



Installation & Operation Manual

BiRotor 3" to 6" Positive Displacement Meter



B063A through B095A
B171A through B195A

[High Pressure]
[APL]

Version	PSI	Lb ANSI	3"	4"	6"
High Pressure	285	150	B061A	B081A	B091A
	300	300	B063A	B083A	B093A
	740	300	B064A	B084A	B094A
	1480	600	B065A	B085A	B095A
	284	150	B071A		
	300	300	B073A		
	740	300	B074A		
	1480	600	B075A		
APL	150	150			B190A
	285	150	B171A	B181A	B191A
	300	300	B173A	B183A	B193A
	740	300	B174A	B184A	B194A
	1480	600	B157A	B185A	B195A

Table of Contents

1 Read Me First	3
2 Essential Instructions	4
3 Receipt of Shipment	8
4 Return of Shipment	8
5 Storage	8
6 General	9
7 Meter Description	9
9 Receipt of Shipment	16
10 Storage, Installation And Operation	17
11 Maintenance	19
12 Troubleshooting	31
13 Warranty Claim Procedures	36

1 Read Me First

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Brodie International
Statesboro, Georgia, USA

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2 Essential Instructions

General

Brodie Meter Co., LLC designs, manufactures and tests its products to meet many international standards. As the instruments are sophisticated technical products they must be installed, used and maintained properly to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and incorporated into onsite safety programs where possible.

Read all instructions prior to installing, operating or servicing the product. If the instruction manual is not the correct one telephone +1 912 489 0200. Retain the instruction manual for future reference.

If you do not understand any of the instructions, contact your local Brodie representative for clarification.

Follow all warnings, cautions and instructions marked on or supplied with the product. It is the end users responsibility to operate the instrument with in the specifications as defined with in the instruction manual or marked on the instruments name plates.

Install the equipment as specified in the installation

instructions of the appropriate manual and in accordance to local and national codes.

To ensure proper performance, use qualified personnel to install, operate, program and maintain the product.

Some types of equipment contain Carbon Steel, Cast Iron and/or Aluminium wetted parts, these instruments are not for use on water service.

It is the end users responsibility to assess the surface temperature of the device when it is in service, and if required take the necessary precautions to avoid personnel injury or damage to other equipment.

When replacement parts are required, ensure that qualified people use replacement parts specified by the manufacturer. Unauthorised parts and procedures can affect the products performance and place the safe operation of the process at risk. Look alike substitution may result in explosion, fire, electrical hazards, improper operation or personnel injury.

Use of this equipment for any other purpose than it is intended for may result in property damage and/or serious personal injury or death.

Essential Instructions for Measuring Equipment Including the European Union (Directive 2004/22/EC MID)

Although measurement transducers are not specifically included in the MID regulations as they do not form a complete measuring (system) instrument ref Article 1 and 4, Annex I and Annex MI-005.

Brodie Meter Co., LLC implements the same stringent regulations for all products and tests to the same standards which are used for complete (systems) instruments.

The complete system must contain all the necessary components to meet the requirements of the local regulations. These components may include, pumps, air eliminators, strainers, valves, flow computers, etc.

The unit must be sealed in accordance with the local regulations; it is the end users responsibility to ensure this happens.

Flow measuring devices are provided with two labels which specify flow ranges. The name plate label which includes the factory serial number; details the operating flow range, this is the flow range the device will operate within without causing damage, and the custody transfer label; this label details the working flow range associated with a particular weights and measures approval.

It should be noted that these may not be the same; therefore in trade applications the flow ranges specified on the custody transfer label should be followed.

Essential Instructions for Electrical Equipment Including the European Union (Directive 2004/108/EC and 2004/22/EC)

This unit contains Electrostatic sensitive circuit boards. Electrostatic safety precautions should be taken to prevent damage.

When connecting wiring it is good practice to use shielded cable. The shield should be connected to earth at the read out or control systems end of the cable; the other end of the shield should not be connected.

This wiring practice is mandatory in order to comply with the requirements for electromagnetic compatibility as per the EMC directive 2004/108/EC and MID 2004/22/EC of the council of the European Union.

It is the end users responsibility to ensure that all protective covers are in place to prevent electrical shock and/or personnel injury.

Essential Instructions for Pressure Containing Equipment, Including the European Union (Directive 97/23/EC)

When installing the equipment the bolting must conform to the requirements of ASME B16.5 paragraph 5.3 and to the material requirements of ASME B16.5 Table 1B. Gaskets must conform to the requirements of ASME B16.20.

Although it is not expected for the device to be used in a service where it would come in to contact with unstable fluids, it is the end users responsibility to assess any risks and take any precautions necessary.

It is the end users responsibility to ensure that piping and other attachments connected to the Brodie instrument do not place adverse stresses upon it, the design of the instrument has not been assessed for the effects of traffic, wind or earthquake loadings.

It is the end users responsibility to ensure that the instrument is mounted when required on suitable supporting foundations.

It is the end users responsibility to install the device in a well designed system to avoid potential hazards such as water hammer, vacuum collapse or uncontrolled chemical reactions.

It is the end users responsibility to provide fire protection measures and equipment in accordance with the local regulations.

It is the end users responsibility to install suitable straining and air/gas elimination systems.

The instrument has been designed without allowance for corrosion or other chemical attack. The end user should implement a periodic inspection and maintenance program to ensure that none of the instruments pressure containing components has been subject to any corrosion. It is possible to examine the instrument for evidence of corrosion through the inlet and the outlet.

When the ambient temperature is below the minimum operating temperature specified on the device, it is the end users responsibility to ensure that the device is warmed to an appropriated temperature before being pressurized.

Do not exceed the operating pressure and temperature limits of the instrument as stamped on the nameplates.

It is the customer's responsibility to install this equipment in a system that provides adequate over pressure protection, and that limit pressure surges to 10% of the maximum allowable working pressure of the instrument.

It is the end users responsibility to provide fire protection measures and equipment in accordance with the local regulations.

Essential Instructions for Equipments To Be Used In Hazardous Locations, Including the European Union (Directive 94/9/EC)

Any Hazardous area approval applies to equipment without cable glands. When mounting the flameproof enclosure in a hazardous area only cable glands / conduit seals certified to meet or exceed the rating of the equipment should be used, refer to the type approval documentation for further details. It is the end users responsibility to ensure this happens.

Cable glands and cable must be suitable for the operating temperature of the device under its rated conditions, this is especially important if the device has an operating temperature above 1580F (700C).

The meter has been provided with an approved sealing device in one of the cable entries, the other entry has been closed with a plastic cap plug. It is the end users responsibility to remove the cap plug and replace it with a suitable cable gland or conduit seal before the equipment is put into service.

It is the end users responsibility to ensure when the instrument is located in a hazardous area that all Cable glands and conduit seals must be installed in accordance with the local codes and regulations.

It is the end users responsibility to ensure that before opening an electronic enclosure in a flammable atmosphere; all the electrical circuits must be interrupted.

If replacement of the screws which secure the sensor housing, the UMB cover of the electronic register and its cover are required, they must be replaced with either factory direct parts or M6-1 x 16 (6g) mm hex socket head screws of equal length. The screws must be made from stainless steel grade A1-70 or A2-70 and be torqued to a value of 55 in lbs upon installation, it is the end users responsibility to ensure this happens.

It is the end users responsibility to assess the maximum surface temperature of the device and the equipment the device is attached to and located next to as this may exceed the temperature ratings of the device itself. If this happens, additional safety precautions will need to be implemented by the end user.

Flame proof housings contain Aluminium; although the composition of these enclosures is carefully maintained to prevent any risk of an ignition source it is the end users responsibility to ensure that the housing is not struck by rusty tools or objects.

If the equipment is to be installed in an area where dust deposits and build up are to be expected, a maintenance plan should be arranged to include regular removal of the dust build up. This will prevent the dusts forming a possible source of ignition.

The power supply requirements for this product are specified with in the operating and maintenance manual, it is the end users responsibility to operate the product with in these specified limits.

The instrument contains surfaces that constitute flame paths, these surfaces should not contain any marks or scratches, if any are present the factory or the local representative should be contacted immediately to obtain a new housing as the safety of the enclosure may be impaired. It is the end users responsibility to inspect these surfaces every time the enclosure is opened.

When flanged flame paths are re assembled the gap between them should be less than 0.0015" (0.038 mm) such that a $\frac{1}{16}$ " (12.5mm) wide feeler 0.0015" (0.038mm) gauge will not enter the gap more than 1/8" (3mm). It is the end users responsibility to ensure this happens each time the enclosure is reassembled.

3 Receipt of Shipment

When the instrument is received, inspect the outside of the packing case for any damage that may have occurred during shipment.

Any damage incurred during shipment is the carrier's responsibility and is not part of the factory warranty. If the packing case is damaged notify the carrier immediately and follow their claim procedures.

If the packaging is undamaged locate the envelope containing the packing list, this will generally be

on the outside of the box. Carefully remove all the contents from the packaging checking for any damage. Make certain spare or replacement parts are not discarded with the packing material.

Check the items against the packing list for correct parts and quantities. If any items are incorrect or damage please contact your sales representative immediately, quoting the sales order reference number.

4 Return of Shipment

To be able to process returned goods quickly and efficiently, it is IMPORTANT that you provide essential information. Do not return any assembly or part without an "R.M.A." (Return Material Authorization). A letter describing the problem; corrective action (if any); and the work to be performed at the factory should be included with the shipment. "R.M.A." forms can be obtained from the local Sales Agent or Brodie International.

If an instrument has been exposed to process fluid, in addition to the RMA, a decontamination statement will be required.

A decontamination form is included in the back of this manual.

Note: When an instrument is removed from service it must be thoroughly drained and hazardous substances neutralized. Any material removed from the meter must be disposed of in accordance with local regulations.

Placing the instrument upright on the inlet flange will aid drainage.

Process connections must be sealed to prevent leakage of residual product during shipment. Contact the local carrier for information on requirements.

Any item must be securely packed and larger instruments mounted on wooden pallets or skids for shipment. The exterior of pallet mounted items should be protected by a suitable means such as a wooden crate.

Place a copy of the RMA inside the shipping container and attach it physically to the material being returned. A copy of your packing list should be placed inside an envelope and attached to the outside of the shipping container or placed inside the container.

Failure to follow the above procedures could possibly result in a considerable delay due to improperly or totally unidentified items.

5 Storage

Brodie International instruments are precision devices and should be handled and stored with care. The inlet and outlet covers should remain on the instrument until the unit is ready for installation.

If extended storage is required it is recommend that the instrument be placed in an environmentally controlled warehouse, if it is not possible, the instrument should be stored in a water proof lined wooden box, desiccant packs should be taped to the inside of the

instrument end connections before they are sealed to reduce the effect of humidity, depending on the storage time it may also be preferable to use a compatible corrosion inhibitor.

Care should be taken to remove any storage protection items before installing the instrument.

If an instrument is removed from service for an extended period of time it should be flushed with an appropriate corrosion inhibitor before being place in long term storage as mentioned above.

6 General

The Brodie BiRotor Meter, hereafter called meter, is a precision made, accurate instrument that uses the positive displacement metering principle to measure flow and is designed to meter all petroleum products, crude and refined, as well as industrial liquids.



7 Meter Description

Models B061A through B061A

The meter generally consists of a measuring unit installed in an outer housing or case and adjuster for calibrating the meter and the necessary counter equipment for registering the amount of liquid throughput.

The principle of operation of the meter is embodied in the function of the two rotors which are the only moving parts within the measuring unit. They are always dynamically balanced but hydraulically unbalanced. The rotors are not in metal-to-metal contact with one another or with the housing in which they rotate. They are maintained in proper timed relationship with one another by helical gears. They divide the volume being measured into segments, separate each segment from the flowing stream momentarily, then return them to the stream. The segments of flow are counted and the results are transferred to a totalizing register or other flow recording device by means of a gear train.

The BiRotor Meter is unique in that it does not use any sliding vanes or reciprocating parts nor are there any shock loads on the mechanism during operation resulting from the shifting of offbalance masses.

An accuracy adjuster, located on the output of the counter drive gearing permits the operator, at the time of installation, to adjust the output of the measuring unit to read in an exact number of units of volume. Thus, the accuracy adjuster acts as a variable gear changer (similar to the speeding up or slowing

down of the timing of a watch) and allows an adjustment of $\pm 3\%$ of meter throughput. The meter may be supplied with any of several accessory items such as high frequency pulse generator, impulse contactor, automatic temperature compensator (ATC), etc. The units provide various functions for local and/ or remote control and local and/or remote readout.

Models B171A through B195A

The Brodie Automatic Pressure Lubricated (APL) Bi-Rotor Meter, Models B171A through B195A, is designed to meter liquids with low lubricity such as butane, propane, ethane, natural gasoline or liquids with entrained solids such as crude oil.

Long life and low maintenance are assured with the automatic pressure lubricating system, hereafter called APL, which provides constant clean lubricant to the ball bearings, timing gears and register drive gears of the measuring unit. Bearing and gears are isolated from the flowing stream by mechanical seals.

The meter generally consists of four basic components: a measuring unit installed in an outer housing case, the APL unit to provide bearing and gear lubrication; an adjuster for calibrating the meter and the necessary counter equipment for registering the amount of liquid throughput. The principle of operation of the meter is embodied in the function of the two rotors which are the only moving parts within the measuring unit. They are always dynamically balanced but hydraulically unbalanced. The rotors are not in metal-to-metal contact with one another or with the housing in which they rotate. They are maintained in

proper timed relationship with one another by helical gears. They divide the volume being measured into segments, separate each segment from the flowing stream momentarily, then return them to the stream. The segments of flow are counted and the results are transferred to a totalizing register or other flow recording device by means of a gear train.

The BiRotor Meter is unique in that it does not use any sliding vanes or reciprocating parts nor are there any shock loads on the mechanism during operation resulting from the shifting of offbalance masses.

An accuracy adjustor, located on the output of the counter drive gearing permits the operator, at the time of installation, to adjust the output of the measuring unit to read in an exact number of units of volume. Thus, the accuracy adjustor acts as a variable gear changer (similar to the speeding up or slowing down of the timing of a watch) and allows an adjustment of +3% of meter throughput. The meter may be supplied with any of several accessory items such as high frequency pulse generator, impulse contactor, automatic temperature compensator (ATC), etc. The units provide various functions for local and/or remote control and local and/or remote readout.

Warning

Before placing the meter into service, refer to the appropriate instruction manual for these accessory units if the meter is so equipped.

The meter has an integral positive lubrication system (APL) to supply constant clean lubricant to the meter's bearings, timing gears, counter drive gears and o-rings. The two rotors are the only moving parts subject to the flowing stream. The APL system, as illustrated in Figure 1-1, is composed of a hydraulic cylinder, relief valve, needle valve, filling fittings and mechanical isolating seals.

Hydraulic Cylinder

The hydraulic cylinder incorporated in the APL unit acts as a lubricant reservoir and a segregating element between the product being metered and the lubricant. It contains a piston and a rod that extends through the cylinder top for visual indication of the lubricant level. Upstream pipeline pressure (meter inlet) is applied to the side of the piston opposite the lubricant supply, thus pressurizing the lubricant to a value equal to or slightly greater than the internal meter pressure.

Relief Valve

The relief valve incorporated in the APL unit serves to protect the meter from excessive pressure when charging the APL system with lubricating oil. Should the lubricant pressure exceed pipeline pressure by 30 psi (206 kPa), this valve will open, releasing a small amount of lubricant to atmosphere.

Crane Seals

Mechanical seals located on the rotor shaft between the rotor and rotor bearings segregate the lubricant from the product being metered. The seals are characterized by their ability to remain effective seals with little or not differential pressure and by their low torque requirement. The low torque characteristic is an important factor in providing accurate metering.

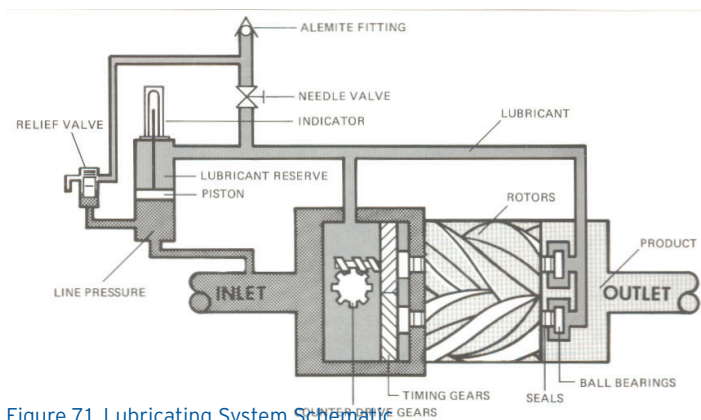


Figure 7.1 Lubricating System Schematic

Needle Valve and Lubricant Fitting

The needle valve is utilized only when necessary to refill the APL with lubricant. A hand pump may be attached to the lubricant fitting, located between the needle valve and relief valve, for recharging the system with lubricant oil. This may be accomplished while the system is under pressure.

Meter Model Number

The model number, serial number, flow range and operating pressure appear on the nameplate attached to the meter body.

Capacities

Model	US GPM	IMP GPM	Bbls/Hr	Cubic Mtr/Hr
B061A B063A B064A B065A	25 to 250	21 to 208	36 to 357	5.7 to 57.8
B071A B073A B074A B075A	42 to 425	35 to 354	61 to 607	9.7 to 96.5
B081A B083A B084A B085A	60 to 600	50 to 500	86 to 857	13.6 to 136.3
B091A B093A B094A B095A	100 to 1,000	83 to 833	143 to 1,493	22.7 to 227
B171A B173A B174A B175A	43 to 425	35 to 350	60 to 607	9.6 to 96.5
B181A B183A B184A B185A	70 to 700	58 to 580	100 to 1000	15.9 to 159
B190A B191A B193A B194A B195A	120 to 1200	100 to 1000	171 to 1714	27 to 273

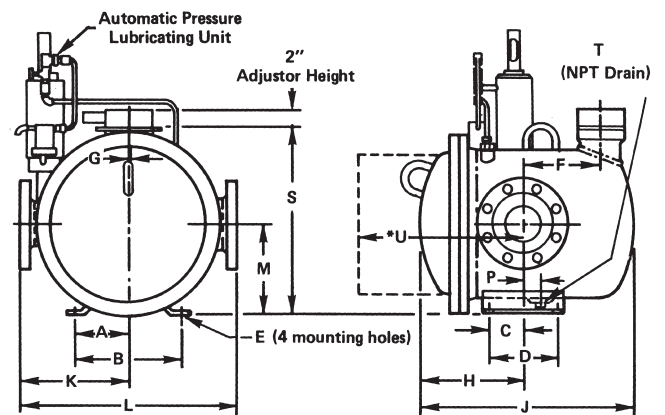
Shipping Weight

Model	Shipping weight
B061A	285 lbs. @ 7.3 Cu. Feet (129 kgs. @ .21 Cu. Meters)
B063A	285 lbs. @ 7.3 Cu. Feet (129 kgs. @ .21 Cu. Meters)
B064A	285 lbs. @ 7.3 Cu. Feet (129 kgs. @ .21 Cu. Meters)
B065A	452 lbs. @ 7.6 Cu. Feet (205 kgs. @ .22 Cu. Meters)
B071A	215 lbs. @ 5.1 Cu. Feet (97 kgs. @ .145 Cu. Meters)
B073A	215 lbs. @ 5.1 Cu. Feet (97 kgs. @ .145 Cu. Meters)
B074A	325 lbs. @ 7.3 Cu. Feet (147 kgs. @ .21 Cu. Meters)
B075A	455 lbs. @ 7.6 Cu. Feet (206 kgs. @ .22 Cu. Meters)
B081A	450 lbs. @ 9.78 Cu. Feet (204 kgs. @ .28 Cu. Meters)
B083A	450 lbs. @ 9.78 Cu. Feet (204 kgs. @ .28 Cu. Meters)
B084A	739 lbs. @ 14.05 Cu. Feet (335 kgs. @ .4 Cu. Meters)
B085A	960 lbs. @ 15 Cu. Feet (435 kgs. @ .42 Cu. Meters)
B091A	758 lbs. @ 21.4 Cu. Feet (344 kgs. @ .68 Cu. Meters)
B093A	758 lbs. @ 21.4 Cu. Feet (344 kgs. @ .68 Cu. Meters)
B094A	1,393 lbs. @ 27.7 Cu. Feet (632 kgs. @ .78 Cu. Meters)
B095A	1,495 lbs. @ 30 Cu. Feet (678 kgs. @ .85 Cu. Meters)
B171A	305 lbs. @ 11 Cu. Feet (138 kgs. @ .31 Cu. Meters)
B173A	305 lbs. @ 11 Cu. Feet (138 kgs. @ .31 Cu. Meters)
B174A	455 lbs. @ 12 Cu. Feet (206 kgs. @ .34 Cu. Meters)
B175A	565 lbs. @ 13 Cu. Feet (256 kgs. @ .37 Cu. Meters)
B181A	535 lbs. @ 20 Cu. Feet (243 kgs. @ .57 Cu. Meters)
B183A	535 lbs. @ 20 Cu. Feet (243 kgs. @ .57 Cu. Meters)
B184A	825 lbs. @ 22 Cu. Feet (374 kgs. @ .62 Cu. Meters)
B185A	915 lbs. @ 22 Cu. Feet (415 kgs. @ .62 Cu. Meters)
B190A	725 lbs. @ 24 Cu. Feet (329 kgs. @ .68 Cu. Meters)
B191A	835 lbs. @ 29 Cu. Feet (379 kgs. @ .82 Cu. Meters)
B193A	835 lbs. @ 29 Cu. Feet (379 kgs. @ .82 Cu. Meters)
B194A	1415 lbs. @ 34 Cu. Feet (642 kgs. @ .96 Cu. Meters)
B195A	1510 lbs. @ 39 Cu. Feet (685 kgs. @ 1.10 Cu. Meters)

Flange Connections

Model	Connections	Max Working Pressure @ 100F (38C)		Max Working Pressure @ 150F (65C)	
		PSI	kPa	PSI	kPa
B061A	3" 150 LB. ANSI	285	1965	272	1875
B063A	3" 300 LB. ANSI	300	2068	300	2068
B064A	3" 300 LB. ANSI	740	5102	707	4874
B065A	3" 600 LB. ANSI	1480	10204	1415	9756
B071A, B171A	3" 150 LB. ANSI	285	1965	272	1875
B073A, B173A	3" 300 LB. ANSI	300	2068	300	2068
B074A, B174	3" 300 LB. ANSI	740	5102	707	4874
B075A, B175A	3" 600 LB. ANSI	1480	10204	1415	9756
B081A, B181A	4" 150 LB. ANSI	285	1965	272	1875
B083A, B183A	4" 300 LB. ANSI	300	2068	300	2068
B084A, B184A	4" 300 LB. ANSI	740	5102	707	4874
B085A, B185A	4" 600 LB. ANSI	1480	10204	1415	9756
B190A	6" 150 LB. ANSI	150	1064		
B091A, B191A	6" 150 LB. ANSI	285	1965	272	1875
B093A, B193A	6" 300 LB. ANSI	300	2068	300	2068
B094A, B194A	6" 300 LB. ANSI	740	5102	707	4874
B095A, B195A	6" 600 LB. ANSI	1480	10204	1405	9756
B095A, B235	16" 600 LB. ANSI	900	6205	900	6205

Certified Dimensions



[See table next page]



Certified Dimensions

Model	Flange Size	mm		Inches		Dimensions		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	R	S	T	U	
B061	3"150lb.	mm	57	mm	114	252	491	-	19	195	-	148	295	225	454	16	-	-	-	-	-	-	-	-	-	-	-	-
		Inches	2 1/4	Inches	4 1/2	9 7/16	18 13/16	-	3/4	7 11/16	-	5 13/16	11 5/8	8 7/8	17 7/8	5/8	-	-	-	-	-	-	-	-	-	-	-	
B063	3"300lb.	mm	57	mm	114	229	473	-	175	195	-	148	295	238	470	16	-	-	-	-	-	-	-	-	-	-	-	
		Inches	2 1/4	Inches	4 1/2	9 3/8	19	-	6 7/8	7 11/16	-	5 13/16	11 5/8	9 3/8	18 1/2	5/8	-	-	-	-	-	-	-	-	-	-	-	
B064	3"300lb.	mm	57	mm	114	229	473	-	175	236	-	160	321	295	571	16	-	-	-	-	-	-	-	-	-	-	-	
		Inches	2 1/2	Inches	5 1/8	10 3/8	20 1/4	-	6 7/8	9 5/16	-	6 5/16	12 5/8	11 5/8	22 1/2	5/8	-	-	-	-	-	-	-	-	-	-	-	
B065	3"600lb.	mm	57	mm	114	229	473	-	175	249	-	160	321	298	597	16	-	-	-	-	-	-	-	-	-	-	-	
		Inches	2 1/2	Inches	5 1/8	22 1/2	22	-	6 7/8	9 13/16	-	6 5/16	12 5/8	11 3/4	23 1/2	5/8	-	-	-	-	-	-	-	-	-	-	-	
B071	3"150lb.	mm	57	mm	114	237	481	-	175	195	-	148	295	225	454	16	-	-	-	-	-	-	-	-	-	-	-	
	ANSI	Inches	2 1/4	Inches	4 1/2	9 1/4	19 1/8	-	6 7/8	7 11/16	-	5 13/16	11 5/8	8 7/8	17 7/8	5/8	-	-	-	-	-	-	-	-	-	-	-	
B073	3"300lb.	mm	57	mm	114	178	329	-	10	195	-	148	295	225	425	16	-	-	-	-	-	-	-	-	-	-	-	
	ANSI	Inches	2 1/4	Inches	4 1/2	9 7/16	19 1/16	-	4 7/8	7 11/16	-	5 13/16	11 5/8	9 3/8	18 1/2	5/8	-	-	-	-	-	-	-	-	-	-	-	
B074	3"300lb.	mm	63	mm	126	263	511	-	175	236	-	160	321	295	571	16	-	-	-	-	-	-	-	-	-	-	-	
	ANSI	Inches	2 1/2	Inches	5 1/8	10 3/8	20 1/4	-	4 5/16	9 5/16	-	6 5/16	12 5/8	11 5/8	22 1/2	5/8	-	-	-	-	-	-	-	-	-	-	-	
B075	3"600lb.	mm	Consult Factory																									
	ANSI	Inches																										
B081	4"150lb.	mm	95	mm	190	295	676	-	533	251	-	148	295	292	584	16	-	-	-	-	-	-	-	-	-	-	-	
		Inches	3 3/4	Inches	7 1/2	11 5/8	23 3/8	-	22 1/2	9 7/8	-	5 13/16	11 5/8	11 1/2	23	5/8	-	-	-	-	-	-	-	-	-	-	-	
B083	4"300lb.	mm	95	mm	191	248	589	-	571	251	-	148	295	300	600	16	-	-	-	-	-	-	-	-	-	-	-	
		Inches	3 3/4	Inches	7 1/2	11 3/16	23	-	22 1/2	9 7/8	-	5 13/16	11 5/8	11 1/2	23 5/8	5/8	-	-	-	-	-	-	-	-	-	-	-	
B084	4"300lb.	mm	102	mm	203	368	668	-	610	300	-	190	381	368	737	16	-	-	-	-	-	-	-	-	-	-	-	
		Inches	4	Inches	8	14 9/16	27 1/4	-	24	11 3/4	-	7 1/2	15	14 1/2	29	5/8	-	-	-	-	-	-	-	-	-	-	-	



Model	Flange Size	mm		Inches		Dimensions		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	R	S	T	U			
B085	4"1600lb.	102	203	4	8	711	408	216	300	190	381	381	381	381	762	22	-	-	-	-	-	-	-	-	-	-	-	-	-	
B090	6"150lb.	781	352	36	13 7/8	432	216	22	268	673	102	203	203	203	414	414	-	-	-	-	-	-	-	-	1060	764	-	-	-	
B091	6"150lb.	781	352	36	13 7/8	432	216	22	268	673	102	203	203	203	414	414	-	-	-	-	-	-	-	-	1060	764	-	-	-	
B093	6"300lb.	794	352	31 1/4	13 7/8	432	216	22	268	698	102	203	203	203	422	422	-	-	-	-	-	-	-	-	1063	768	-	-	-	
B094	6"300lb.	822	381	32 3/8	15	381	195	22	268	762	102	203	203	203	470	470	-	-	-	-	-	-	-	-	1091	886	-	-	-	
B095	6"600lb.	822	381	32 3/8	15	381	195	22	268	787	102	203	203	203	514	514	-	-	-	-	-	-	-	-	1091	930	-	-	-	
B171	3"150lb.	148	295	5 13/16	11 5/8	114	57	17	229	473	470	470	470	470	195	195	-	-	-	-	-	-	-	-	400	-	419	-	-	-
B173	3"300lb.	148	295	5 13/16	11 5/8	114	57	17	229	473	470	470	470	470	195	195	-	-	-	-	-	-	-	-	400	-	419	-	-	-
B174	3"300lb.	160	321	6 5/16	12 5/8	127	64	17	264	511	572	572	572	572	237	237	-	-	-	-	-	-	-	-	441	-	457	-	-	-
B175	3"600lb.	160	321	6 5/16	12 5/8	127	64	17	281	519	597	597	597	597	249	249	-	-	-	-	-	-	-	-	454	-	464	-	-	-
B181, B183	4"150lb.	148	295	5 13/16	11 5/8	191	863	-	287	589	600	600	600	600	251	251	-	-	-	-	-	-	-	-	524	-	472	-	-	-
B183	4"300lb.	148	295	5 13/16	11 5/8	191	863	-	287	589	600	600	600	600	251	251	-	-	-	-	-	-	-	-	524	-	472	-	-	-
B184	4"300lb.	191	381	7 1/2	3	203	102	-	367	668	737	737	737	737	300	300	-	-	-	-	-	-	-	-	567	-	610	-	-	-



Model	Flange Size	mm	Dimensions		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	R	S	T	U
			Inches	mm																				
B185	4"1600lb.		191	381	102	203	22	216	-	406	-	711	381	762	300	-	106	-	567	-	622			
			Inches	7 1/2	4	8	7/8	8 1/2	-	16 1/6	-	28	15	30	11 13/16	-	4 3/16	-	22 5/16	-	24 1/2			
B190	6"150lb.		216	432	102	203	22	268	10	414	10	764	387	762	352	-	152	-	735	-	673			
			Inches	8 1/2	4	8	7/8	10 9/16	3/8	16 5/16	-	30 1/16	15 1/4	30	13 7/8	-	6	-	28 15/16	-	11/2			
B191	6"150lb.		Consult Factory																					
			mm																					
			Inches																					
B193	6"300lb.		216	432	102	203	22	268	10	414	10	764	387	762	352	-	152	-	735	-	673			
			Inches	8 1/2	4	8	7/8	10 9/16	3/8	16 5/16	-	30 1/16	15 1/4	30	13 7/8	-	6	-	28 15/16	-	26 1/2			
B194	6"300lb.		195	391	102	203	22	268	10	471	10	886	438	379	381	-	127	-	760	-	762			
	ANSI		Inches	7 11/16	4	8	7/8	10 9/16	3/8	18 9/16	-	34 7/8	17 1/4	34 5/8	15	-	5	-	29 15/16	-	30			
B195	6"600lb.		195	291	102	203	22	268	10	516	10	830	457	914	381	-	127	-	760	-	787			
	ANSI		Inches	7 11/16	4	8	7/8	20 9/16	3/8	10 5/16	-	36 5/8	18	36	15	-	5	-	29 15/16	-	31			

8 Specifications

The following specifications apply to the meter unless otherwise noted.

WARNING

Do NOT operate this instrument in excess of the specifications listed. Failure to heed this warning could result in serious injury and/or damage to the equipment.

Materials of Construction		
Housing	Welded steel construction combining steel castings and draw steel plate.	
Measuring Unit	Rotors	Three lobe, cast iron or four fluted, heat treated aluminum.
	Rotor Shafts	Ground and polished nitralloy
	Rotor Bearings	Stainless Steel
	Body and End Covers	Nickel cast iron
Counter Base Plate	Body	Steel
	O-Ring	Viton standard
	Counter Base Drive Gears	Stainless Steel
	Drive Shafts	Stainless Steel
	Drive Shaft Ball Bearing	Stainless Steel
Connections	3", 4", or 6" ANSI Flange	

9 Receipt of Shipment

When you receive your meter, inspect the outside of the packing case for damage which may have incurred during shipping. **Damage incurred during shipment is the responsibility of the carrier and is not part of the factory warranty.** If the package is in good condition remove the envelope containing the packing list and carefully remove the meter and all components included in the shipment from the packing case. Inspect for damaged or missing parts, referring to the packing list, and prior to discarding the packing material. If items are missing from your shipment, contact your sales representative. Your sales order number will be required.

If the packing case is damaged, notify the local carrier immediately. If the meter must be returned to the factory for repair or replacement, a Returned Materials Report (RMR) must be included with the meter or components. RMR forms may be obtained from your sales representative or from the Product Service Department. In addition to the RMR, a Material Safety

Data Sheet and a Decontamination Statement must be included with items being returned to the factory.

A Decontamination Statement is included in the back of this manual (see page 30).

If the meter is removed from service it must be thoroughly drained and neutralized before it is packed for shipment. Care must be taken to ensure that product removed from the meter is disposed of in accordance with all applicable local, state and federal regulations.

NOTE:

Place the meter on the inlet flange to completely drain the meter of fluid.

The flanges should be sealed to keep residual fluid from leaking out of the meter during transport. The type of flange seal required will vary with the form of transportation used. Contact the carrier for specific instructions.

The meter should be securely mounted on a wooden skid for shipment. The original container or a solid wooden box should be used to protect the exterior of the meter.

When packing the meter or components for return to the factory, place the RMR and a copy of the packing list that was delivered with the meter inside an envelope. Place the envelope inside the shipping container with the item being returned and reference the RMR number on the outside of the shipping container.

Equipment returned to the factory without the proper documentation will be returned to sender at their expense.

Ship the container to:

Brodie Meter Co., LLC
Product Service Department
19267 Hwy. 301 North
Statesboro, GA 30461
Phone: 912-489-0200
Fax: 912-489-0294
service@brodiemeter.com

10 Storage, Installation And Operation

General

The following is a general outline for the proper storage, shipment, installation, and start up of any Brodie BiRotor meter. Additional information on the proper use of Positive Displacement Meters can be obtained from API Standard 1101 -Measurement of Petroleum Liquid Hydrocarbons by Positive Displacement Meter.

Storage

Brodie meters are precision instruments and should be handled with care. They should not be subjected to rough or improper handling or stored in an environment where moisture, extreme temperatures, or foreign material can damage the meter.

Flange covers must remain on the meter until it is ready for installation.

If extended storage is anticipated under harsh field conditions the meters should be stored in waterproof lined wooden boxes. Desiccant packs should be taped to the inside of the meter flanges to reduce the effects of humidity on the measuring element. Caution must be used to insure the desiccant packs are removed prior to installation.

If the meter is removed from service for an extended period of time it should be flushed with a light oil before being placed into storage. The meter flanges should be securely covered.

Installation

WARNING

Compounds used in the making of elastomer gaskets, O-Rings and seals will, by nature, deteriorate over an extended period of time. This is dependent on elastomer material, frequency of operation and the product being measured. Extreme caution should be used when measuring volatile liquids or when using a meter that has been stored for an extended period of time. Loss of seal integrity can result in leakage, damage to the equipment and/or personal injury.

1. The BiRotor meter should be mounted on a secure foundation. Considerations for placement of a right angle adaptor and meter weight must be made when vertical installation is required.
2. Care should be taken to insure that the drain plug remains accessible. A valve may be installed on the drain line to facilitate draining of water and sediment from the meter. A lockable valve is recommended to reduce the chance of accidentally draining the meter. **Any product drained from the meter, either manually or through a centralized drain system, must be disposed of in accordance with all local, state, and federal laws.**
3. Skid foundations and process piping must be properly secured in order to minimize line vibration at the meter.

4. Process piping should not place undue strain on the meter.
5. Provisions should be made to insure that thermal expansion does not raise line pressure above the maximum pressure rating of the meter.
6. All process piping should be clean and free of debris to insure foreign material does not enter the meter.
7. A flow limiting valve should be installed downstream of the meter to maintain adequate back pressure and to protect the meter from excessive flow rates.
8. If require, an air eliminator should be installed upstream of the meter.
9. Do not allow water to remain in the meter. If water has entered the meter remove the inner unit and clean it with a light lubricating oil.
10. Standard flow through the meter is from left to right. If right to left flow is required, consult your local Brodie agent or an authorized repair center.
11. The bolt pattern on the meter accessories allows the meter accessory stack to be rotated in 90 degree increments. The required position should be selected prior to installing electrical service to the meter. Care should be taken not to damage the capillary tube on the temperature compensator if so equipped.
12. Isolation valves should be installed on both ends of the meter run to minimize product loss when removing any of the components from the line.

Operation

CAUTION

Do not operate this meter in excess of the values stated in 8 Specifications.

Brodie Meter Co., LLC has highly qualified service technicians who are available to provide start up assistance. Contact Brodie or your local Brodie Authorized Repair Center if service assistance is required.

Starting Flow Through the Meter

The following recommendations should be considered when the meter is first put into operation or any time that the meter has been drained.

1. If large volumes of debris are expected in the process piping during start up it is recommended that the measuring element be removed from the meter until the lines are free of pipe scale, weld beads and other types of foreign material. A spool piece may be used as a temporary replacement for the meter. **The strainer basket should be removed to eliminate the possibility of rupturing.**
2. Slowly introduce product into the meter. Open the upstream valve while the downstream valve remains closed.
3. Slowly bleed air from the system through the high point vent.
4. Once all air has been eliminated, slowly open the downstream valve. Allow the meter to run at approximately 20 percent of the maximum rated flow for two minutes. Observe the rotation of the counter wheels to insure the meter is operating smoothly. Continue opening the downstream valve until it is fully open. **Care should be taken to insure the maximum flow rate of the meter is not exceeded.** Confirm that the setting on the flow control valve is properly fixed and is in control of the system.
5. Do not close valves quickly. This can cause a pressure spike which can damage the meter.
6. Do not make adjustments to the meter or its accessories while the meter is turning. When adjuster settings are changed, a small batch should be run through the meter prior to making the next proving run. This allows the adjuster components to shift to the new setting.
7. Prove the meter in order to establish a meter factor under actual operating conditions. Proving records and other pertinent meter data should be retained in order to establish a performance history for the meter.

11 Maintenance

WARNING

Extreme care must be exercised when the measuring chamber is exposed and handled. Hands must be kept clear of the timing gears, rotors and measuring chamber or serious personal injury can occur. Due to the precision balance of the rotors and timing gears, they can be set in motion easily. Keep hands clear of these parts at all times! At no time should hands be used to brace these

11.1 General

The amount of maintenance necessary for efficient meter performance depends upon such factors as:

1. Continuity of Operation - A meter which operates almost continuously, obviously will require more attention than one on intermittent duty.
2. Rate of Flow - The practical life of any piece of equipment is proportional to its speed of operation. A meter operating at, or close to, its maximum rating will naturally have a shorter life than one operating at a reduced rate.
3. Lubricating Value of Product - Other factors being equal, a meter handling a light lubricating oil will have a longer life than one measuring a dry motor fuel.
4. Cleanliness of Product - Abrasive solid matter accelerates meter wear.

Meters that are given a little attention regularly will deliver better performance and have a longer life than those that are not given any attention until they have failed. Frequently, a meter's performance will depend, to a considerable extent, upon the proper functioning of the accessory equipment in the piping system. Following are listed some of the conditions and factors influencing meter performance:

1. A meter should be kept filled with the liquid it is measuring. Draining results in the formation of deposits and gums which increase the mechanical friction. Any leaky shut-off valves or check valves which would permit the meter to drain should be repaired or replaced.

2. A petroleum meter should be kept free of water. Usually, regular inspection and draining of storage tanks are sufficient protection.
3. Clean the strainer basket frequently.
4. Soft closing loading valves or shock chambers for eliminating water hammer should be kept in good working order.
5. The valves and operating mechanism of an air eliminator should be given occasional inspection. This is especially true where a critical air condition exists and for this reason, meter performance is very dependent upon proper air elimination. The valves and operating mechanism of an air eliminator are subject to very difficult operating conditions. With some products, alternate wetting and drying results in gum formations. The vapors of most petroleum products are more corrosive than the liquids. In some installations, salt air is a corrosive factor.
6. The counter of the meter should be given some protection during extreme weather conditions.
7. A meter taken out of service for any length of time should be filled with light lubricating oil.
8. Keep Brodie manuals available for reference.

11.2 General Meter Disassembly

CAUTION

Before performing any disassembly or reassembly procedures, all flow to meter should be off. All electrical connections to accessories should be disconnected. Service should be performed by trained and qualified personnel only.

Cleanliness is of prime importance when working on a precision instrument. The work area should be clean and the meter parts thoroughly washed. All gaskets and O-ring should be removed and replaced. This policy will assure maximum performance from your Brodie BiRotor Meter at less expense and with greater accuracy.

WARNING

Verify that all pipeline/process fluid has been removed from the meter. Failure to release pressure prior to servicing meter may result in personal injury and/or damage to meter.

11.3 Removing Measuring Unit - Models B061A-B095A

1. Remove all accessories.
2. Remove drain plug (item 22), drain meter and replace plug.
3. Remove adjuster (item 31) and counter base plate assembly (item 27) by removing screws (items 35 and 28).
4. Remove nuts (item 16) to allow separation of housing cover (item 4) from meter housing (item 20).

NOTE: Use care not to damage front dome gasket (item 19) when separating the front dome (item 4) from the meter housing (item 20).

5. Remove screws (item 3), washer (item 42) and seal washer (item 43) attaching measuring unit assembly (item 1) to meter housing (item 20).
6. Lift measuring unit assembly (item 1) out of the meter housing.
7. The measuring unit may now be inspected. In some cases, a thorough washing in cleaning solvent or kerosene will be sufficient to free the rotors of corrosion or foreign material and the unit may be re-installed without further disassembly. In the event the rotors are blocked with solid matter, it will be necessary to remove the rotors and rear end cover assembly for further cleaning.

11.4 Removing Measuring Unit - Models B171-B195

1. Remove all accessories.
2. Remove pipe plug (item 22), drain meter and replace pipe plug.
3. Remove adjuster (item 31) and counter base plate assembly (item 27) by removing screws (items 35 and 28).

NOTE:

Do not damage counter base plate gasket (item 26) when lifting off the counter base plate.

4. Lift out static seal tube (item 45) with attached O-ring (item 52) from meter housing (item 20).
5. Disconnect tubing (item 46) connected to APL Unit (item 50) and remove.
6. Remove nuts (item 16) to allow separation of housing cover (item 4) from meter housing (item 20).

NOTE:

Use care not to damage front dome gasket (item 19) when separating the front dome (item 4) from the meter housing (item 20).

7. Remove tubing (item 46) attached to measuring unit (item 1) and meter housing (item 20) by disconnecting tubing at the connectors.
8. Remove screws (item 3), washer (item 42) and seal washer (item 43) attaching measuring unit assembly (item 1) to meter housing (item 20).
9. Lift measuring unit assembly (item 1) out of the meter housing.
10. The measuring unit may now be inspected. In some cases, a thorough washing in cleaning solvent or kerosene will be sufficient to free the rotors of corrosion or foreign material and the unit may be re-installed without further disassembly. In the event the rotors are blocked with solid matter, it will be necessary to remove the rotors and rear end cover assembly for further cleaning.

11.5 Disassembly of Measuring Units

WARNING

Extreme care must be exercised when the measuring chamber is exposed and handled. Hands must be kept clear of the timing gears, rotors and measuring chamber or serious personal injury can occur. Due to the precision balance of the rotors and timing gears, they can be set in motion easily. Keep hands clear of these parts at all times! At no time should hands be used to brace these

Disassembly - Models B061A-B095A

1. Place measuring unit in wooden cradle as illustrated in Figure 11-1. Orient measuring unit with front end cover (item 4) upward.

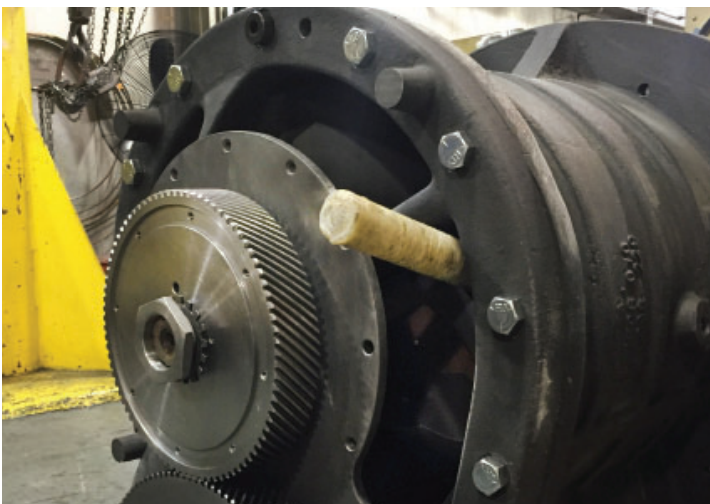


Figure 11-1 Proper Method for Blocking Rotors

2. Remove the two bearing retainer caps (items 46 or 48), screws (item 8) and bearings (item 6).

NOTE: Do not remove front end cover (item 4).

3. Rotate the measuring unit and remove screws (items 1 and 381). This will enable removing the rear gear cover assembly (item 21).
4. Remove screws (item 5) and separate rear end cover (item 15) from body (item 3).
5. The rotors and rear end cover assembly can now be washed thoroughly with solvent or kerosene and inspected. If the rotors show no evidence of contact with each other, and if the timing gears appear satisfactory, further disassembly will not be necessary.

Removing Timing Gears and Rotors

6. Remove screw (item 43) and locknut retainer (item 421).
7. Place a small piece of rubber between the timing gears (items 17 and 32) and remove locknuts (items 19 and 41) and lock washer (item 40).
8. Timing gears are taper fitted to the shafts and can be removed one at a time by striking the face of the gear inside the teeth with a plastic hammer. Be careful not to damage the rotor shaft threads when removing the timing gears. Remove screw (Item 26) and separate mounting plate (Item 23) from the end plate.
9. Remove bearings retainer (item 11) and bearings (item 6) from rear end cover.

NOTE: Ball bearings (item 6) can be removed from end covers by gently tapping or pressing on the inner race of the ball bearings from inside the end covers.

10. Separate rotors (items 13 and 33) and rear end cover (item 15). Be careful when removing rotor spacing springs (item 34).

NOTE: Rotor spacing springs (item 34) used on B-160A thru B-180A Meters ONLY.

11. Remove front end cover (item 4) and bearings (item 6).

Cleaning Measuring Unit

12. Scored metal should be removed with a scraper or file. Remove only the high points and do not remove any more metal than necessary.
13. Polish rotors with crows cloth and wash carefully in solvent or kerosene to remove all particles of grit or metal.
14. File lightly the end covers (items 4 and 15) to remove any burrs or high spots. Use fine sandpaper to remove corrosion and burrs from the surface of the bores that carry the bearings.
15. Ball bearings should be cleaned and inspected for wear.
16. All gears and shafts in rear gear cover assembly (item 2) should be inspected. Check all o-rings and gaskets for wear and replace where necessary.

NOTE: Wash all parts thoroughly in solvent, light fuel oil or kerosene. Dry thoroughly with compressed air and/or with lint free wipers.

Disassembly - Models B171A-B195A

1. Place measuring unit in wooden cradle as illustrated in Figure 4-1. Orient measuring unit with front end cover (item 4) upward.
2. Disconnect and remove tubing (item 67) attached between the front bearing caps (items 46 and/or 48) and the rear gear cover assembly (item 2).
3. Remove the two bearing retainer caps (items 46 or 48), by removing screws (item 47) and lock-washers (item 21).

NOTE: Remove gasket or O-ring (item 60) and inspect for damage

4. Remove screws (Items 10, 17 and/or 42) and bear-

ing retainer (Item 18). On the 113505-030 measuring unit, remove the drive adaptor (Item 11). Do not remove front end plate (Item 3) at this time.

Disassembly - 203505-030 & 223505-030

1. Position measuring unit assembly in a wooden support block with the gear box assembly downward.
2. Disconnect and remove tubing (Item 49) attached between the front bearing caps (Item 6) and the rear gear box assembly (Item 5).
3. Remove screws and washers (Items 8 and 38) then remove front bearing caps (Item 6).
4. Block rotors with a plastic or wooden rod as illustrated in Figure 11-1.
5. Separate bearing retainer (item 7) from end of rotor shafts by removing screws (item 8).
6. Remove ball bearings (item 6), seal retainer (item 62) and crane seals (item 57).

NOTE: Do not remove front end cover (item 4). Ball bearings (item 6) can be removed from end cover by gently tapping or pressing on the inner race of the ball bearings from inside the end cover. Use care not to damage crane seals (item 57) when removing ball bearings.

7. Rotate the measuring unit and remove screws (items 1 and 66). This will enable removing the rear gear cover assembly (item 2).
8. Remove screws (item 5) and separate rear end cover (item 15) from body (item 3).
9. The rotors and rear end cover assembly can now be washed thoroughly with solvent or kerosene and inspected. If the rotors show no evidence of contact with each other, and if the timing gears appear satisfactory, further disassembly will not be necessary.

Removing Timing Gear and Rotors

9. (Measuring Unit Part Numbers 172205 and 182105) Remove screw (item 43) and locknut retainer (item 42).
 10. Place a small piece of rubber between the timing gears (items 17 and 32) and remove locknuts (items 19 and 41) and lockwasher (item 40). Bend tab on lockwasher to remove locknuts.
 11. Timing gears are taper fitted to the shafts and can be removed one at a time by striking the face of the gear inside the teeth with a plastic hammer. Be careful not to damage the rotor shaft threads when removing the timing gears.
 13. Remove rotor spacers (item 16), ball bearings (item 6) seal retainers (item 62) and crane seals (item 53).
- NOTE:** Ball bearings (item 6) can be removed from end covers by gently tapping or pressing on the inner race of the ball bearings from inside the end covers. Use care not to damage crane seals (item 57) when removing ball bearings.
14. Separate rotors (items 13 and 33) from the front end cover (item 5) and remove front end cover from meter housing.

Cleaning Measuring Unit

15. Scored metal should be removed with a scraper or file. Remove only the high points and do not remove any more metal than necessary.
16. Polish rotors with crocos cloth and wash carefully in solvent or kerosene to remove all particles of grit or metal.
17. File lightly the end cover (items 4 and 15) to remove any burrs or high spots. Use fine sandpaper to remove corrosion and burrs from the surface of the bores that carry the bearings.
18. Ball bearings should be cleaned and inspected for wear.
19. All gears and shafts in rear gear cover assembly (item 2) should be inspected. Check all O-rings and gaskets for wear and replace where necessary.

NOTE: Wash all parts thoroughly in solvent, light fuel oil or kerosene. Dry thoroughly with compressed air and/or with lint free wipers.

Assembly - Models B061A-B095A

1. Lubricate all bearings and o-rings with a light weight oil.
2. Position measuring unit body (item 3) in wooden cradle and attach front end plate (item 4) by installing screws (items 5 and 12).

1. Rotate measuring unit body in cradle and replace rotors (items 13 and 33) in proper slots with the tapered end of the rotors upward.
2. Slide on rotor spacing springs (item 34) over the taper shaft of the rotors and attach rear end plate (item 15) by installing screws (item 5).

NOTE: Rotor spacing springs (item 34) are not used on the 92205 Measuring Unit.

3. Install ball bearings (item 6) within the bearing bore of the rear end plate (item 15).

NOTE: Slot in outer race of ball bearing (item 6) must align with roll pin (item 45) in bottom of bearing bore.

8. Position a bearing retainer (item 11) over each ball bearing (item 6) and attach by installing lock washers (item 9) and screws (item 10). The above items are not carried by the 92205 Measuring Unit.
9. Replace spacer key (item 16), timing gears (items 17 and 32), locknut retainer (item 42), lock washer (item 44) and screw (item 43). The large timing gear fits on the 4T rotor.

NOTE: Short tab on the spacer key fits in the inner race of the ball bearings and the long tab seats into slot on the timing gears.

10. Replace lock washer (item 40) and locknuts (items 19 and 41).

Note:

Tab on washer (item 40) must seat into slot on timing gears.

11. Rotate body and install bearings (item 6), bearing key (item 36), snap ring (item 7), lock washer (item 37) and screws (item 8) onto front end cover (item 4).

Note:

Tab on bearing key (item 36) must seat into slot on inner race of ball bearing.

13. Measuring Unit must have rotor clearance as described in Sections 4-7 and 4-8.

11.7 Reassembly of Measuring Unit

Models B101-B135 (Refer to Figures 6-3, 6-4, 6-5 and 6-6)

1. Lubricate all bearings and O-rings with a light-weight oil.
2. Oil dowel screws (Item 4) and replace front end plate (Item 3) on opposite end from timing gears. Replace screws (Item 22).
3. Rotate housing body (Item 2) and replace rotors (Item 1 & 21) in proper slots with the taper ends of the rotors up. (Figure 11-3/4-5 and 11-4/4-6)
4. Replace rear end plate (Item 3). Oil dowel screws (Item 4) and screws (Item 22) before replacing. (Figure 11-5/4-7).
5. Install bearings (Item 12) into bearing bore provided in end plate. (Figure 11-6/4-9)

NOTE: Slot on outer race of ball bearing must engage with roll pin (Item 14) in the end plate (See Figure 11-7/4-11).

6. Replace mounting plate (Item 23) and screws (Item 26).

NOTE:

The wide end of the mounting plate (Item 23) mounts over the 4T Rotor (Item 21).

7. Replace rotor spacer (Item 27) and timing gears (Items 20 & 28).

NOTE:

Bearing dowel on the rotor spacer fits on the inner race of the ball bearing and outer dowel must seat into slot located on the timing gear.

NOTE:

The large timing gear fits on the 4T Rotor and the small timing gear fits on the 3T Rotor. (Figure 11-8/4-13).

8. Replace lock washers (Item 31) and jam nuts (Item 30).

NOTE: Tab on washer (item 31) must seat into slot on timing gears. (Figure 11-9/4-12).

9. Rotate body (Item 2) and install the ball bearings (Item 12) into bearing bore in the end plate.

NOTE: Slot on outer race of ball bearing must engage with roll pin (Item 14) in the end plate.

10. Replace bearing retainer (Item 18). Measuring unit 113505-030 will use one bearing retainer and one drive adaptor (Item 11) on the three tooth rotor. The rest require two bearing retainers each.

NOTE: The dowel on the bearing retainer or the drive adaptor will fit on the inner race of the ball bearing.

11. Measuring unit 103505-030 will require two screws (Item 17) and two washers (Item 16) to hold bearing retainer in place.

NOTE: Measuring unit 113505-030 will require replacing one screw (Item 10) on the 3T Rotor and one screw (Item 17) and washer (Item 16) on the four tooth rotor.

Measuring unit 123505-030 has two nuts (Item 42).

Measuring unit 133505-030 has two different size screws. The four tooth rotor has four screws (Item 17) and washers (Item 16). Place two of (Items 17 & 16) opposite each other on the three tooth rotor. Now replace the two long screws (Item 47), drive keys (Item 46) and washers (Item 16).

Models B201-B235 (Refer to Figures 6-3, 6-4, 6-5 and 6-6)

1. Lubricate all bearings and O-rings with a light-weight oil.
2. Replace front end plate (Item 3) on opposite end from timing gears. Align the port openings of the front end plate (Item 3) with those of the meter body (Item 2) using care to align the two locating dowel screws (Item 4) with their corresponding holes (Figure 11-7/4-11).
3. Secure the front end plate (Item 3) to the body by the two dowel screws and install the socket head screws (Item 22), alternating from one side to another when tightening.
4. Replace crane seal (Item 44) with rubber face downward (Figure 11-10/4-4).

NOTE: The polished steel ring (Figure 11-5/4-7) portion of the crane seal can be installed more conveniently in a later operation.

5. Position bearing thrust washer (Item 13) over the crane seal (Figure 11-3/4-5).

NOTE: The inside holes of the thrust washer (Item 13) fit onto the dowels of the crane seal and the outside hole fits over the roll pin (Item 14 and/or 9) as shown in Figure 11-11/4-16.

6. Install ball bearing (Item 12) within bearing bore of the end plate (Figure 11-4/4-6). Press into place using a sleeve or deep socket until ball bearings (Item 12) are bottomed.

NOTE: Slot on outer race of ball bearing must align with roll pin (Item 14 and/or 9) in the end plate (Figure 4-16). A special adaptor can be made to fit over the bearings (indicated by arrow on Figure 4-15) to hold in place.

7. Rotate the housing body (Item 2). Slide on each end of the rotors (Items 1 & 21) the polished steel ring (Figure 11-5/4-7) that goes to the crane seal (Item 44).
8. Insert the rotors (Items 1 & 21) into proper slots so that the threaded, tapered rotor shafts protrude from the open end of the measuring unit body (Figure 11-6/4-9).
9. Align the port openings of the end plate (Item 3) with those of the measuring unit body (Item 2) using care to align the two locating dowel screws (Item 4) with their corresponding holes. Secure the end plate (Item 3) to the measuring unit body by the two dowel screws (Item 4) and install the socket head screws (Item 22) alternating from one side to another when tightening (Figures 11-12/4-10 and 11-7/4-11).
10. Rotate measuring unit and replace crane seal (Item 44) with rubber face downward (Figure 11-10/4-4).
11. Position bearing thrust washer (Item 13) over the crane seal (Figure 11-3/4-5).

NOTE: The inner holes on the thrust washer (Item 13) fits over the dowels on the crane seal and the outer hole fits into the roll pin as illustrated in Figure 11-11/4-16.

12. Install ball bearing (Item 12) within bearing bore of the end plate (Figure 4-6). Press into place using a sleeve or deep socket until ball bearings (item 12) are bottomed.

NOTE: Slot on outer race of ball bearing must align with roll pin in the end plate (Figure 4-16).

13. Replace mounting plate (Item 23), secure with screws (Item 26) and washers (Item 38, Figure 4-12). NOTE: The wide end of the mounting plate (Item 23) mounts over the four tooth (4T) Rotor (Item 21).

14. Replace rotor spacer (Item 27, Figure 4-13).

NOTE: Make certain the short roll pin on the rotor spacer mates properly into the slot on the inner race of the ball bearing.

15. Place the small timing gear (Item 20) on the threaded shaft of the three-tooth (3T) rotor (Item 1) and the large timing gear (Item 28) on the threaded shaft of the 4T rotor (Item 21). The rotor shafts and timing gear bores are tapered allowing only one manner of assembly.

NOTE: Back out the set screws (Item 15) so that the timing gears will be flushed when installed. The long roll pin on the rotor spacer mates with the hole in the timing gear.

16. Install lockwasher (Item 31) over rotor shafts engaging bent tab of lockwasher with hole in the flat side of timing gears. Secure lockwasher by installing jam nuts (Item 30, Figure 4-14).
17. The measuring unit can now be laid on its side for better access or further reassembly.
18. Replace bearing retainer (Item 18) on the 4T and 3T rotors. All measuring units will require two bearing retainers except the measuring unit assembly number 213505-030 which has one bearing retainer (Item 18) and one drive adaptor (Item 11) on the 3T rotor.

NOTE: The dowel on the bearing retainer or drive adaptor will mate with the slot on the inner race of the ball bearings.

19. To secure the bearing dowels, each measuring unit is listed below:

- A. Measuring unit 203505-030 has two screws and two washers (Items 16 & 17).
- B. Measuring unit 213505-030 will require replacing one screw (Item 10) on the 3T rotor and one screw and one washer (items 16 & 17) on the 4T rotor.
- C. Measuring unit 223505-030 has two nuts (Item 42).
- D. Measuring unit 233505-030 has two different size screws. The 4T rotor has four screws (Item 17) and washers (Item 16). Place two screws and washers opposite each other on the 3T rotor. Now replace the two long screws (Item 47), drive key (Item 46) and washers (Item 16). See figure 4-15 for illustration.

- 4. With bearing retainer screws or nuts (Items 10, 17, 42 or 47) tight, tighten the set screws in the retainers to obtain a clearance of .0004 between each rotor and end plate.

NOTE: Measuring unit 113505-030 will have one retainer and one drive adaptor.

NOTE: Bend two tabs of lock washer (Item 31) against side of jam nut (Item 30) to secure jam nut.

Models B201 - B235

- 1. Adjust the two set screws located on each of the drive gears (Items 20 and 28) until both rotors (items 1 and 21) are flush with the backside of the rear end plate (Item 3).
- 2. Insert a shim into the outlet port located on the front end plate (Item 3) and determine the total distance between the backside of the front end plate and the 3T rotor (Item 1). Repeat this procedure for the 4T rotor (Item 21).
- 3. Adjust the two set screws located on the small drive gear (Item 20) until the distance between the backside of the front end plate (Item 3) and the 3T rotor is half of the total distance determined. Repeat this procedure for the large drive gear (Item 28) and the 4T rotor (Item 21).
- 4. If end clearance is adjusted properly, rotors will spin freely with the meter in any position. If rotors fail to spin freely, repeat procedure for setting end clearance.

11.8 Setting End Clearance (Refer to Figure 4-3)

Models B101 - B135

The following procedure is applicable if clearance between the rotors and end plate requires adjustment.

- 1. Loosen set screws (Item 15) in the bearing retainer and tighten screws or nuts (Items 10, 17, 42 or 47), pulling the rotors against the front end plate (Item 3).

NOTE: Refer to correct measuring unit assembly for the correct nut or screw.

- 2. Determine the clearance between the rotors and rear end cover (Item 3) with a feeler gauge. For example, .0008.
- 3. With timing gear jam nuts (Item 3) tight, tighten set screws (Item 37) in each timing gear unit until a clearance of .0004 is obtained between each rotor and rear end plate. (See Figure 4-4).

NOTE: The set screws on the 133505-030 measuring unit will be Item 15.

11.9 Timing Gear Adjustment (refer to Figure 4-2)

Models B101 - B135

1. Loosen the jam nut (Item 30) on the large timing gear (Item 28) and with feeler gauge or shims, carefully centralize a lobe of the three tooth rotor in a flute of the four tooth rotor. This may be done through the inlet and outlet openings of the unit.
2. Using a small piece of rubber between the timing gears, tighten the jam nut, remove shims and check for freeness of operation.
3. If the rotors contact one another, the timing operation must be repeated.
4. If the rotors were damaged, it will sometimes be found that all of the high spots were not removed. In such cases, it is necessary to find these spots and remove them.

Models B201 - B235

1. Loosen the jam nut (item 30) on the large timing gear (Item 28) and, with feeler gauge or shims, carefully centralize the lobe of the 3T rotor in a flute of the 4T rotor.
2. Determine the total distance between the lobe and flute of the two rotors. Set the rotor clearance to one half of the total distance using the appropriate shim.

NOTE:

This may be done through the inlet and outlet openings of the unit.

3. Using a piece of rubber between the timing gears, tighten the jam nut (Item 30), remove shim and check for freeness of operation. If the rotors contact one another, the timing operation must be repeated.
4. If the rotors were damaged, it will sometimes be found that all of the high spots were not removed. In such cases, it is necessary to find these spots and remove them.

5. When rotor timing is completed, bend two tabs of lockwasher (Item 31) against side of jam nut (Item 30). This will secure the jam nut.

11.10 Completion of Measuring Unit Reassembly and Installing into Meter (refer to Figures 6-1 - 6-5)

Models B101 - B135

1. Replace gear box assembly (Item 5).

NOTE:

Roll pin on gear box assembly (Item 5) must engage with coupling jaw (Item 40) or the drive key (Item 46).

2. Replace front bearing caps (Item 6), washers (Item 38) and screws (Item 8). The 113505-030 and 133505-030 measuring units use screws (Figure 6-3, Item 35) on the four tooth rotor gearing cap.
3. Connect the measuring unit (Figure 6-1, Item 23) to the end cover (Item 1) with socket head screws (Item 24).
4. Replace meter housing (Item 4) and O-ring (Item 5).

NOTE:

A light film of grease will aid in holding O-ring in place.

5. Rotate the coupling tube on the pinion shaft assembly of the counter base plate assembly (Item 6) until the drive pin is positioned the same as the slot of the coupling jaw on the gear box assembly.
6. Reinstall other accessories.

Models B201 - B235

Measuring unit 213505-030 and 233505-030, refer to Figures 6-4 and 6-6.

1. Replace top gear cover (Item 25), secure with screws (Item 29).
2. Replace gear box assembly (Item 5) gasket (Item 7 and 55) and front bearing cap (Item 6)

3. Replace gear box assembly (Item 5) gasket (Item 7 and 55) and front bearing cap (item 6). Secure the above on the 3T rotor with screws (item 8) and washers (Item 36). The bearing cap will attach to the end plate over the 4T rotor with screws (Item 35) and washers (Item 36).
7. Replace tubing and connect the APL unit (Item 23) to meter housing.
8. Reinstall other accessories.
9. Refill APL unit with lubricating oil.

NOTE:

The gear box assembly must mate correctly with the connection on the 3T rotor.

Measuring unit 203505-030 and 223505-030, refer to Figure 6-3.

1. Replace gear box assembly (Item 5), gasket (item 24) and secure with screws (Item 22).
2. Replace front bearing caps (Item 6), gasket (Item 7) and secure with screws and washers (Items 38 and 8).
3. Attach piping to the measuring unit (Item 23, Fig. 6-5).
4. Connect the measuring unit (Item 35) to the end cover (item 1) with socket head screws (Items 36, Figure 4-17). Replace meter housing (Item 4) and O-ring (Item 5). Secure with nuts and bolts (items 2 and 3, Figures 4-18 and 4-19).

NOTE:

A light film of grease will aid in holding O-ring in place.

5. Replace static seal tube (Item 19) with attached O-ring (Item 20).
6. Replace the counter base plate (item 6).

NOTE:

Rotate the coupling tube on the pinion shaft assembly of the counter base plate assembly (Item 6) until the drive pin is positioned the same as the slot of the coupling jaw on the gear box assembly.

11.11 Filling APL Unit with Lubricating Oil (refer to Figure 6-6)

Lubricating oil used in the APL unit should be a good quality SAE ten weight non-detergent oil. Select a hand oil pump with a mating connection able to connect to the alemite fitting (Item 7) on the APL unit.

1. Connect oil pump to alemite fitting (Item 7) on the APL unit. Open the needle valve (Item 6).
2. Fill the APL unit until the external relief valve (Item 12) opens and allows lubricating oil to be expelled to the atmosphere.

NOTE:

The APL unit can be filled with lubricating oil whether the meter system is in service or not.

3. Close relief valve (Item 12) and disconnect oil pump from alemite fitting (item 7).

NOTE:

The indication rod is now at the bottom mark groove located on the hydraulic cylinder (Item 1). This indicates that the APL unit is full of lubricating oil. When the indication rod is located near the top mark groove on the hydraulic cylinder (Item 1) the APL unit is low of lubricating oil and should be refilled as described above.

11.12 Torque Specifications

Meter	Number	Torque
B101, B201	2	110
	36	110
B103, B203	2	110
	36	110
B104, B204	2	300
	36	110
B105, B205	2	800
	36	110
B111, B211	2	110
	36	110
B113, B213	2	110
	36	110
B114, B214	2	300
	36	110
B115, B215	2	800
	36	110
B111, B221	2	235
	36	400
B113, B223	2	235
	36	400
B124, B224	2	635
	36	400
B125, B225	2	C/F
	36	C/F
B133, B233	2	300
	36	1500
B131, B231	2	300
	36	1500
B134, B234	2	725
	36	1500
B135, B235	2	900
	36	1500

12 Troubleshooting

Table 12.1 has been provided to aid in basic troubleshooting. Disassembly procedures are covered in Section 11 Maintenance. If the flowmeter is found to be in need of repair, it is important that servicing be performed by trained and qualified service personnel and it is recommended the user contact the Brodie Meter Co., LLC Repair Department.

Symptom	Possible Cause	Service Required
Meter runs but counter does not register.	Faulty Register.	Remove register and see if output shaft on adjustor rotates with metered fluid flow. If output shaft on adjustor rotates, replace register.
	Faulty adjustor or broken coupling between adjustor and counter base plate.	Remove adjustor and verify if output shaft on counter base plate rotates with metered fluid flow. If output shaft of counter base plate assembly rotates, then inspect the following: <ol style="list-style-type: none"> 1. Check coupling on input shaft of adjustor to see if it's broken. If broken, replace coupling. 2. If coupling is not broken, replace adjustor.
Meter runs but is noisy.	Meter is not timed properly.	Check rotor clearances as described in Section 11-8. If discrepancy is found, re-time rotors.
	Damaged rotors.	Remove rotors as described in Section 11.5. If rotors are scored or galled, clean them as described in Section 11.6. If rotors are damaged beyond repair, replace with a new set. Install rotors as described in Section 11.7.
	Worn ball bearings.	Remove ball bearings as described in Section 11.5. Check to see if ball bearings turn freely with no free play. If discrepancy is found, replace ball bearings and install as described.
	Damaged gears in counter base plate assembly.	Disassemble counter base plate assembly. Check for worn or damaged gears. Replace gears as necessary and re-assemble.

Figure 12.1 Basic Troubleshooting Guide

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Appendix A

Decontamination Statement

RMA Number: _____

Item Being Returned: _____

List all chemicals, process fluids and gases that have come in contact with the equipment, including cleaning agents. Attach additional pages of information if necessary. A Material Safety Data Sheet (MSDS) is required if non-food grade products have been used with the item being returned.

Information Required	Product 1	Product 2
Chemical Name		
Health and Safety Hazards		
Precautions, First Aid		

I hereby certify the equipment being returned has been cleaned and decontaminated in accordance with good industrial practices and in compliance with OSHA and DOT regulations. This equipment poses no health or safety risks due to contamination.

Signature: _____

Name (Please Print): _____

Title: _____

Company Name: _____

Phone Number: _____

Fax: _____

E-mail: _____

Reason for Return: _____

REMINDER

All items being returned must be packaged separately. This decontamination statement and the MSDS sheet(s) must be placed on the outside of the shipping container.

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Appendix B

Customer Problem Report

For faster service, complete this form and return it along with the affected equipment to customer service at the address indicated below. If you require technical assistance, please contact the Product Service Department at the phone number listed below.

Company Name: _____ Phone: _____

Technical Contact: _____

Repair PO#: _____

Invoice Address: _____

Shipping Address: _____

Return Shipping Method: _____ S/N: _____

Equipment Model #: _____ Failure Date: _____

Description of Problem: _____

What was happening at time of failure: _____

Additional Comments: _____

Report Prepared by: _____ Title: _____

13 Warranty Claim Procedures

3.1 - Limited Warranty

Brodie Meter Co., LLC ("Brodie") warrants the Goods-manufactured by Brodie will be free from defects in materials or workmanship under normal use and care until the expiration of the applicable warranty period.

Goods are warranted for twelve (12) months from the date of installation and 18 months from date of shipment, whichever occurs first. Consumables and Services are warranted for a period of 90 days from the date of shipment or completion of the Services.

Products purchased by Brodie from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer.

Buyer agrees that Brodie has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products.

If Buyer discovers any warranty defects and notifies Brodie thereof in writing during the applicable warranty period, Brodie shall, at its option, repair or replace, that portion of the Goods found by Brodie to be defective or refund the purchase price of the defective portion of the Goods/Services.

All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources, unsuitable environmental conditions, accident, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Brodie, are not covered by this limited warranty, and shall be at Buyer's expense.

Brodie shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by an authorized Brodie representative.

All costs of dismantling, reinstallation and freight and the time and expenses of Brodie's personnel for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Brodie.

Brodie is not responsible for damages that incur during shipment to Buyer for shipments that are F.O.B. Brodie Factory, FCA Brodie Factory, or EX-WORKS Brodie Factory. Shipping charges for goods returned to Brodie under warranty will be at Buyer's expense.

Products found not to be warranted can be repaired and returned at Buyer's expense and return charges born by Brodie will be added to the cost of repair or returned to Buyer "as received" at Buyer's expense. Insurance for returned products will be at Buyer's expense.

For all returned products please package to prevent damage, or future damage during shipment. Make sure the products are cleaned, free from grease oil, chemicals and other materials that may hamper defect detection and impede repair.

All returned items must be accompanied with a MSDS for the products that have been in contact with the equipment, including cleaning agents. A decontamination statement, RMA, and Customer Problem Report must also accompany equipment returned. Product received in an unsuitable condition will be returned at Buyer's expense without being examined.

Goods repaired, and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer.

This limited warranty is the only warranty made by Brodie and can be amended only in a writing signed by an authorized representative of Brodie. Except as otherwise expressly provided in the Agreement, there are no representations or warranties of any kind, expressed or implied, as to merchantability, fitness for a particular purpose, or any other matter with respect to any of the goods or services.

It is understood that corrosion or erosion of materials is not covered by our guarantee unless the Buyer has notified the Seller the product will be used in an environment conducive to corrosion and/or erosion and the product has been coated with Brodie's recommended method of protection against corrosion / erosion.

13.2 - Limitation of Remedy and Liability

Brodie International, a Brodie Meter Co., LLC Company ("Brodie") shall not be liable for damages caused by delay in performance.

The sole and exclusive remedy for breach of warranty hereunder shall be limited to repair, correction, replacement or refund of purchase price under the limited warranty clause in Section 1 herein.

In no event, regardless of the form of the claim or cause of action (whether based in contract, infringement, negligence, strict liability, other tort or

otherwise), shall "Brodie's" liability to buyer and/or its customers exceed the price to buyer of the specific goods manufactured or services provided by Brodie giving rise to the claim or cause of action.

Buyer agrees that in no event shall Brodie's liability to buyer and/or its customers extend to include incidental, consequential or punitive damages.

The term "consequential damages" shall include, but not be limited to, loss of anticipated profits, loss of use, loss of revenue and cost of capital.

Brodie International

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