

X-BM101/235
Revision 02

BiRotor Meter Models B-101 through B-135 APL BiRotor Meter Models B-201 through B-235

Installation and Operation Manual



Brodie Meter Co., LLC

19267 Highway 301 North (30461)
PO Box 450
Statesboro, GA 30459-0450

Phone: (912) 489-0200
Fax: (912) 489-0294
www.brodiemeter.com

Manufacturers of BiRotors and Oval Gear Meters

Essential Instructions

Brodie Meter Co., LLC designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using and maintaining Brodie Meter Co., LLC products.

- Read all instructions prior to installing, operating, and servicing the product. If this instruction manual is not the correct manual, telephone 1-912-489-0200 and the requested manual will be provided. Save this instruction manual for future reference.
- If you do not understand any of the instructions, contact your Brodie representative for clarification.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.
- Install your equipment as specified in the installation instructions of the appropriate instruction manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by the manufacturer. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look-alike substitutions may result in fire, electrical hazards, or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.
- When installing this equipment, 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.
- It is the customer's responsibility to ensure that piping or other attachments connected to the BiRotor Meter do not place adverse stresses on the BiRotor Meter. The design of the BiRotor Meter has not been assessed for the effects of traffic, wind or earthquake loading.
- It is the customer's responsibility to provide fire prevention measures and equipment per local regulations.
- The BiRotor Meter has been designed without allowance for corrosion. The customer should implement a periodic inspection and maintenance program to ensure that no part of the BiRotor Meter's pressure-retaining components has been subjected to corrosion.
- Use of this equipment for any purpose other than its intended purpose may result in property damage and/or serious personal injury or death.

WARNING

Do not exceed the maximum working pressure of BiRotor Meter as stamped on the nameplates. It is the customer's responsibility to install this equipment in a system that provides adequate over-pressure protection.

NOTICE

Lines should be flushed thoroughly to rid piping of potentially damaging foreign material such as welding bead, pipe scale, etc. before the BiRotor Meter is placed into service. A strainer of proper size should be installed upstream of the BiRotor Meter to protect it from the introduction of foreign material.

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Statesboro, Georgia, USA**

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1.0 Introduction

1.1 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.

1.2 Meter Description

Models B101 through B135

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 off-balance 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 B201 through B235

The Brodie Automatic Pressure Lubricated (APL) BiRotor Meter, Models B201 through B235, 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.

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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 $\pm 3\%$ 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.

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.

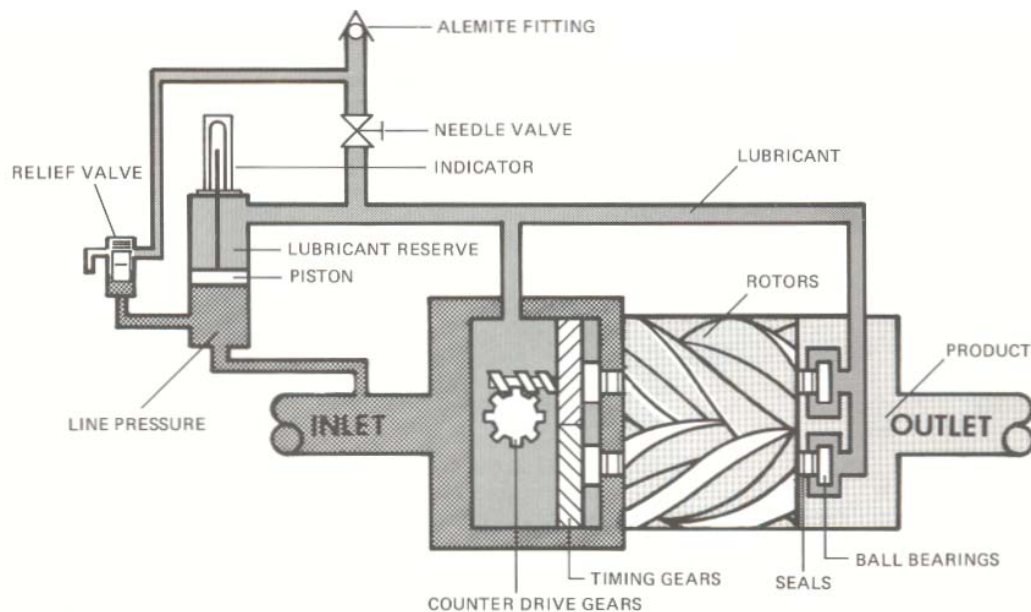
Relief Valve

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 1.1 Lubricating System Schematic



Capacities

Model	US GPM	IMP GPM	Bbls/Hr	Cubic Mtr/Hr
B101 B103 B104 B105	150 to 1,500	125 to 1,249	214 to 2,143	34 to 340
B111 B113 B114 B115	250 to 2,500	208 to 2,082	357 to 3,571	57 to 568
B121 B123 B124 B125	350 to 3,500	291 to 2,914	500 to 5,000	79 to 795
B131 B133 B134 B135	875 to 8,750	729 to 7,290	1,250 to 12,500	199 to 1,986
B201 B203 B204 B205	210 to 2,100	175 to 1,750	300 to 3,000	47 to 470
B211 B213 B214 B215	330 to 3,300	275 to 2,750	470 to 4,700	75 to 750
B221 B223 B224 B225	437 to 4,375	364 to 3,640	625 to 6,250	99 to 999
B231 B233 B234 B235	910 to 9,100	758 to 7,580	1,300 to 13,000	207 to 2,070

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.

1.3 Meter Model Number

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

Shipping Weight and Volume

Model	Weight and Volume
B101, B201	842 lbs. @ 20.7 Cu. Feet (382 kgs. @ .58 Cu. Meters)
B103, B203	898 lbs. @ 20.7 Cu. Feet (407 kgs. @ .58 Cu. Meters)
B104, B204	1,275 lbs. @ 23.1 Cu. Feet (578 kgs. @ .65 Cu. Meters)
B105, B205	1,766 lbs. @ 24.1 Cu. Feet (801 kgs. @ .68 Cu. Meters)
B111, B211	1,294 lbs. @ 24.5 Cu. Feet (587 kgs. @ .69 Cu. Meters)
B113, B213	1,368 lbs. @ 24.5 Cu. Feet (620 kgs. @ .69 Cu. Meters)
B114, B214	1,623 lbs. @ 27.6 Cu. Feet (736 kgs. @ .78 Cu. Meters)
B115, B215	2,475 lbs. @ 29.7 Cu. Feet (1,122 kgs. @ .84 Cu. Meters)
B111, B221	3,050 lbs. @ 48 Cu. Feet (1,383 kgs. @ 1.36 Cu. Meters)
B113, B223	3,154 lbs. @ 48 Cu. Feet (1,430 kgs. @ 1.36 Cu. Meters)
B124, B224	3,495 lbs. @ 49 Cu. Feet (1,585 kgs. @ 1.38 Cu. Meters)
B125, B225	4,895 lbs. @ 51 Cu. Feet (2,220 kgs. @ 1.44 Cu. Meters)
B131, B231	8,500 lbs. @ 136 Cu. Feet (3,855 kgs. @ 3.85 Cu. Meters)
B133, B233	8,650 lbs. @ 136 Cu. Feet (3,923 kgs. @ 3.84 Cu. Meters)
B134, B234	8,900 lbs. @ 136 Cu. Feet (4,036 kgs. @ 3.84 Cu. Meters)
B135, B235	9,000 lbs. @ 136 Cu. Feet (4,090 kgs. @ 3.84 Cu. Meters)

Connections

Model	Connections	Max Working Pressure @ 100F (38C)		Max Working Pressure @ 150F (65C)	
		PSI	kPa	PSI	kPa
B101, B201	8" 150 LB. ANSI	285	1965	272	1875
B103, B203	8" 300 LB. ANSI	300	2068	300	2068
B104, B204	8" 300 LB. ANSI	740	5102	707	4874
B105, B205	8" 600 LB. ANSI	1480	10204	1415	9756
B111, B211	10" 150 LB. ANSI	285	1965	272	1875
B113, B213	10" 300 LB. ANSI	300	2068	300	2068
B114, B214	10" 300 LB. ANSI	740	5102	707	4874
B115, B215	10" 600 LB. ANSI	1480	10204	1415	9756
B111, B221	12" 150 LB. ANSI	285	1965	272	1875
B113, B223	12" 300 LB. ANSI	300	2068	300	2068
B124, B224	12" 300 LB. ANSI	740	5102	707	4874
B125, B225	12" 600 LB. ANSI	1480	10204	1415	9756
B131, B231	16" 150 LB. ANSI	285	1965	272	1875
B133, B233	16" 300 LB. ANSI	300	2068	300	2068
B134, B234	16" 300 LB. ANSI	740	5102	707	4874
B135, B235	16" 600 LB. ANSI	900	6205	900	6205

Figure 1.4 Typical Accuracy Curve

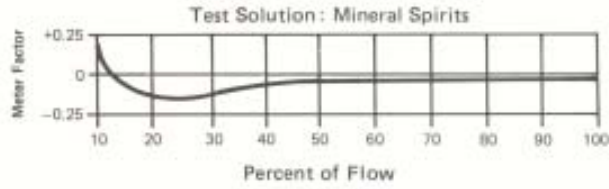


Figure 1.4 Typical Pressure Drop

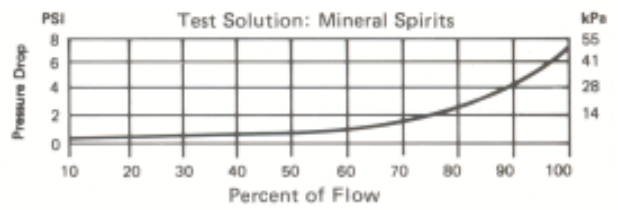
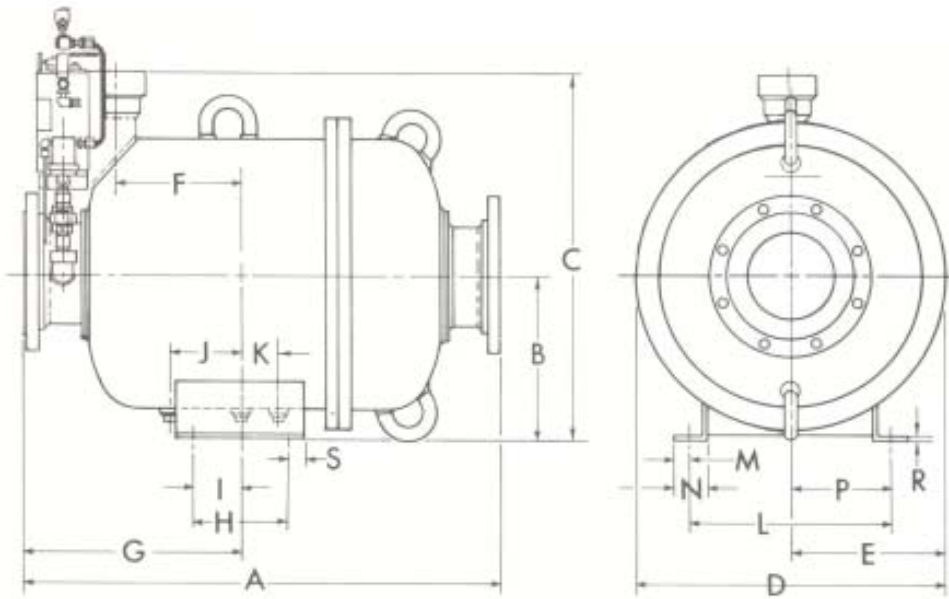


Figure 1.4 Certified Dimensions



Model	Flange Size	mm	Dimensions														
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	P
B101, B201	8"150lb.	mm	1016	352	792	686	343	257	468	203	-	152	-	432	36	76	216
		Inches	40	13 7/8	31 3/16	27	13 1/2	10 1/8	18 7/16	8	-	6	-	17	1 7/16	3	8 1/2
B103, B203	8"300lb.	mm	1035	352	792	686	343	257	478	203	-	152	-	432	36	76	216
		Inches	40 3/4	13 7/8	31 3/16	27	13 1/2	10 1/8	18 13/16	8	-	6	-	17	1 7/16	3	8 1/2
B104, B204	8"300lb.	mm	1137	378	810	730	365	246	527	203	-	127	-	432	36	76	216
		Inches	44 3/4	14 7/8	31 7/8	28 3/4	14 3/8	9 11/16	20 3/4	8	-	5	-	17	1 7/16	3	8 1/2
B105, B205	8"600lb.	mm	1194	375	806	737	368	208	521	203	-	108	-	432	36	76	216
		Inches	47	14 3/4	31 3/4	29	14 1/2	8 3/16	20 1/2	8	-	4 1/2	-	17	1 7/16	3	8 1/2
B111, B211	10"150lb.	mm	1067	352	792	686	343	257	468	20	-	152	-	432	36	76	216
		Inches	42	13 7/8	31 3/16	27	13 1/2	10 1/8	18 7/16	8	-	6	-	17	1 7/16	3	8 1/2
B113, B213	10"300lb.	mm	1099	352	792	686	343	257	484	20	-	152	-	432	36	76	216
		Inches	43 1/4	13 7/8	31 3/16	27	13 1/2	10 1/8	19 1/16	8	-	6	-	17	1 7/16	3	8 1/2
B114, B214	10"300lb.	mm	1270	378	810	730	365	246	594	20	-	127	-	432	36	76	216
		Inches	50	14 7/8	31 7/8	28 3/4	14 3/8	9 11/16	23 3/8	8	-	7	-	17	1 7/16	3	8 1/2
B115, B215	10"600lb.	mm	1270	375	806	737	368	208	559	20	-	108	-	432	36	76	216
		Inches	50	14 3/4	31 3/4	29	14 1/2	8 3/16	22	8	-	4 1/4	-	17	1 7/16	3	8 1/2
B111, B221	12"150lb.	mm	1422	533	1057	1010	505	306	632	483	-	-	79	533	41	10	267
		Inches	56	21	41 5/8	39 3/4	19 7/8	12 1/16	24 7/8	19	-	-	3 1/8	21	1 5/8	4	10 1/2
B113, B223	12"300lb.	mm	1454	533	1057	1010	505	306	648	483	-	-	79	533	41	10	267
		Inches	57 1/4	21	41 5/8	39 3/4	19 7/8	12 1/16	25 1/2	19	-	-	3 1/8	21	1 5/8	4	10 1/2
B124, B224	12"300lb.	mm	1549	533	1099	1016	508	319	660	432	-	-	79	533	41	10	267
		Inches	61	21	43 1/4	40	20	12 9/16	26	17	-	-	3 1/8	21	1 5/8	4	10 1/2
B125, B225	Consult Factory																
B133, B233	16"150lb.	mm	1880	711	1480	1372	68	425	813	483	241	-	-	603	41	10	302
		Inches	74	28	58 1/4	54	27	16 3/4	32	19	9 1/2	-	-	23 3/4	1 5/8	4	11 7/8
B131, B231	16"300lb.	mm	1918	711	1480	1372	68	425	832	483	241	-	-	603	41	10	302
		Inches	75 1/2	28	58 1/4	54	27	16 3/4	32 3/4	19	9 1/2	-	-	23 3/4	1 5/8	4	11 7/8
B134, B234	16"300lb.	mm	1981	711	1480	1372	68	425	864	483	241	-	-	603	41	10	302
		Inches	78	28	58 1/4	54	27	16 3/4	34	19	9 1/2	-	-	23 3/4	1 5/8	4	11 7/8
B135, B235	16"600lb.	mm	1981	711	1480	1372	68	425	864	483	241	-	-	603	41	10	302
		Inches	78	28	58 1/4	54	27	16 3/4	34	19	9 1/2	-	-	23 3/4	1 5/8	4	11 7/8

1.4 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 drawn steel plate.

Measuring Unit

Rotors: Three lobe, cast iron or four fluted, heat treated aluminum

Rotor Shafts: ground and polished ETD 150

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

Connection: 8", 10", 12" or 16" ANSI Flange

Product Temperature Range: -20° to 150°F (-29° to 66°C)

2.0 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 Appendix A).

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

3.0 Storage, Installation And Operation

3.1 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.

3.2 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.

3.3 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 insure the drain plug remains accessible.
 - A. A valve may be installed on the drain line to facilitate draining water and sediment from the meter. A lockable valve is recommended to reduce the chance of accidentally draining the meter.
 - B. Any product drained from the meter, either manually or through a centralized drain system, must be disposed of in accordance with 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 must be clean and free of debris to insure foreign material does not enter the meter. For continuous protection a strainer should be installed upstream of 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 required, 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 belt 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 compensatory 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.

3.4 Operation

CAUTION

Do not operate this meter in excess of the values stated in 1.4 Specifications.

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.

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.

4.0 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 parts while servicing.

4.1 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.

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.

4.2 General Meter Disassembly

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.

Removing Measuring Unit - Models B101-B135

1. Remove drain plug (Item 18), drain meter and replace plug.
2. Remove all accessories, including adjustor (Item 10) and counter base plate (Item 6) by removing screws (Items 9 and 17).
3. Remove meter from line to allow for further disassembly.
4. Remove nuts and bolts (Items 2 & 3) to allow separation of housing end cover (Item 1) from the meter housing (Item 4).
5. Disconnect the measuring unit (Item 23) from the end cover (Item 1) by removing socket head screws (Item 24).
6. The measuring unit may now be inspected. In some cases, a thorough washing in a cleaning solvent or kerosene will be sufficient to free the rotors of corrosion or foreign material and the unit may be reinstalled without further disassembly. In the event the rotors are blocked with solid matter, it will be necessary to remove the rotors and gear box assembly for further cleaning.

Removing Measuring Unit - Models B201-B235

1. Remove drain plug (Item 18), drain meter and replace plug.
2. Remove all accessories, including adjustor (Item 10) and counter base plate (Item 6) by removing screws (Items 9 and 17).
3. Lift out static seal tube (Item 19) with attached o-ring (Item 20) from meter housing (Item 4).
4. Disconnect tubing (Item 24) connected to APL Unit (item 23). Remove APL Unit from meter by unscrewing nipple (Item 28).
5. Remove nuts and bolts (Items 2 & 3) to allow separation of housing end cover (Item 1) from the meter housing (Item 4).
6. Remove tubing attached to measuring unit (Item 35) and meter housing (Item 4) by disconnecting tubing (Item 22) at the connectors.
7. Disconnect the measuring unit (Item 23) from the end cover (Item 1) by removing socket head screws (Item 24).
8. The measuring unit may now be inspected. In some cases, a thorough washing in a cleaning solvent or kerosene will be sufficient to free the rotors of corrosion or foreign material and the unit may be reinstalled without further

disassembly. In the event the rotors are blocked with solid matter, it will be necessary to remove the rotors and gear box assembly for further cleaning.

WARNING

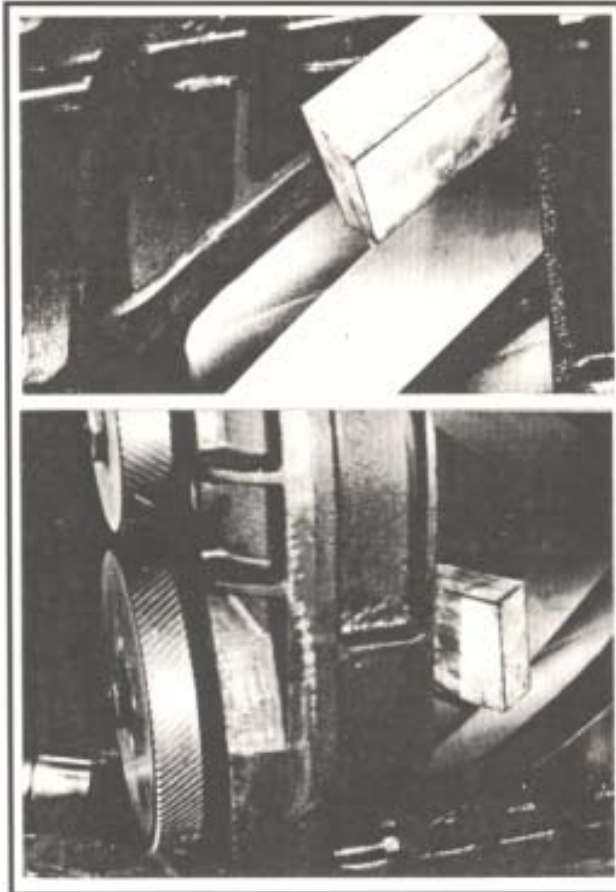
Extreme care must be exercised when the measuring chamber is exposed and handled. Hands must be kept clear of the timing gears, rotors and measuring chamber or serious personal injury can occur. Due to the precision balance of the rotors and timing gears, they can be set in motion easily. Keep hands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

4.3 Disassembly of Measuring Units

Disassembly - 103505-030 and 123505-030

1. Position measuring unit assembly in a wooden support block with the gear box assembly

Figure 4.1 Proper Method for Blocking Rotors



2. Remove screws and washers (Items 8 and 38) then remove front bearing caps (Item 6).
3. Block rotors with a plastic or wooden rod as illustrated in Figure 4.1.
4. Remove screws or nuts (Items 17 or 42) and bearing retainer (Item 18). Do not remove front end plate (Item 3) at this time.
5. Rotate measuring unit body (Item 2) so that front of housing rests on wooden support blocks and Gear box assembly (Item 5) is upward.
6. Remove gear box assembly (Item 5) by removing screws (Item 29).
7. Remove drive gears (Item 20 and 28) from each rotor shaft by removing jam nut (Item 30). To aid in removal, lightly tap the gears on a flat surface with a plastic or rubber mallet.

NOTE:

Avoid hitting the teeth of the gears (Items 20 & 28). The center hole of each timing gear is a tapered bore which fits the tapered end of the rotor shafts. Tapping the gears will break the "taper lock" and release the gears from the rotor shaft.

8. Remove the rotor spacers (Item 27) used to separate the drive gears from the mounting plate (Item 23).
9. Remove screw (Item 26) and separate mounting plate (Item 23) from the end plate.
10. The rotors and gear box assembly (Item 5) 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. To completely disassemble, go on to Step 11.
11. Remove end plate (Item 3) from measuring unit body (Item 2) by removing dowel screws (Item 4) and socket head screws (Item 22).

NOTE:

It may be necessary to lightly tap the edge of the end plate (Item 3) to assist removal. Light tapping on opposite end of rotor shafts will assist removal of end plate.

12. Ball bearings (Item 12) can be removed from end plate (Item 3) by gently tapping or pressing on the inner race of the ball bearings from inside the end plate.
13. Remove the two rotors (Items 1 & 21) from

the measuring unit body (Item 2).

14. To completely disassemble, rotate the body and remove ball bearings (Item 12). Remove screws (Items 4 & 22) and disassemble end plate (Item 3) from body.

Disassembly - 113505-030 and 133505-030

1. Position measuring unit assembly in a wooden support block with the gear box assembly (Item 5) upward.
2. Remove screws (Items 8 and 35), washers (Item 36) then remove front bearing caps (Item 6) and gear box assembly.
3. Block rotors with a plastic or wooden rod as illustrated in Figure 4-1.
4. Remove screws (Items 10, 17 and/or 42) and bearing 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. Remove screws or nuts (Items 17 or 42) and bearing retainer (Item 18).

NOTE:

Do not remove front end plate (Item 3) at this time.

5. Rotate measuring unit body (Item 2) so that front of housing rests on wooden support blocks and gear box assembly (item 5) is upward.
6. Remove screws (Item 29) attaching rear gear box assembly (Item 5) to rear end plate (Item 3).
7. Bend tab on lockwasher (Item 31), remove jam nut (item 30) and lockwasher from shaft of each rotor.

NOTE:

Block rotors as illustrated in Figure 4-1.

8. Remove timing gears (Item 20 and 28) from each rotor shaft by tapping the gears lightly on a flat surface with a plastic or rubber mallet.

NOTE:

Avoid hitting the teeth of the gears (Items 20 & 28). The center hole of each timing gear is a tapered bore which fits the tapered end of the rotor shafts. Tapping the gears will break the "taper lock" and release the gears from the rotor shaft.

9. Remove the rotor spacers (Item 27) from each rotor shaft.
10. Remove screws (Item 26) and separate mounting plate (Item 23) from the end plate (Item 3).
11. The rotors and gear box assembly (Item 5) 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. To completely disassemble, go on to Step 12.
12. Remove end plate (item 3) from measuring unit body (Item 2) by removing dowel screws (Item 4) and socket head screws (Item 22).

NOTE:

It may be necessary to lightly tap the edge of the end plate (Item 3) to assist removal. Light tapping on opposite end of rotor shafts will assist removal of end plate.

13. Ball bearings (Item 12) can be removed from end plate (Item 3) by gently tapping or pressing on the inner race of the ball bearings from inside the end plate.

NOTE:

Use care not to damage crane seals (Item 44) when removing ball bearings (Item 12).

14. Carefully remove crane seals (item 44) from end plate.
15. Remove the two rotors (Items 1 and 21) from the measuring unit body (Item 2).
16. To completely disassemble, rotate the body and remove ball bearings and crane seals from end plate. Remove screws (Items 22 & 24) and disassemble plate (Item 3) from body.

Dissemble - 213505-030 and 233505-030

1. Position measuring unit assembly in a wooden support block with the gear box assembly (Item 5) upward.
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 (Items 8 and 35), washers (Item 36) then remove front bearing caps (item 6) and gear box assembly.
4. Remove screws (items 10, 17 and/or 47) and bearing retainer (Item 18). On the 213505-030 measuring unit, remove the drive adaptor (Item 11).

NOTE:

Do not remove front end plate (Item 3) at this time.

5. Rotate measuring unit body (Item 2).
6. Remove screws (item 29) and top gear cover (Item 25).
7. Bend tap on lockwasher (Item 31), remove jam nut (Item 30) and lockwasher from shaft of each rotor.

NOTE:

Block rotors as illustrated in Figure 4-1.

8. Remove timing gears (Item 20 and 28) from each rotor shaft by tapping the gears lightly on a flat surface with a plastic or rubber mallet.

NOTE:

Avoid hitting the teeth of the gears (Items 20 & 28). The center hole of each timing gear is a tapered bore which fits the tapered end of the rotor shafts. Tapping the gears will break the "taper lock" and release the gears from the rotor shaft.

9. Remove the rotor spacers (Item 27) from each rotor shaft.
10. Remove screws (Item 26) and separate mounting plate (Item 23) from the end plate.
11. The rotors and gear box assembly (Item 5) 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. To completely disassemble, go on to Step 12.
12. Remove end plate (Item 3) from measuring unit body (Item 2) by removing dowel screws (Item 4) and socket head screws (Item 22).

NOTE:

It may be necessary to lightly tap the edge of the end plate (Item 3) to assist removal. Light tapping on opposite end of rotor shafts will assist removal of end plate.

13. Ball bearings (Item 12) can be removed from

end plate (Item 3) by gently tapping or pressing on the inner race of the ball bearings from inside the end plate.

NOTE:

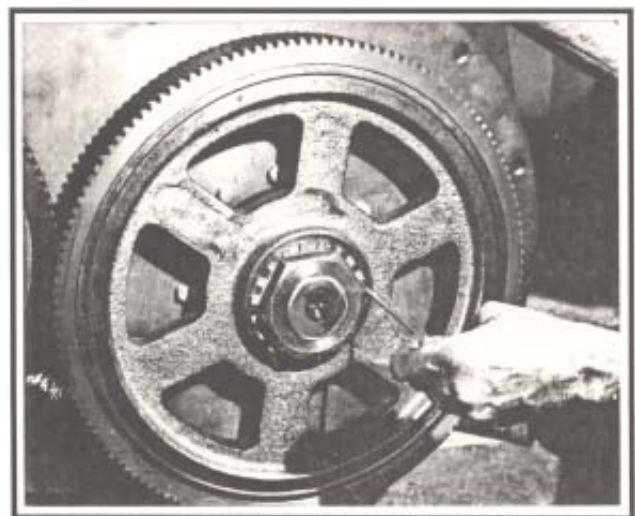
Use care not to damage crane seals (Item 44) when removing ball bearings (Item 12).

14. Carefully remove crane seals (Item 44) from end plate.
15. Remove the two rotors (items 1 & 21) from the measuring unit body (Item 2).
16. To completely disassemble, rotate the body and remove ball bearings and crane seals from end plate. Remove screws (Items 4 & 22) and disassemble end plate (Item 3) from body.

4.4 Cleaning Measuring Unit (Refer to Figure 4-8)

1. Scored metal should be removed with a scraper or file. Remove only the high points and do not remove any more metal than necessary.
2. Polish rotors with crocus cloth and wash carefully in solvent or kerosene to remove all particles of grit or metal.
3. File lightly the end plates (item 3) 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.
4. Ball bearings should be cleaned and inspected for wear. Excessive wear dictates the need for bearing replacement.
5. All gears and shafts in the gear box assembly (Item 5) should be inspected. Check all 0-

Figure 4.3 Proper Method for Setting Rotor End Clearance



rings for wear and replace if necessary.

4.5 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 lightweight 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 4.5 and 4.6)
4. Replace rear end plate (Item 3). Oil dowel screws (Item 4) and screws (Item 22) before replacing. (Figure 4.7).
5. Install bearings (Item 12) into bearing bore provided in end plate. (Figure 4-9)

NOTE:

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

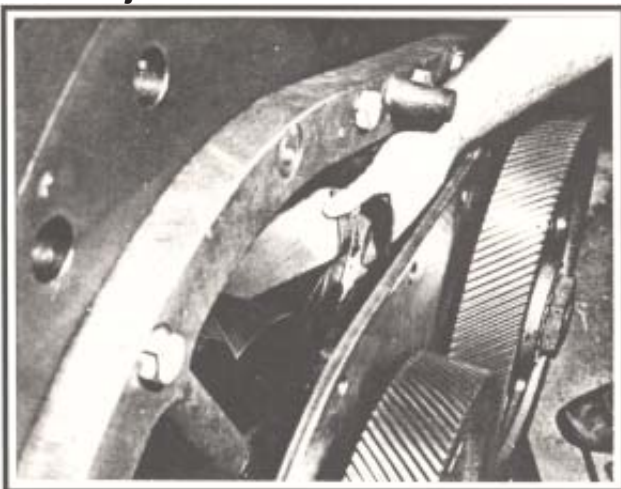
6. Replace mounting plate (Item 23) and screws (Item 26).

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).

Figure 4.2 Proper Method for Timing Gear Adjustment



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 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 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.
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 lightweight 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 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 4-4).

NOTE:

The polished steel ring (Figure 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 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 4-16.

6. 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.

Figure 4.3 Proper Method for Setting Rotor End Clearance

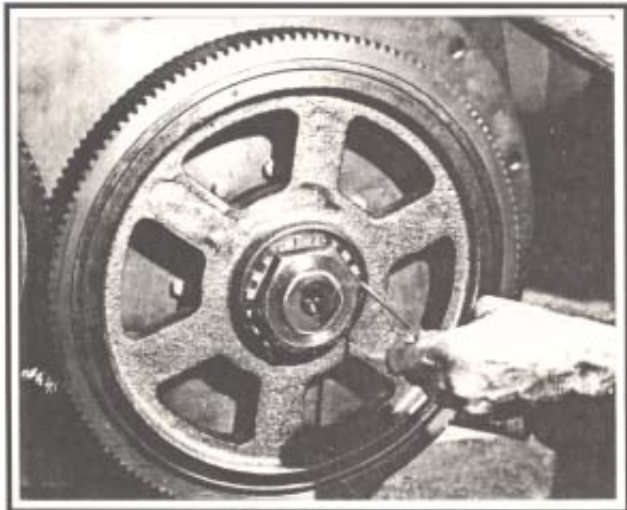


Figure 4.4 Install Crane Seals

Note: The ring part of the crane seal is easier to install when replacing rotors (See Figure 4.7).



Figure 4.5 Install Bearing Thrust Washer

Note: Slots in the thrust washer fit over the dowels on the crane seal.





Figure 4.6 Installing Ball Bearings into Bearing Bore Provided in End Plate

Note: Slot on outer race of bearing must engage with roll pin in end plate.



Figure 4.7 Install Ring of the Crane Seal

Note: See Figure 4.4 for illustration in installing crane seal.



Figure 4.8 Proper Method for Filing Rotors



Figure 4.9 Position the Rotors and Lower into Appropriate Cavity

Note: Caution should be taken at this point to avoid scoring rotors.



Figure 4.10 Position and lower rear end plate in place

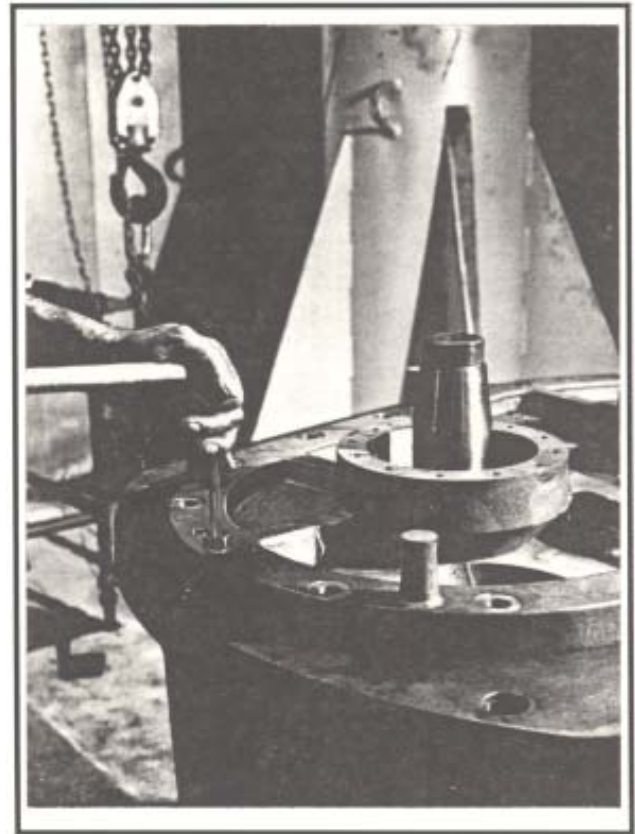


Figure 4.11 Oil and Replace Dowel Screws Following with Remaining Screws



Figure 4.12 Replace Mounting Plate and Screws. The Wide End of Mounting Plate Fits Over the 4T Rotor Shaft.

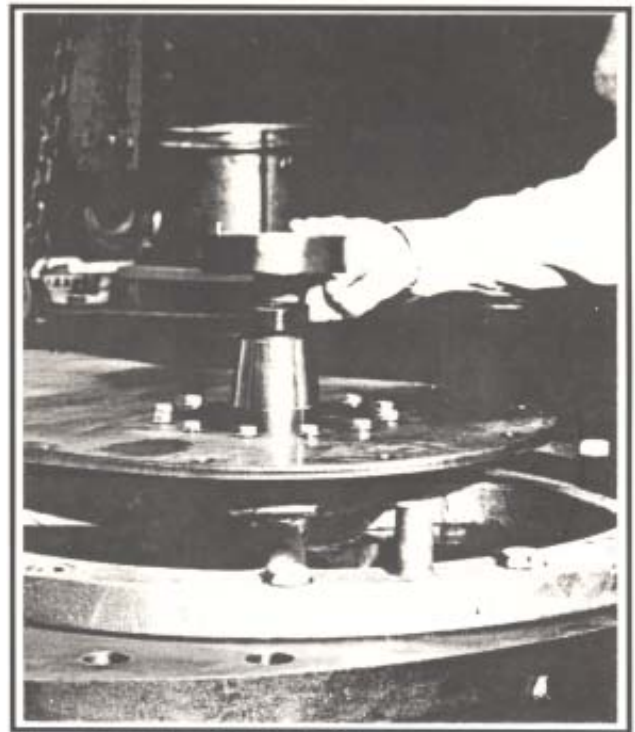


Figure 4.13 Install Rotor Space and Slide Trimming Gears onto Proper Rotor Shaft Before Replacing Lockwashers as Illustrated in Figure 4.14

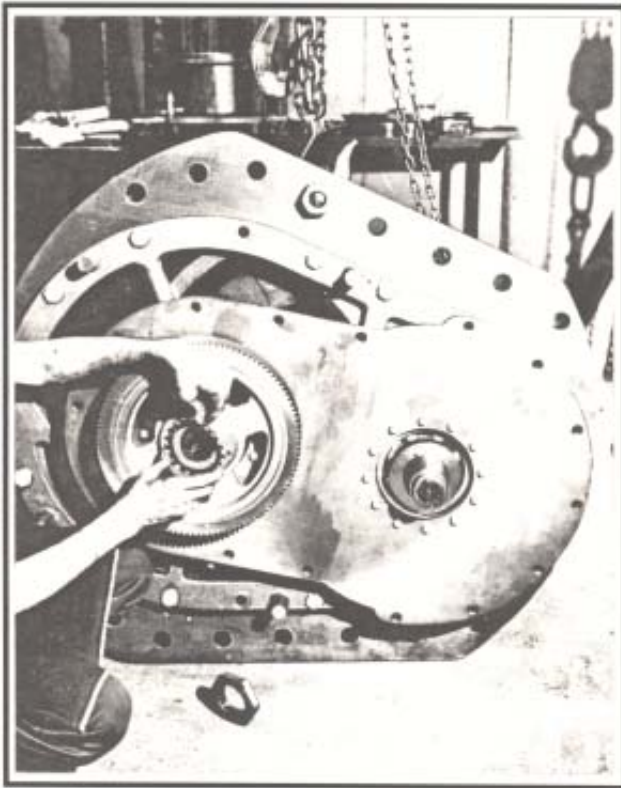


Figure 4.14 Replace Lockwashers. Tab on Washer Must Seat Into Slot on Timing Gear

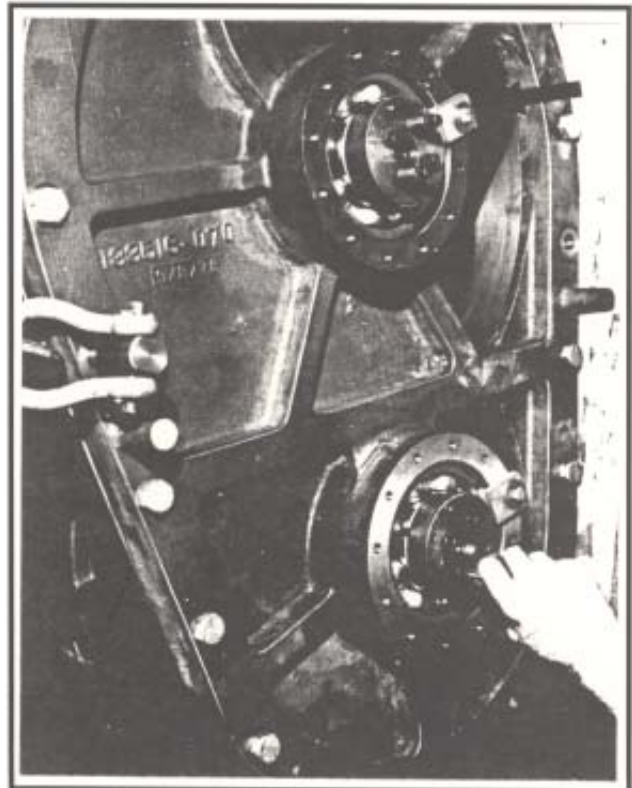


Figure 4.15 Illustration of the Front End Plate on the 233505-030 Measuring Unit
 Note: The special adaptor that is used to hold the ball bearing in place during reassembly.

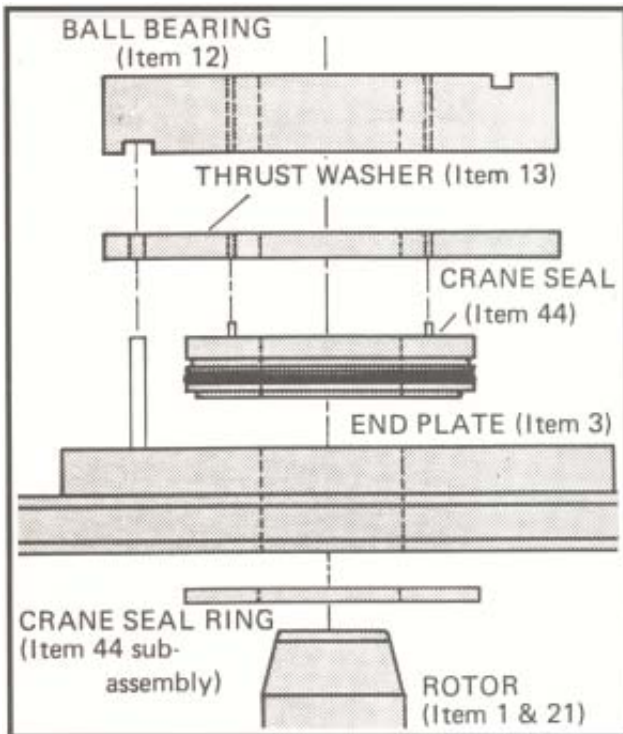


Figure 4.16 Rotor, End Plate, Crane Seal, Thrust Washer, and Ball Bearing Adjustment Detail



Figure 4.17 Secure All Nuts to Their Proper Torque and Mount Accessories as Desired

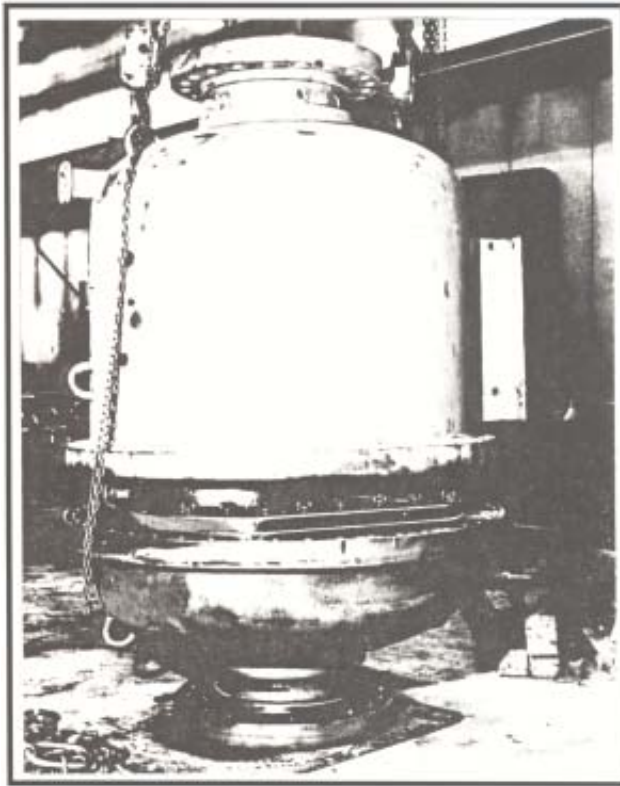


Figure 4.18 Position the Meter Body

Note: Rotate the coupling tube on the pinion shaft assembly until the drive pin is positioned the same as the slot on the coupling jaws of the gear box assembly..

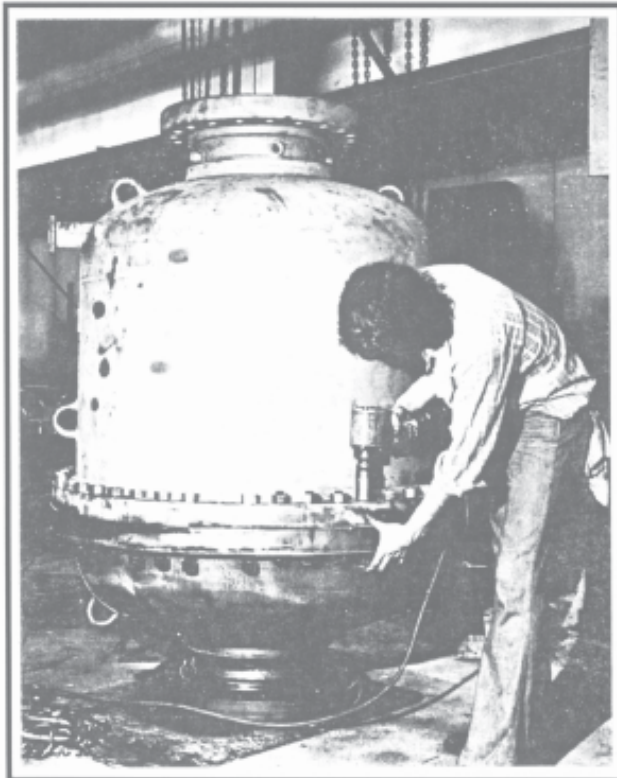


Figure 4.19 Secure All Nuts to Proper Torque and Mount Desired Accessories

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 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 4-9).
9. Align the port openings of the end plate (Item 2) 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 4-10 and 4-11).
10. Rotate measuring unit and replace crane seal (Item 44) with rubber face downward (Figure 4-4).
11. Position bearing thrust washer (Item 13) over the crane seal (Figure 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 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.

4.6 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.

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.

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

Models B101 - B135

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. Using a small piece of rubber between the timing gears, tighten the jam nut, remove shims and check for freeness of operation. If the rotors contact one another, the timing operation must be repeated.

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. 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.

2. 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.
3. 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.
4. 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.

4.8 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

1. Measuring unit 213505-030 and 233505-030, refer to Figures 6-4 and 6-6.
 - a. Replace top gear cover (Item 25), secure with screws (Item 29).
 - b. 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).

NOTE:

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

2. Measuring unit 203505-030 and 223505-030, refer to Figure 6-3.
 - A. Replace gear box assembly (Item 5), gasket (item 24) and secure with screws (Item 22).

- B. 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
 5. 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.

6. Replace static seal tube (Item 19) with attached O-ring (Item 20).
7. 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.

8. Replace tubing and connect the APL unit (Item 23) to meter housing.
9. Reinstall other accessories.
10. Refill APL unit with lubricating oil (refer to Section 4-1 0).

4-9 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

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

1. Select a hand oil pump with a mating connection able to connect the alemite fitting (Item 7) on the APL unit. Lubricating oil used in the APL unit should be a good quality SAE ten weight non-detergent oil.
2. Connect oil pump to alemite fitting (Item 7) on the APL unit. Open the needle valve (Item 6).
3. 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 while meter system is either in service or not in service.

4. 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 the APL unit is full of lubricating oil. Once 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.

5.0 Troubleshooting

Table 5.1 has been provided to aid in basic troubleshooting. Disassembly procedures are covered in Section 4.0 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.

Table 5.1 Troubleshooting

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 see 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: 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 4-6. If discrepancy is found, re-time rotors.
	Damaged rotors.	Remove rotors as described in Section 4-3A and 4-3B. If rotors are scored or galled, clean them as described in Section 4-4. If rotors are damaged beyond repair, replace with a new set. Install rotors as described in Section 4-5.
	Worn ball bearings.	Remove ball bearings as described in Section 4-3A and 4-3B. 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.

Appendix A - Decontamination Statement



Brodie Meter Co., LLC

19267 Highway 301 North (30461)
PO Box 450
Statesboro, GA 30459-0450

Phone: (912) 489-0200
Fax: (912) 489-0294
www.brodiemeter.com

Decontamination Statement

RMA Number: _____

Item Being Returned: _____

List all chemicals and 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



Brodie Meter Co., LLC

19267 Highway 301 North (30461)
PO Box 450
Statesboro, GA 30459-0450

Phone: (912) 489-0200
Fax: (912) 489-0294
www.brodiemeter.com

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.

Company Name: _____

Technical Contact: _____ Phone: _____

Repair PO#: _____ If Warranty, Unit S/N: _____

Invoice Address: _____

Shipping Address: _____

Return Shipping Method: _____

Equipment Model #: _____ S/N: _____ Failure Date: _____

Description of Problem: _____

What was happening at time of failure? _____

Additional Comments: _____

Report Prepared By: _____ Title: _____

If you require technical assistance, please contact the Product Service Department at:

Phone: (912) 489-0200

Fax: (912) 489-0294

service@brodiemeter.com

Reminder:

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

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Brodie Meter Co., LLC

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PO Box 450
Statesboro, GA 30459-0450

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Fax: (912) 489-0294
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