308.2	26.4 to 396.3	17.6 to 396.3
	9959	lpm	133.3 to 1000.1	166.7 to 666.7	250.0 to 1166.8	166.7 to 1166.8	133.3 to 1166.8	100.0 to 1500.1	66.7 to 1500.1

Table 4: Operating Range, Water and Petroleum Products, Mass

Line Size	Model	Units	Cold Water Sp. Gr. = 1	Hot Water 140 to 230 DF Sp. Gr. = 0.98	LPG 0.2 cP Sp. Gr. = 0.05	Gasoline 0.3 to 0.7 cP Sp. Gr. = 0.78	Kerosene 0.78 to 1.8 cP Sp. Gr. = 0.82	Light Oil 2 to 4 cP Sp. Gr. = 0.90	Heavy Oil 5 to 300 cP Sp. Gr. = 0.95
1/2"	9402 9852 9952	lb/min	11.0 to 55.1	14.4 to 36.0	12.8 to 33.0	11.5 to 51.5	9.03 to 54.2	5.0 to 66.1	2.8 to 69.8
		kg/min	5.0 to 25.0	6.5 to 16.3	5.8 to 15.0	5.2 to 23.4	4.1 to 24.6	2.2 to 30.0	1.3 to 31.6
1"	9453 9853 9953	lb/min	20.2 to 110.1	25.2 to 72.0	20.2 to 66.1	20.0 to 103.1	16.56 to 108.4	9.3 to 132.2	5.2 to 139.5
		kg/min	9.2 to 50.0	11.4 to 32.6	9.2 to 30.0	9.1 to 46.8	7.5 to 49.2	4.2 to 59.9	2.4 to 63.3
1"	9455 9855 9955	lb/min	36.7 to 257.0	43.2 to 179.9	33.0 to 156.0	34.4 to 243.4	30.10 to 255.9	13.2 to 330.4	9.1 to 348.8
		kg/min	16.7 to 116.6	19.6 to 81.6	15.0 to 70.8	15.6 to 110.4	13.7 to 116.1	6.0 to 149.9	4.1 to 158.2
1-1/2"	9456 9856 9956	lb/min	73.4 to 513.9	90.0 to 359.8	64.2 to 312.0	71.6 to 486.8	60.21 to 511.7	29.7 to 660.8	20.9 to 697.5
		kg/min	33.3 to 233.1	40.8 to 163.2	29.1 to 141.5	32.5 to 220.8	27.3 to 232.1	13.5 to 299.7	9.5 to 316.4
2"	9457 9857 9957	lb/min	146.8 to 1101.3	179.9 to 719.6	146.8 to 642.4	229.1 to 1002.2	120.41 to 1053.6	66.1 to 1321.6	41.9 to 1395.0
		kg/min	66.6 to 499.6	81.6 to 326.4	66.6 to 291.4	103.9 to 454.6	54.6 to 477.9	30.0 to 599.5	19.0 to 632.8
3"	9459 9859 9959	lb/min	293.7 to 2202.6	359.8 to 1439.2	275.3 to 1284.9	286.3 to 2004.4	240.82 to 2107.2	198.2 to 2973.6	139.5 to 3138.8
		kg/min	133.2 to 999.1	163.2 to 652.8	124.9 to 582.8	129.9 to 909.2	109.2 to 955.8	89.9 to 1348.8	63.3 to 1423.7

Figure 2: Pressure Loss and Flow Range for High Viscosity Liquids

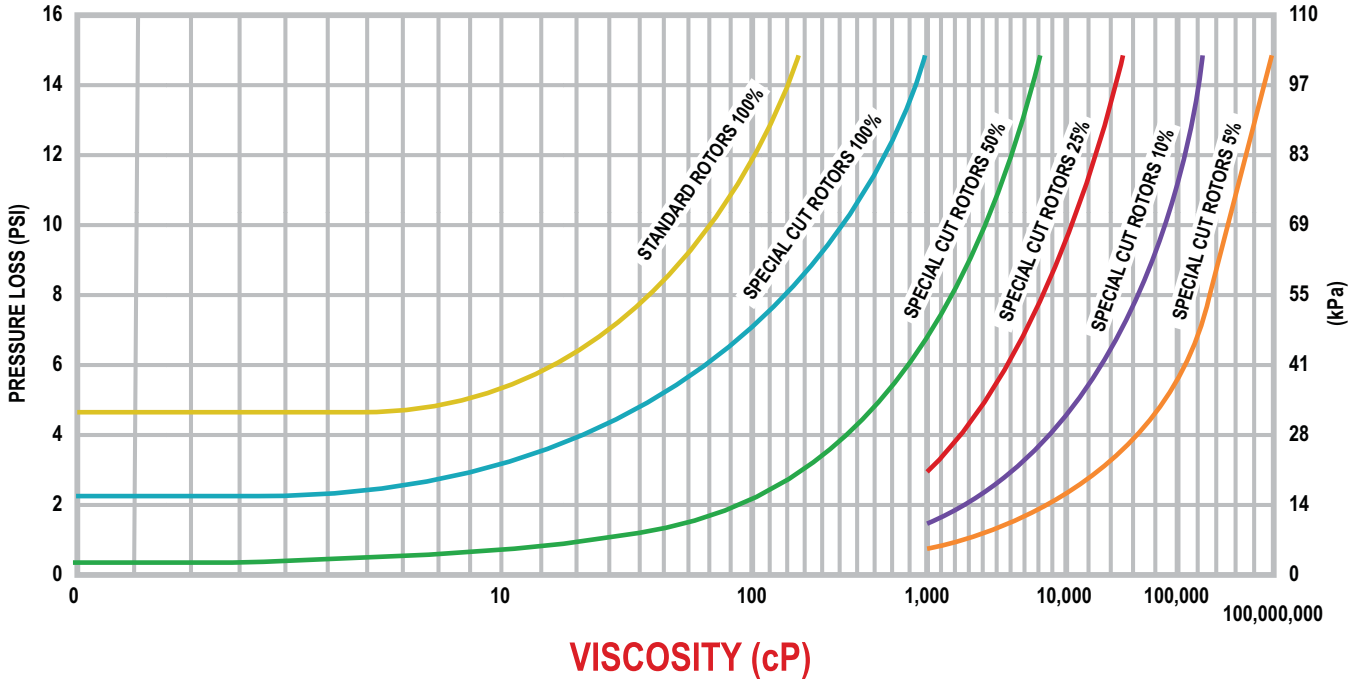


Figure 3: Relationship Between Viscosity and Coeffecient of Maximum Flow Rate

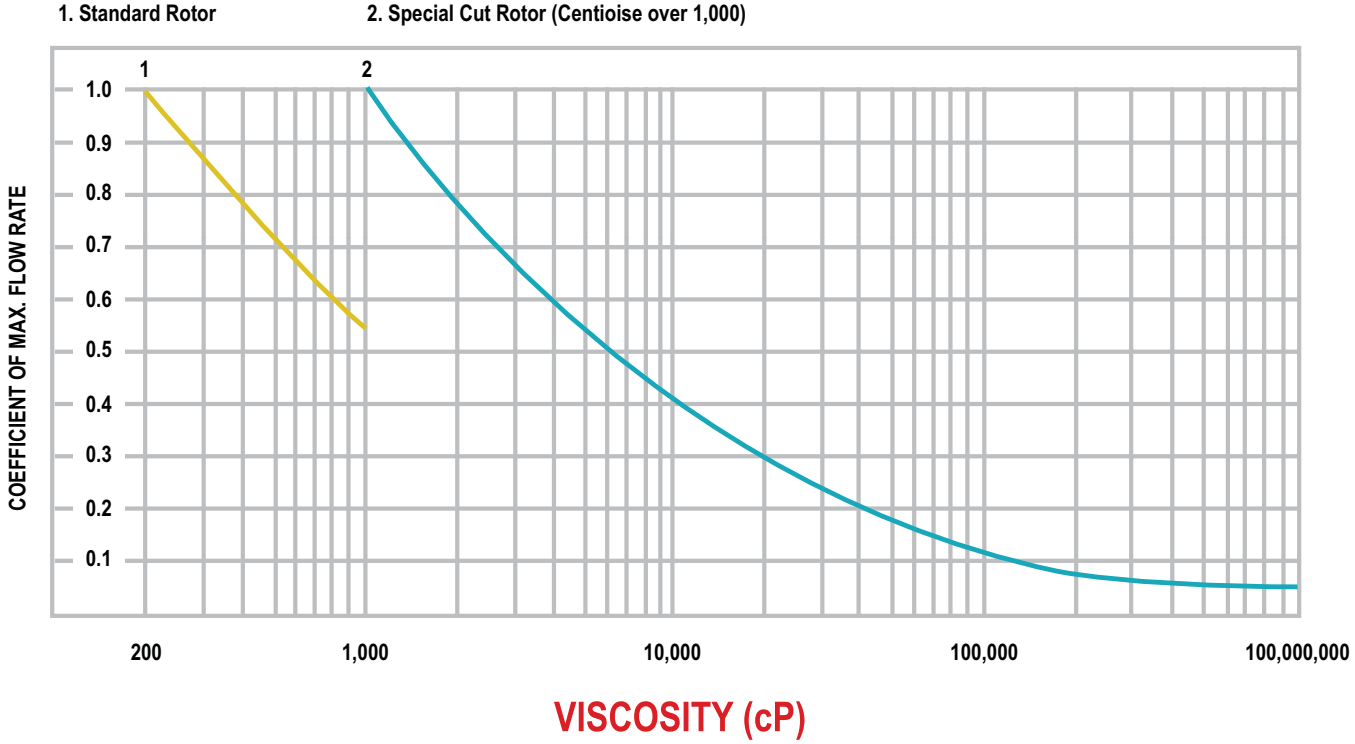


Table 5: Model Code

Code	Standard Series Number
98	Base Model Number

Code	Meter Size
52	1/2″
53	1″
55	1″
56	1-1/2″
57	2″
59	3″

Code	Revision Level
B	Initial Release

Code	Meter Output
A	Electrical Output- One Pickoff W/O Preamp
B	Electrical Output-Two Pickoff W/O Preamp *
C	Electrical Output- One Pickoff With Preamp
D	Electrical Output-Two Pickoff With Preamp *

Code	Housing	Rotors	Elastomer	Notes
1	316 Stainless Steel	316 Stainless Steel	Viton (-15 to 400F)	Standard
2	316 Stainless Steel	316 Stainless Steel	Teflon (-40 to 400F)	
3	316 Stainless Steel	316 Stainless Steel	EPR	
4	316 Stainless Steel	316 Stainless Steel	Silicon	FDA Approved

Code	Process Connection Type
A	ANSI Class 150, RF, Carbon Steel
B	ANSI Class 150, RF, Carbon Steel, 125-250 AARH
C	ANSI Class 150 RF, 316 Stainless Steel
D	ANSI Class 150 RF, 316 Stainless Steel, 125-250 AARH
E	ANSI Class 300, RF, Carbon Steel
F	ANSI Class 300, RF, Carbon Steel, 125-250 AARH
G	ANSI Class 300 RF, 316 Stainless Steel
H	ANSI Class 300 RF, 316 Stainless Steel, 125-250 AARH
J	Sanitary (Tri-Clover Type) 150 PSI Max WP. Clamps By Customer
K	DIN Spud, No Flange
N	DIN 2501, PN 16, DN 15, 125-250 AARH, Carbon Steel
P	DIN 2501, PN 16, DN 15, 125-250 AARH, 316 Stainless Steel

Code	Housing	Temperature Class
1	316 Stainless Steel	A
3	316 Stainless Steel	C
5	316 Stainless Steel - Thermonized	A
7	316 Stainless Steel - Thermonized	C
9	316 Stainless Steel - CIP	A

Code	Bearing Material	Viscosity Type
A	Carbon	Standard Viscosity (< 300cP)
B	Carbon	High Viscosity (>300cP)
C	Waukesha	Standard Viscosity (< 300cP)
D	Waukesha	High Viscosity (>300cP)
E	Carbon Ceramic	Standard Viscosity (< 300cP)
F	Carbon Ceramic	High Viscosity (>300cP)

Code	Register/Counter
1	None/Remote
4	Integral Mounted BERT-E
5	Remote Pipe Mounted BERT-E

Code	Approvals
A	None

Code	Documentation
1	None
2	Material Test Reports
3	NACE (with MTR's)
4	SEP (except 9859 3004 rating)
5	SEP (with MTR's)
6	SEP/NACE (with MTR's)
7	PED with MTR's (9859 300# only)
8	PED/NACE with MTR's (9859 300# only)

**Only available with 9857 and 9859 meters.*

Figure 4: 9800 Oval Gear Meter with BERT-E Dimensions

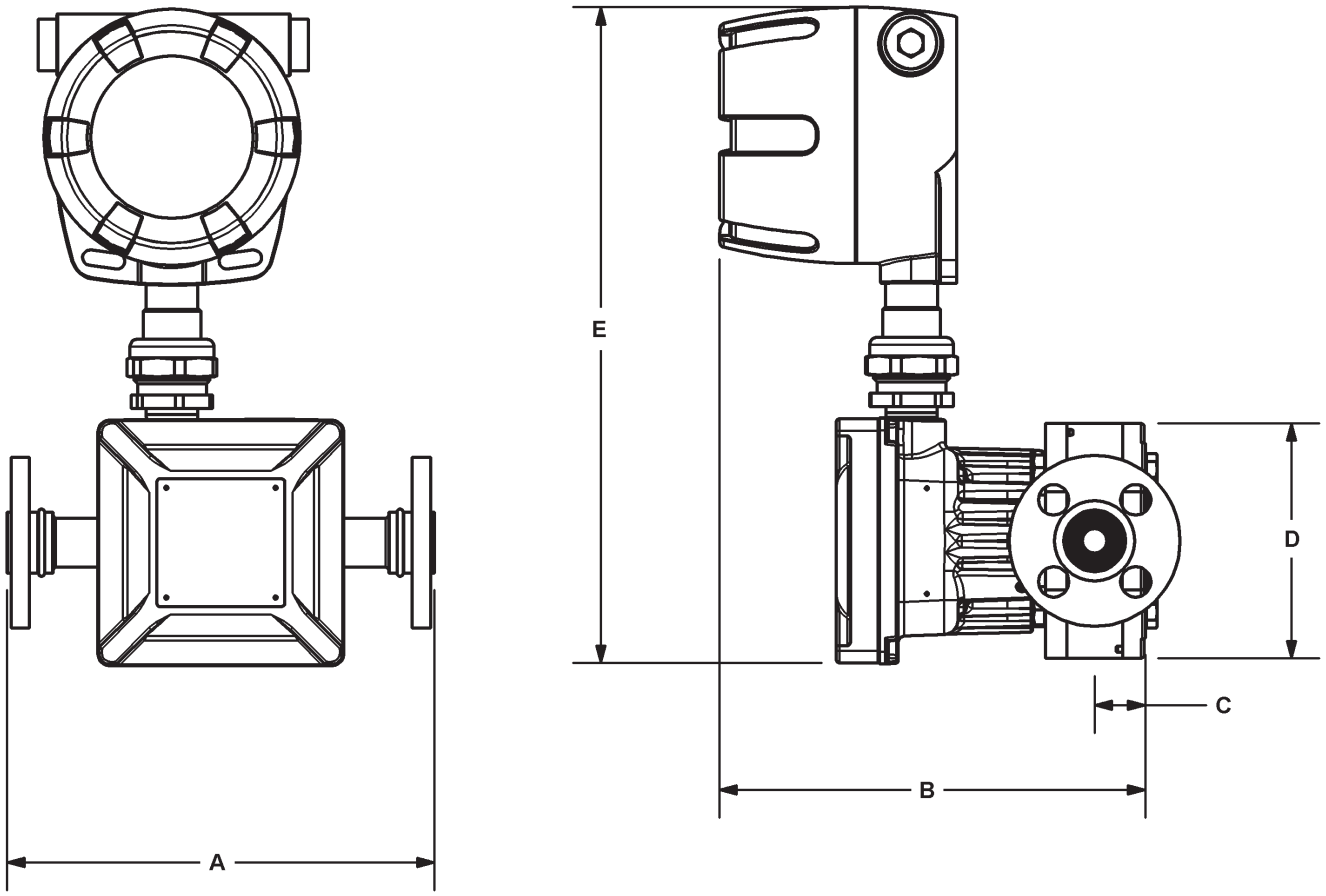


Table 6: Dimensions, 9800 Oval Gear Meter with BERT-E

Model	Size	ANSI Flange Rating	Dimension inch (mm)					Net Weight* Lbs. (kg)	Volume ft3 (m3)
			A	B	C	D	E		
9852	1/2”	150#/300# (1034kPa/2068 kPa)	8-3/4 (222)	8-3/4 (222)	1-1/16 (26)	4-13/16 (122)	13-7/16 (342)	18 (8.2)	0.74 (0.021)
9853	1”		8-3/4 (222)	9-11/16 (246)	1-1/2 (38)	4-13/16 (122)	13-7/16 (342)	25 (11.3)	2.64 (0.075)
9855	1”		8-3/4 (222)	10-5/16 (261.9)	1-3/4 (45)	5-7/8 (150)	13-7/8 (353)	30 (13.6)	2.68 (0.076)
9856	1.5”		10 (254)	11-3/8 (288.9)	2-1/4 (58)	7-1/8 (181)	14-1/2 (369)	50 (22.7)	2.64 (0.075)
9857	2”		13-3/4 (349)	13-3/16 (334.9)	3-1/16 (78)	9-7/8 (252)	15-7/8 (404)	114 (51.7)	9.16 (0.259)
9859	3”		17-3/8 (441)	16-1/16 (408)	4-5/16 (109)	13-1/2 (343)	17-11/16 (450)	274 (124.3)	9.16 (0.259)

**Net Weight is meter only.*

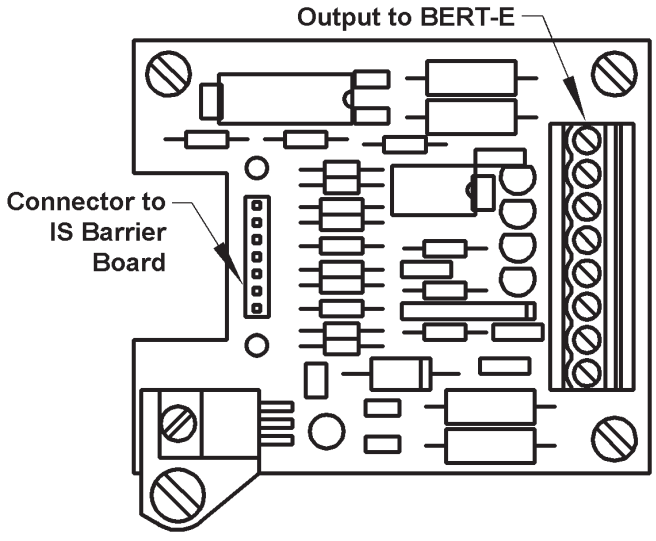
Table 7: Operating Range, Industrial Chemicals

Operating Range As A Function Of Liquid Type, Viscosity And Temperature																	
Meter Size	Liquid Viscosity Temp.	Maximum Flow Capacity					Minimum Flow Capacity										
		Liquid Type					Up to 0.2 cP	0.2 to 0.8 cP			0.8 to 1.8 cP		1.8 to 5 cP		5 to 2000 cP		Above 2000cp
		A	B	C	D	E	Up to 140°F	Up to 140°F	Up to 230°F	Above 230°F	Up to 230°F	Above 230°F	Up to 230°F	Above 230°F	Up to 230°F	Above 230°F	
52	Cont.	7.05	5.28	4.40	3.52	2.42	1.76	1.76	1.76	3.52	1.32	2.20	0.66	1.01	0.35	0.66	0.11
	Inter.	8.81	7.93	6.60	4.40	2.86											
53	Cont.	14.10	10.56	8.80	7.04	4.84	3.52	3.52	3.52	7.04	2.64	4.40	1.32	2.02	1.14	1.76	0.22
	Inter.	17.62	15.86	13.20	8.80	5.72											
55	Cont.	35.2	24.2	22.0	17.6	11.0	7.93	5.28	7.93	10.6	4.40	6.6	2.28	3.52	1.76	2.64	0.44
	Inter.	44.0	37.4	30.8	22.00	13.2											
	Limit	44.0	44.0	39.6	26.4	15.4											
56	Cont.	70.5	48.4	44.0	35.2	22.0	15.4	11.0	15.4	22.0	8.81	13.4	3.96	6.16	2.64	3.96	.88
	Inter.	88.1	70.5	61.6	44.0	24.0											
	Limit	88.1	88.1	79.3	52.8	28.6											
57	Cont.	141	96.9	88.1	66.0	44.0	35.2	22.0	35.2	44.0	17.6	26.4	8.81	13.2	5.28	8.81	2.20
	Inter.	176	154	132	88.1	48.4											
	Limit	176	176	154	110	57.2											
59	Cont.	308	220	176	154	88.0	66.0	44.0	44.0	51.7	21.5	34.9	12.8	22.0	7.90	12.9	4.40
	Inter.	396	308	264	176	110											
	Limit	396	396	352	200	132											

Liquid Type, Ranked by Lubricity

A	Cocoa Butter, Edible Oils, Glycerine, etc.
B	Acrylonitrile, Asphalt, Acetone, Carbonic Acid, Soda, Cresol, QOP, Formalin, Pitch, Silicicacid Soda, etc.
C	Acetachyde, Aniline, Beer, Benzene, Butanol, Caustic Soda, (Up to 10%), Carbontetrachloride, Chloroform, Copper Sulfate Solution, Ethyl Alcohol, Ethyleneglycol, Isopropyl Alcohol, Lactam, Phosphoric Acid, Liquid Ammonia (0.17 cP, 55°F), Liquor, Methanol, Milk, Nitrobenzene, Sodium Sulfide, Styrene Monomer, Sugar liquid, Toluene, Xylene, etc.
D	Acetic Acid, Brine, DMT, Ether, Hydocanic Acid, Liquid Ammonia (68-86°F, 0.13 to 0.2 cP), Perchlorethylene, Phthalic, Anhydride, Saturated Brine, Soy Sauce, Styrene, Sulfuric Acid, Terepht, Halicacid, etc.
E	EDC, Fuming Sulfuric Acid, Melting Sulfur, Nitric Acid, Sodium Hypochlorite, Sulfuric Acid (77°F, 20.2 cP), etc.

Figure 5: Preamp Board



Brodie International
19267 Highway 301 North • Statesboro, GA 30461
Phone: 001.912.489.0200 • Fax: 001.912.489.0294
A Brodie Meter Co., LLC Company
www.brodieintl.com