

## 9800 Series Power Pulse Oval Flowmeter

### DESCRIPTION

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 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.

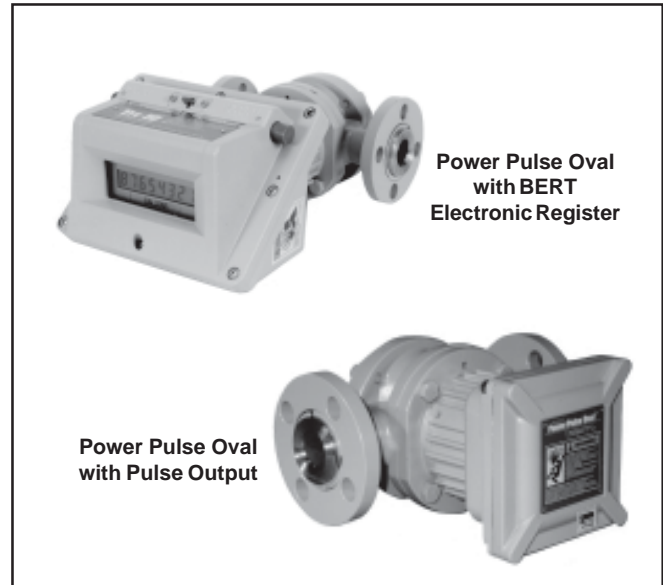
The 9800 Series oval is available in three basic configurations:

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

### PRINCIPLE OF OPERATION

The Power Pulse Oval meter is a positive displacement meter. As the fluid being measured passes through the meter, it rotates 2 oval gears in a measuring chamber to displace a precision volume of fluid. A sensor detects the gear rotation to determine displaced volume and flow rate.

Fluid pressure rotates the oval gears, Figure 1. In position 1, the fluid exerts a clockwise driving force on Gear A. There is no net driving force on Gear B. It is perpendicular to the flow so the fluid forces are balanced around the shaft.



As the gears rotate to position 2, the fluid begins to exert a force on Gear B. At position 3, all the driving force is on Gear B. This alternating driving force provides a smooth rotation of almost constant torque.

The meter design minimizes the slippage between the gears and the measuring chamber wall. As a result, the oval meter is less affected than other designs by the liquid's viscosity and lubricity.

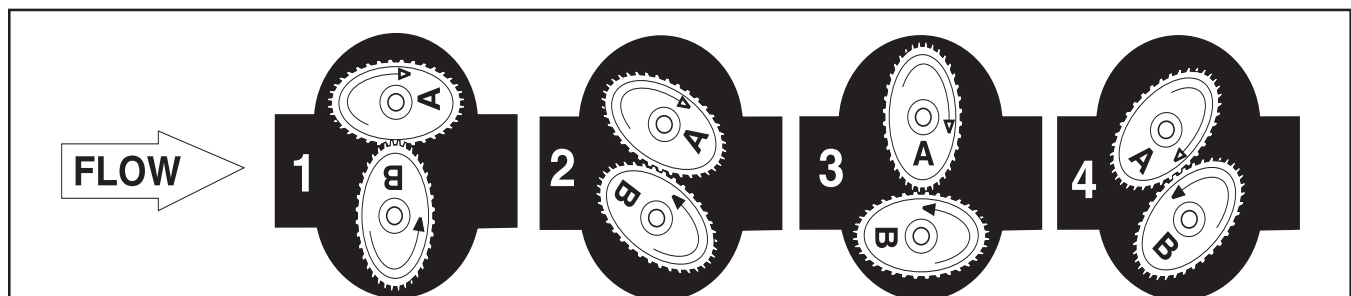


Figure 1 Principle of Operation Chart

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

#### Maximum Working Temperature (Limited by Electronics)

Process Operating Temperature:  
Class A:  $-40^{\circ}\text{F}$  to  $230^{\circ}\text{F}$  ( $-40^{\circ}\text{C}$  to  $110^{\circ}\text{C}$ )  
Class C:  $230^{\circ}\text{F}$  to  $400^{\circ}\text{F}$  ( $110^{\circ}\text{C}$  to  $204^{\circ}\text{C}$ )  
Ambient Operating Temperature:  
 $-40^{\circ}\text{F}$  to  $140^{\circ}\text{F}$  ( $-40^{\circ}\text{C}$  to  $60^{\circ}\text{C}$ )  
Storage:  $-58^{\circ}\text{F}$  to  $175^{\circ}\text{F}$  ( $-50^{\circ}\text{C}$  to  $79^{\circ}\text{C}$ )  
Class I, Division 1, Groups C & D, Class II, Division 1  
Groups E, F & G

#### Maximum Working Pressure at $100^{\circ}\text{F}$ ( $38^{\circ}\text{C}$ )

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,  $\pm 20\%$   
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,  $\pm 20\%$   
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

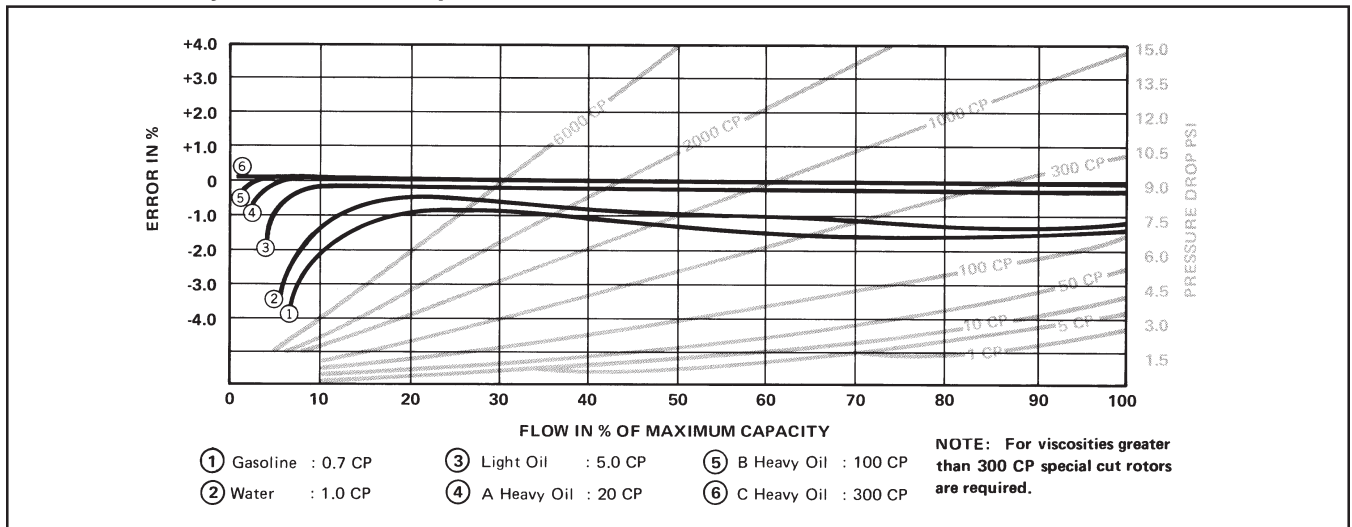
**Table 1 Operating Range, Water and Petroleum Products - US gpm**

Flow Range Capacities - M <sup>3</sup> /H										
Size	Model Number	Cold Water	Hot Water 140 to 230° F	LPG 0.2 cP	Gasoline 0.3 to 0.7 cP	Kerosene 0.7 to 1.8 cP	Light Oil to 4 cP	2	Heavy Oil to 300 cP	5
1/2"	02/52	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	
1"	53	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	
1"	55	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	
1-1/2"	56	2 to 14	2.5 to 1	3.5 to 17	2.5 to 17	2 to 17	0.9 to 20		0.6 to 20	
2"	57	4 to 30	5 to 20	8 to 35	5 to 35	4 to 35	2 to 40		1.2 to 40	
3"	59	8 to 60	10 to 40	15 to 70	10 to 70	8 to 70	6 to 90		4 to 90	

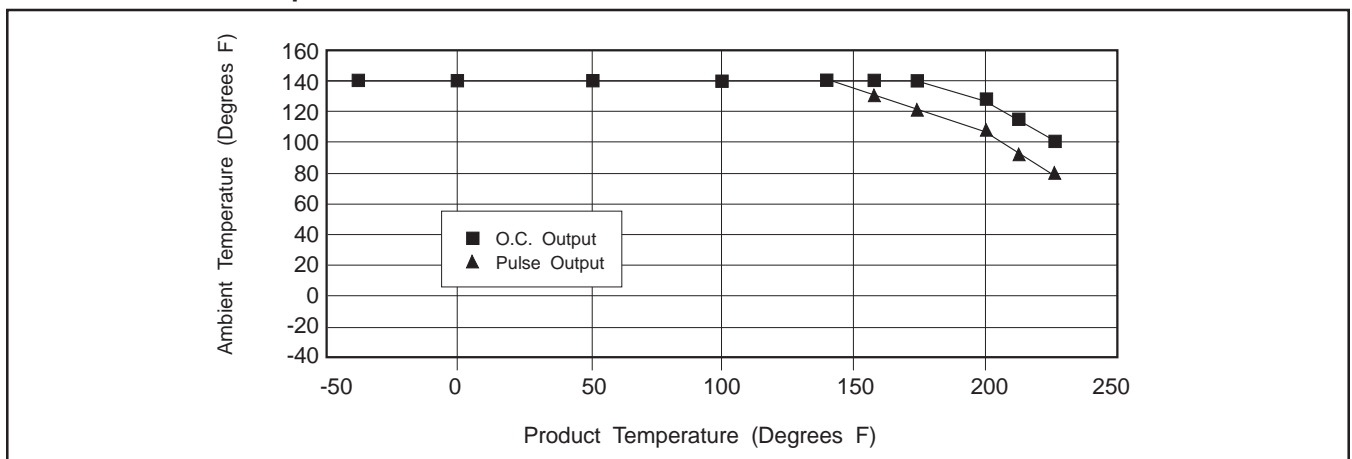
Flow Range Capacities - USGPM										
Size	Model Number	Cold Water	Hot Water 140 to 230° F	LPG 0.2 cP	Gasoline 0.3 to 0.7 cP	Kerosene 0.7 to 1.8 cP	Light Oil to 4 cP	2	Heavy Oil to 300 cP	5
1/2"	02/52	1.3 to 6.6	1.8 to 4.4	3.1 to 7.9	1.8 to 7.9	1.3 to 7.9	0.7 to 8.8		0.4 to 8.8	
1"	53	2.4 to 13.2	3.1 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	
1"	55	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	
1-1/2"	56	8.8 to 61.6	11.0 to 4.4	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	
2"	57	17.6 to 132.1	22.0 to 88.1	35.2 to 154.1	22.0 to 154.1	17.6 to 154.1	8.8 to 176.1		5.3 to 176.1	
3"	59	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	

Flow Range Capacities - LPM										
Size	Model Number	Cold Water	Hot Water 140 to 230° F	LPG 0.2 cP	Gasoline 0.3 to 0.7 cP	Kerosene 0.7 to 1.8 cP	Light Oil to 4 cP	2	Heavy Oil to 300 cP	5
1/2"	02/52	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"	53	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"	55	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"	56	33.3 to 233.3	41.7 to 16.7	58.3 to 283.3	41.7 to 283.3	33.3 to 283.3	15.0 to 333.3		10.0 to 333.3	
2"	57	66.7 to 500.0	83.3 to 333.3	133.3 to 583.3	83.3 to 583.3	66.7 to 583.3	33.3 to 666.7		20.0 to 666.7	
3"	59	133.3 to 1000.0	166.7 to 666.7	250.0 to 1166.7	166.7 to 1166.7	133.3 to 1166.7	100.0 to 1500.0		66.7 to 1500.0	

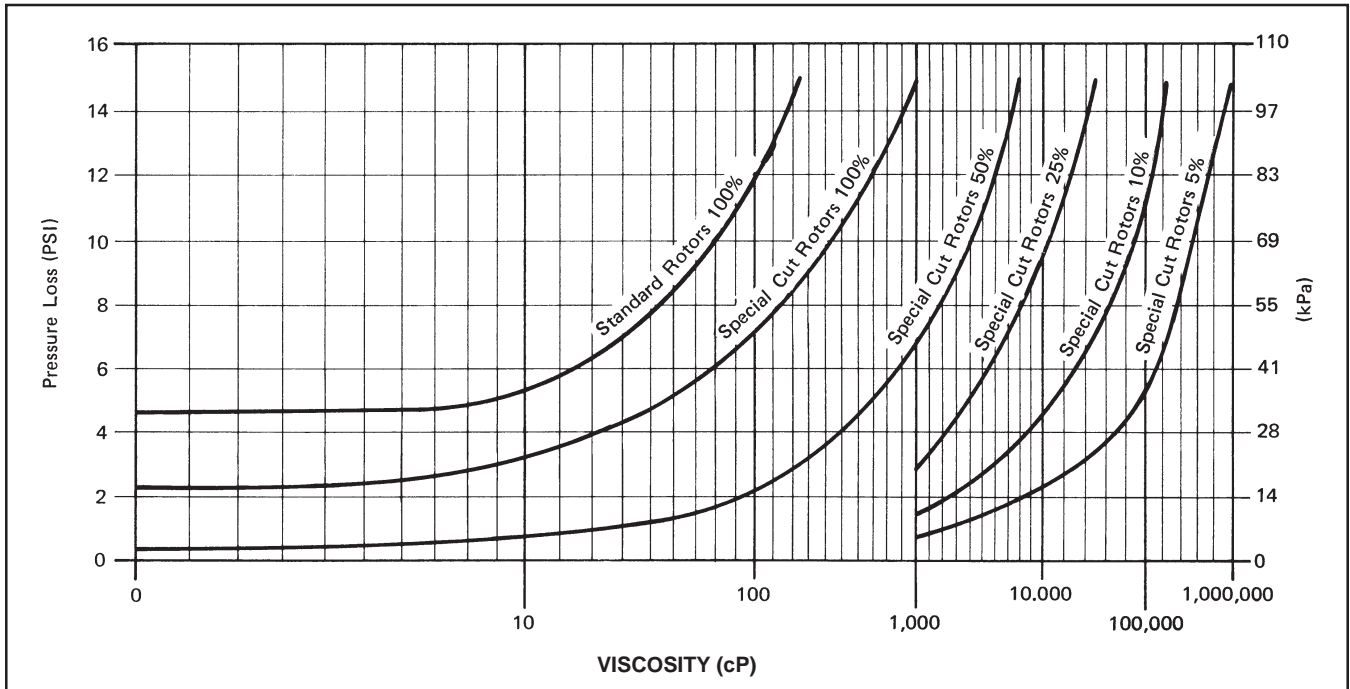
**Table 2 Accuracy vs Pressure Drop**



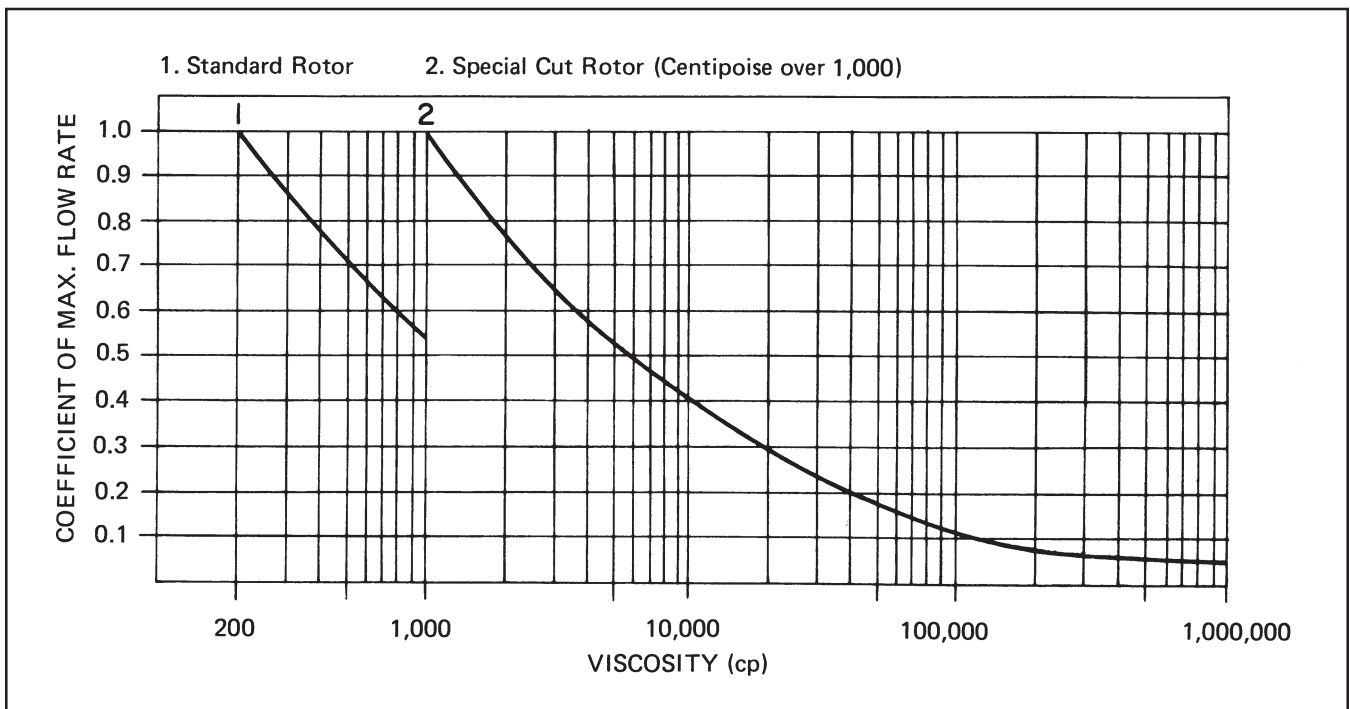
**Table 3 Class "A" Temperature Chart**

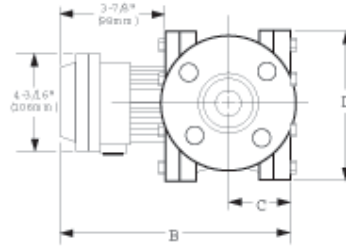
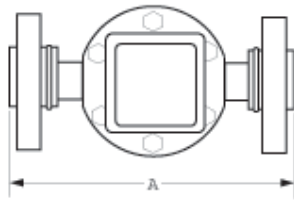


**Table 4 Pressure Loss and Flow Range for High Viscosity Liquids**

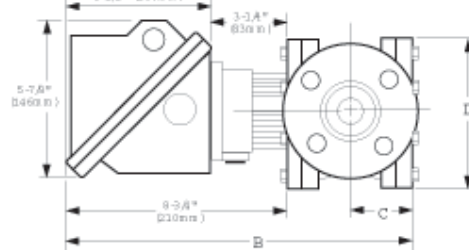
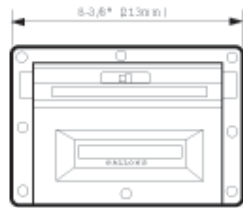
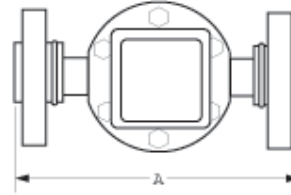


**Table 5 Relationship Between Viscosity and Coefficient of Maximum Flow Rate**





Mounting Dimensions  
Brodie Series 9800 Power Pulse Oval



Mounting Dimensions  
Brodie Series 9800 Power Oval and BERT Electronic Register

**Series 9800 Oval with BERT Electronics**

Model Number	Connection Size (ANSI Flg)	A		B		C		D	
		in.	mm	in.	mm	in.	mm	in.	mm
9852	1/2", 150/300 lb.	8-3/4	222	11-5/8	295	1-7/16	37	5-1/8	130
9853	1", 150/300 lb.	8-3/4	222	12-5/8	321	1-15/16	49	5-1/8	130
9855	1", 150 lb.	8-3/4	222	14-1/8	359	2-11/16	68	6-1/4	158
9855	1", 300 lb.	8-3/4	222	14-1/2	368	2-7/8	73	6-1/4	158
9856	1-1/2", 150 lb.	10	254	15-5/8	397	3-7/16	87	7-1/4	184
9856	1-1/2", 300 lb.	10	254	16-1/8	410	3-11/16	96	7-1/4	184
9857	2", 150 lb.	13-3/4	349	16-3/16	411	3-13/16	99	10	254
9857	2", 300 lb.	13-3/4	349	17-1/4	438	4-1/4	108	10	254
9859	3", 150 lb.	17-3/8	441	18-1/4	463	4-3/4	121	13-3/4	349
9859	3", 300 lb.	17-3/8	441	18-1/4	463	4-3/4	121	13-3/4	349

**Series 9800 Oval with Universal Mounting Box Only**

Model Number	Connection Size (ANSI Flg)	A		B		C		D	
		in.	mm	in.	mm	in.	mm	in.	mm
9852	1/2", 150/300 lb.	8-3/4	222	6-3/4	171	1-7/16	37	5-1/8	130
9853	1", 150/300 lb.	8-3/4	222	7-3/4	196	1-15/16	49	5-1/8	130
9855	1", 150 lb.	8-3/4	222	9-1/4	235	2-11/16	68	6-1/4	158
9855	1", 300 lb.	8-3/4	222	9-5/8	245	2-7/8	73	6-1/4	158
9856	1-1/2", 150 lb.	10	254	10-3/4	273	3-7/16	87	7-1/4	184
9856	1-1/2", 300 lb.	10	254	11-1/4	286	3-11/16	96	7-1/4	184
9857	2", 150 lb.	13-3/4	349	11-1/2	292	3-13/16	99	10	254
9857	2", 300 lb.	13-3/4	349	12-3/8	314	4-1/4	108	10	254
9859	3", 150 lb.	17-3/8	441	13-3/8	340	4-3/4	121	13-3/4	349
9859	3", 300 lb.	17-3/8	441	13-3/8	340	4-3/4	121	13-3/4	349

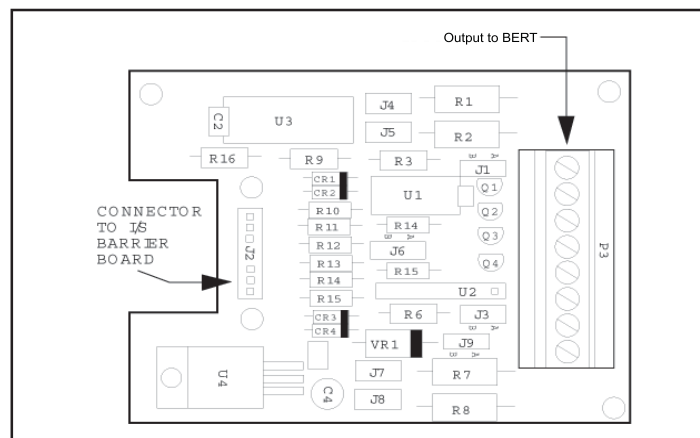
Figure 2 Brodie Series 9800 Power Pulse Oval

**Table 7 Operating Range, Industrial Chemicals**

Operating range as a function of liquid type, viscosity and temperature																		
		Maximum Flow Capacity					Minimum Flow Capacity											
		Liquid Type A B C D E					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	
							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		
9852	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												
9853	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												
9855	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												
9856	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	.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												
9857	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												
9859	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), Perchlroethylene, 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 3 Preamp Board**

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