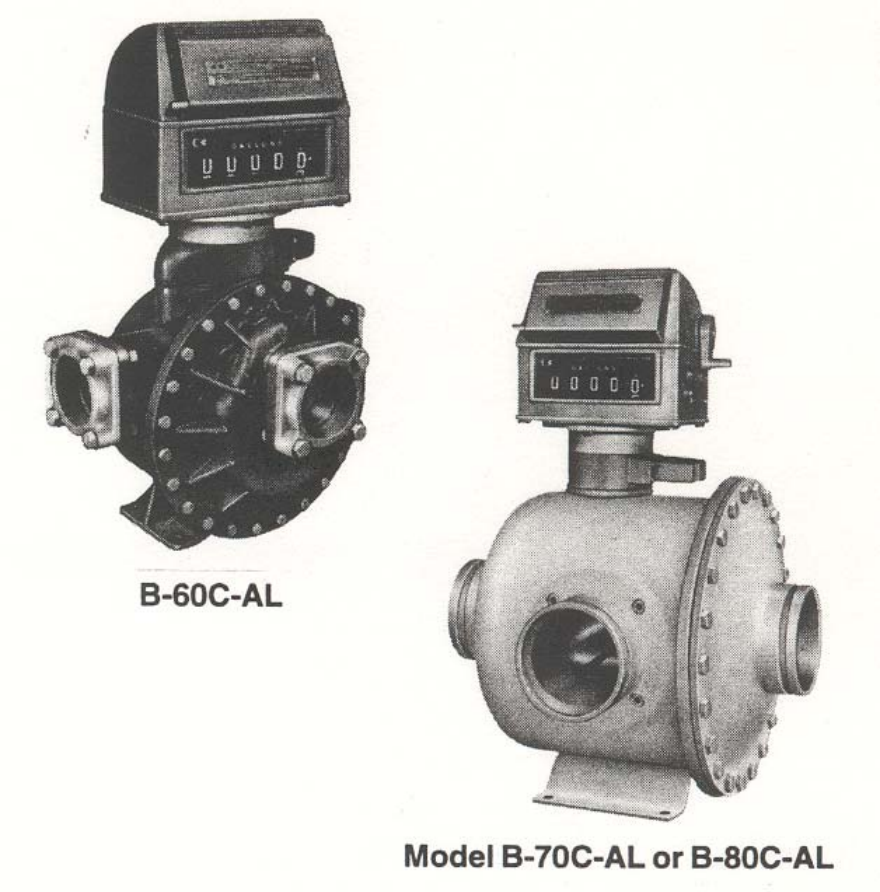
X-B60/80CAL
Revision 01

Brodie BiRotor Models B-60/80CAL

Installation and Operation Manual



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Manufacturers of BiRotors, Oval Gear Meters, and Control Valves

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.
- Before opening the flameproof enclosure in a flammable atmosphere, the electrical circuits must be interrupted.
- The ATEX approval applies to equipment without cable glands. When mounting the flameproof enclosure in a hazardous area, only flameproof cable glands certified to EN 50018 must be used.
- If replacement of screws that secure the gear housing, sensor housing, UMB, cover, or electric register is necessary, they must be replaced with M6-1 X 16 mm hex socket head cap screws. The screws must be made of 304 stainless steel and have a minimum tensile strength of 125 KSI.
- 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 equipment 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 meter is placed in service. A strainer of proper size should be installed upstream of the meter to protect it from

Notice

Brodie Meter Co., LLC ("Brodie") shall not be liable for technical or editorial errors in this manual or omissions from this manual. **Brodie makes no warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose with respect to this manual and, in no event, shall Brodie be liable for any special or consequential damages including, but not limited to, loss of production, loss of profits, etc.**

Product names used herein are for manufacturer or supplier identification only and may be trademarks/ registered trademarks of these companies.

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Brodie does not assume responsibility for the selection, use or maintenance of any product. Responsibility for proper selection, use and maintenance of any Brodie product remains solely with the purchaser and end-user.

Brodie Meter Co., LLC
Statesboro, Georgia, USA

Warranty

1. <u>LIMITED WARRANTY:</u> Subject to the limitations contained in Section 2 herein and except as otherwise expressly provided herein, Brodie Meter Co., LLC ("Brodie") warrants that the firmware will execute the programming instructions provided by Brodie, and that the Goods-manufactured or Services provided 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 initial installation or eighteen (18) months from the date of shipment by Brodie, whichever period expires 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, promptly correct any errors that are found by Brodie in the firmware or Services, or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware 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. 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 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.**

2. <u>Limitation Of Remedy And Liability:</u> 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.

Table of Contents

1.0 Introduction

1.1 Description

The Brodie BiRotor Meter is a precision made, accurate flow measurement device which utilizes the positive displacement principle of operation. It is designed to measure crude and refined petroleum products as well as many industrial liquids.

The standard meter consists of a measuring unit installed in an outer housing or case, an adjustor for calibration and selected registration equipment.

As product enters the intake of the measurement element, two finely timed rotors divide the liquid into precise segments of known volume and return those seg-ments to the flowing stream. During this transition, the rotation of the two rotors is directly proportional to volumetric throughput. The rotors are always dynamically balanced, but hydraulically unbalanced, and have no metal-to-metal contact with one another or the measuring unit housing. Volume indication is determined by either mechanical output gearing leading to registration devices, or by an electrical output signal to remote registration equipment.

The accuracy adjustor, located on the output shaft of the counter drive gearing of the mechanical meter, permits the operator to adjust output registration to read in exact units of volume. It allows for adjustments up to +/-3% of meter throughput in determining accurate measurement. The meter may be supplied with any of several accessory items including two-stage electric valves, preset counters, high frequency pulse generators, impulse contactors, etc. These units provide various func-tions for local and/or remote control and readout.

1.2 Specifications

Caution

Do not operate generator in excess of specifications listed below. Failure to heed this warning may result in serious personal injury and/or damage to the equipment.

Materials of Construction

Outer Housing and Cover:
- B-60CAL: Aluminum
- B-70CAL & B-80CAL: Nickel Coated Carbon Steel

Measuring Unit:
- Rotors: Aluminum
- Rotor Bearings: Stainless Steel
- Body and End Covers: Aluminum
- Counter Base Plate: Aluminum

Capacities:

Continuous Service				
Model	Max. Capacity - Gasoline/Light Oils			
	US GPM	Imp. GPM	Bbls/hr	Liters/min
B-60CAL	250	208	357	946
B-70CAL	425	354	607	1609
B-80CAL	600	500	857	2271
Intermittent Service				
Model	Max. Capacity - Gasoline/Light Oils			
	US GPM	Imp. GPM	Bbls/hr	Liters/min
B-60CAL	300	250	429	1135
B-70CAL	550	458	786	2082
B-80CAL	800	667	1143	3028

Maximum Safe Working Pressure:
- B-60CAL: 125 psi (861 kPa)
- B-70CAL and B-80CAL: 150 psi (1034 kPa)

Maximum Working Temperature:
- 20 to 150°F (-29 to 65°C)

Connections:
- B-60CAL: 3" Screwed
- B-70CAL: 3" or 4" Victaulic or 150 lb. ANSI
- B-80CAL: 4" or 6" Victaulic or 150 lb. ANSI

1.3 Meter Model Number

The Meter Model Number, Serial Number, Flow Range and Operating Pressure appear on the nameplate attached to the meter body. This information is vital to proper operation and identification, and should not be removed for any reason.

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, Shipment, Installation And Operation

3.1 General

The information contained in this section has been presented to acquaint the user with general storage, installation and start-up practices. It should be remembered that Brodie meters are precision, flow measurement instruments and should under no circumstances be subjected to rough or improper handling.

3.2 Storage

1. A storage site should be selected that will protect the meter from moisture, extreme temperatures, and foreign materials that could damage the meter.
2. Flange covers must remain on the meter until it is ready for installation.
3. If extended storage under harsh field conditions is anticipated, 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

Desiccant packs must be removed prior to installation.

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

3.3 Shipment

1. If the meter is removed from service it must be thoroughly drained and neutralized before being packaged for shipment. Care must be taken to insure that all product removed from the meter be disposed of in accordance with all applicable local, state and federal laws.
2. Flanges must 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.
3. The meter should be securely packaged for shipment using the original container supplied by Brodie, or bolted within a solid wooden box to protect the meter from damage during shipment.

3.4 Installation

NOTE: Before placing the meter into service reference the appropriate instruction manuals for all accessories. This includes hook-up, electrical wiring, and specification requirements and restrictions.

Caution

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 hazardous 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 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 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 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.

3.5 Operation

Warning

Do not operate this meter in excess of those values listed in Section 1.2 Specifications. At no time should hands, tools or other apparatus be inserted into the inlet or outlet of the meter as serious personal injury and/or damage to the equipment could result.

3.5.1 General

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

3.5.2 Starting Flow Through the Meter

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 adjustor settings are changed, a small batch should be run through the meter prior to making the next proving run. This allows the adjustor 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, Statesboro, or your local Brodie Authorized Repair Center if service assistance is required.

4.0 Maintenance

Warning

Before attempting any disassembly procedure shut off all power to electrical components in use and disengage. Shut off all flow to the meter and release all pressure from the process line and meter. Extreme care should be exercised when the measuring element is exposed and handled. Hands must be kept clear or serious personal injury can occur. Because the measuring unit is finely balanced, it is easily put in motion. At no time should hands be used to brace these parts during servicing.

4.1 General

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

A. Continuity of Operation -A meter which operates con-tinuously, will require more attention than one on intermittent duty.

B. Rate of Flow -The practical life of any piece of equip-ment is proportional to its speed of operation. A meter operating at, or close to, its maximum rating will have a shorter life than one operating at a reduced rate.

C. Lubricating Value of Product -A meter handling a light lubricating oil will have a longer service life than one measuring a dry motor fuel.

D. Cleanliness of Product - Abrasive solid material entrained in the measured product will accelerate wear.

All meters should receive routine maintenance checks to avoid potential problems that could lead to failure. To a considerable extent, a meter's performance is dependent on the proper functioning of accessory equipment in use. The following list highlights some of the conditions and factors that may influence meter performance.

1. A meter should be kept filled with the liquid it is mea-suring. Draining results in the formation of deposits which increase mechanical friction, thus decreasing service life. Any leaking shut-off or check valves should be repaired or replaced.
2. A petroleum meter should be kept free of water. Under normal circumstances regular inspection and drainage of storage tanks is 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 inspected on a routine basis. This is especially true where a critical air condition exists. For this reason meter performance is dependent on proper air elimination. Factors leading to difficult valve and air eliminator operating conditions include: gum formations caused by alternate wetting and drying, formation of corrosive vapors, and presence of salt air.
6. The meter counter should be protected from extreme weather and any potential hazardous condition.
7. A meter taken out of service for any length of time should be filled with light lubricating oil.
8. Proper Service Bulletins should be available for reference at all times.

4.2 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 0-Rings should be removed, examined and replaced as required. This policy will assure maximum performance from your Brodie BiRotor Meter at less expense and with greater accuracy.

Reference Figures 6-1 and 6-2 and Tables 6-1 and 6-2 for basic part identification.

Warning

All pressure must be relieved, flow stopped and electrical connections to the meter disconnected before any disassembly can take place. Failure to comply can result in serious personal injury and/or damage to the equipment. Service should be performed by trained and qualified personnel only.

1. Remove the Drain Plug and completely drain the meter.
2. Remove the Accuracy Adjustor and Counter Base Plate Assembly.
3. Remove Hex Nuts and Housing Cover from the Meter Housing.
4. Disconnect the Measuring Unit from the Meter Hous-ing by first removing the Screws, Washers and Seal Washers from the unit.
5. Carefully lift the Measuring Unit away from the meter body and place on a clean dry surface.
6. 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. In the event that solid material or corrosion prevents proper operation it will be necessary to remove the Rotors and Rear End Cover Assembly for further cleaning.

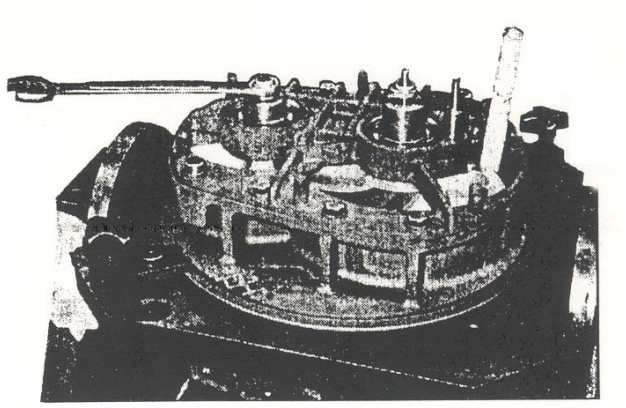
Warning

Extreme care must be exercised when the Measuring Unit Assembly is exposed or handled. Hands must be kept clear of all Gears and Rotors or serious personal injury can occur. Due to the precision of the Rotors and Drive Gears, they can easily be set into motion. Keep Hands clear of these parts at all times. At no time should the hands be used to brace these parts while servicing.

4.3 Measuring Unit Disassembly

1. Position the Measuring Unit with the Front End Plate facing out in such a way as to afford easy access.
2. Remove the two front Bearing Retainer Caps.
3. Remove the Drive Gear Assembly, Retainer Ring and Key (if applicable) and Bearings from the 3-Tooth Rotor.
4. Remove the Screw, Washer, Bearing Key and Bearings from the 4-Tooth Rotor. DO NOT remove the Front End Plate at this time.
5. Rotate the Measuring Unit, remove Screws from the Rear End Cover and separate from the Measuring Unit Body.
6. The Rotors and Rear End Cover 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 required.

Figure 4.1 Proper Method for Blocking Rotors



4.4 Removing Timing Gears and Rotors

Severe scoring of the Rotors, or grit in the Bearings, may necessitate removal of the Rotors from the Rear End Cover.

1. Remove Lock Nut Retainer and Washer.
2. Using a small piece of rubber, or nylon stock, block the Timing Gears.
3. Timing Gears are taper fitted to the shafts and can be removed one at a time by striking the inside face of the gear (do not strike teeth) with a rubber mallet. Care should be taken not to damage the Rotor Shaft threads when removing the Timing Gears.
4. Remove the Bearing Spacers and Bearings from the Rear Cover.

NOTE: Ball Bearings can be removed from the End Covers by gently tapping or pressing on the inner race of the Bearings from the inside of the End Cover.

5. Separate the Rotors from the Rear End Cover.
6. Remove the Front End Cover and Bearings.

4.5 Cleaning the Measuring Unit

1. Scored metal should be removed with a file taking care only to remove the high points. Do not remove any more metal than is necessary.
2. Wash thoroughly in solvent or kerosene to remove all particles of grit or metal.
3. Lightly file the End Covers to remove any burrs or high spots. Use fine sand paper to

remove corrosion and burrs from the surface of the bores that house the Bearings.
4. Ball Bearing should be cleaned and inspected for wear.
5. All Gears and Shafts in the Rear End Cover Assem-bly should be inspected. Check all O-Rings and Gaskets for wear and/or distortion and replace as required.

NOTE: All parts should be thoroughly cleaned in solvent, light fuel oil, kerosene or a suitable cleaning agent compatible with the metallurgy of the meter and the liquid being measured.

4.6 Measuring Unit Assembly

1. Lubricate all Bearings and O-Rings with a light weight oil.
2. Position the Measuring Unit Body and attach the Front End Plate by installing Screws.
3. Rotate the Measuring Unit Body and replace the Rotors in the proper slots with the tapered end of the Rotors upward.
4. Position and attach the Rear End Plate using the Screws previously removed.
5. Install the Bearings.
6. Position a Bearing Retainer or Spacer over each Bearing and attach by installing Lock Washers and Screws.
7. Replace the Spacer Key (if applicable), Timing Gears, Lock Nut Retainer, Lock Washer and Screws.

NOTE: The large Timing Gear fits on the 4-tooth Rotor. The short tab on the Spacer Key fits in the inner race of the Ball Bearings and the longer tab seats into the slot on the Timing Gear.

8. Replace Lock Washers and Lock Nuts. The tab on the Lock Washer must seat into the slot on the Timing Gear.
9. Rotate the body and install Bearings, Bearing Key, Snap Ring, Lock Washer and Screws onto the Front End Cover.

NOTE: The tab on the Bearing Key must seat into the slot on the inner race of the Bearing.

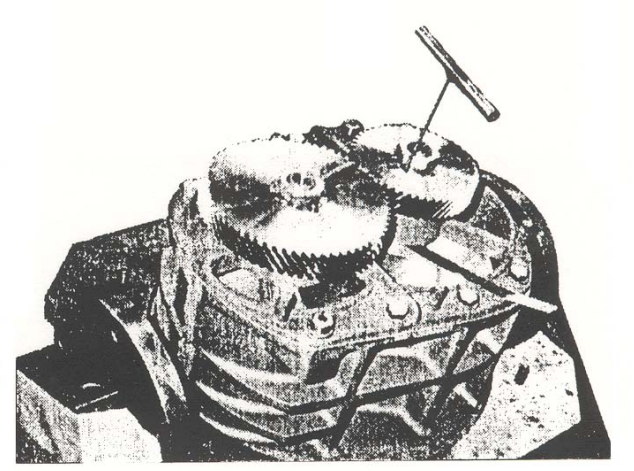
10. The Measuring Unit must have Rotor clearance as described in Sections 4.7 and 4.8.

4.7 Setting End Rotor Clearance

Note: End rotor clearance is not required on all models. Units requiring end rotor clearance can be identified by the presence of set screws on the face of Timing Gears.

1. Adjust the two Set Screws located on the face of the Timing Gears until both Rotors are flush with the back side of the Rear End Plate.
2. Insert a shim into the outlet port, located on the Front End Plate, and determine the total distance between the backside of the Front End Plate and the 3-tooth Rotor. Repeat this procedure for the 4-tooth Rotor.
3. Adjust the two Set Screws located on the small Timing Gear until the distance between the back side of the Front End Plate and the 3-tooth Rotor is one-half the distance previously determined. Repeat this procedure for the 4-tooth Rotor and the large Timing Gear.
4. If the end clearance is adjusted properly, the Rotors will spin freely in any position. If the Rotors fail to spin freely, repeat procedure for setting end clearance.

Figure 4.2 Proper Method for Settign Rotor End Clearance



4.8 Timing Gear Adjustment

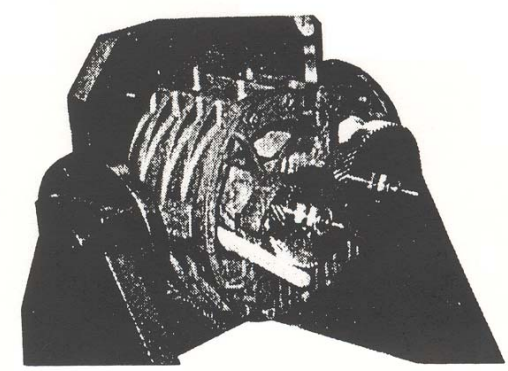
1. Loosen the Jam Nut on the large Timing Gear and with a feeler gauge or shims, carefully centralize a lobe of the 3-toothed Rotor in a flute of the 4-toothed Rotor. Determine the distance between the lobe and the flute of the

two Rotors and shim the Rotors one -half of the determined distance between them.

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

2. Position the Measuring Unit into the Meter Housing so that the inlet on the Measuring Unit couples with the inlet on the Meter Housing.
3. Replace Screws, Washers and Seal Washers attaching the Measuring Unit to the Meter Housing.
4. Replace the Meter Cover Housing and the Front Dome Gasket. A light film of grease will aid in holding the Gasket in place.
5. Rotate the Coupling Tube on the Pinion Shaft A-sembly of the Counter Base Plate Assembly until the Drive Pin is positioned the same as the slot of the Coupling Jaw on the Counter Drive Gear Train.
6. Install the Adjustor and all other accessories. See Section 3 - Operation for Start-up recommendations.

Figure 4.3 Proper Method for Timing Rotors



4.9 Meter Adjustment

The standard mechanical BiRotor meter is supplied with a Series 4000 Adjustor whereby incremental changes can be made to calibrate meter output with registration equipment. This is accomplished by changing the gear ratio between the meter Packing Shaft and the Counter. To make adjustments:

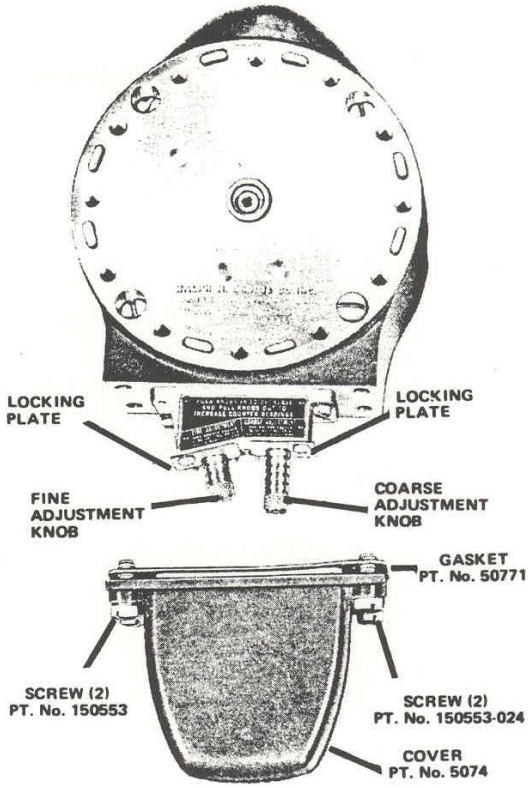
1. Remove the protective security cover of the Adjustor.
2. Lift the Adjustor Locking Plate.
3. Adjust the meter as required. Adjustment Knobs are labeled for COARSE and FINE adjustment.

Pushing the adjustment knob IN decreases the counter reading. Pulling the adjustment knobs OUT increases the counter reading.

Each groove of the FINE adjustment is equal to:
.05% of the volume delivered
.0005 gals. per gallon delivered
.116 cu. in.(U.S) per gallon delivered
.064 oz.(U.S.) per gallon delivered
.139 cu. in. (Brlmp.) per gallon delivered
.50 c.c. per liter delivered

Each groove of the COARSE adjustment is equal to:
.60% of the volume delivered.
.006 gals. per gallons delivered
1.386 cu. in. (U.S.) per gallon delivered
.768 oz. (U.S.) per gallon delivered
1.665 cu. in. (Br.lmp.) per gallon delivered
6 c.c. per liter delivered

Figure 4.4 Model 4000 Adjustor



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 preformed by trained and qualified service personnel and it is recommended the user contact the Brodie Meter Co., LLC Repair Department.

Table 5.1 Troubleshooting

Symptoms	Possible Cause	Service Required
Meter runs but counter does not register.	Faulty Register	Remove register and see if output shaft on adjuster 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 is 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 clearance. If descrepancy is found, re-time rotors.
	Damaged Rotors	Remove rotors. If rotors are scored or galled, clean them. If rotors are damaged beyond repair, replace with a new set.
	Worn ball bearings	Remove ball bearings. Check to see if ball bearings turn freely with no free play. If descrepancy 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 reassemble.

6.0 Warranty Claim Procedures

To make a warranty claim, you, the Purchaser, must:

1. Provide Brodie with proof of the Date of Purchase and proof of the Date of Shipment of the product in question.
2. Return the product to Brodie within twelve (12) months of the date of original shipment of the product, or within eighteen (18) months of the date of original shipment of the product to destinations outside of the United States. The Purchaser must prepay any shipping charges. In addition, the Purchaser is responsible for insuring any product shipped for return, and assumes the risk of loss or damage of the product during shipment.
3. To obtain Warranty service or to locate the nearest Brodie office, sales, or service center call (912) 489-0200.
4. When contacting Brodie for product service, the purchaser is asked to provide information as indicated on the following page entitled “Customer Problem Report” (Appendix C).
5. For product returns from locations outside the United States, it will be necessary for you to obtain the import consignment address so that Brodie’s customs broker can handle the importation with the U.S. Customs Service.
6. Brodie Measurement Services offers both on call and contract maintenance service designed to afford single source responsibility for all its products.
7. Brodie reserves the right to make changes at any time to any product to improve its design and to insure the best available product.

7.0 Parts List

This section contains the necessary parts required for routine maintenance and service of the BiRotor Plus. Each parts list also contains the recommended spare and replacement parts denoted by an asterisk. For Items not listed, or additional information, consult factory. When ordering, the following information must be furnished:

1. Part Number
2. Model Number of the flow meter
3. Serial Number
4. Quantity required.

Figure 7.1 Meter Assembly

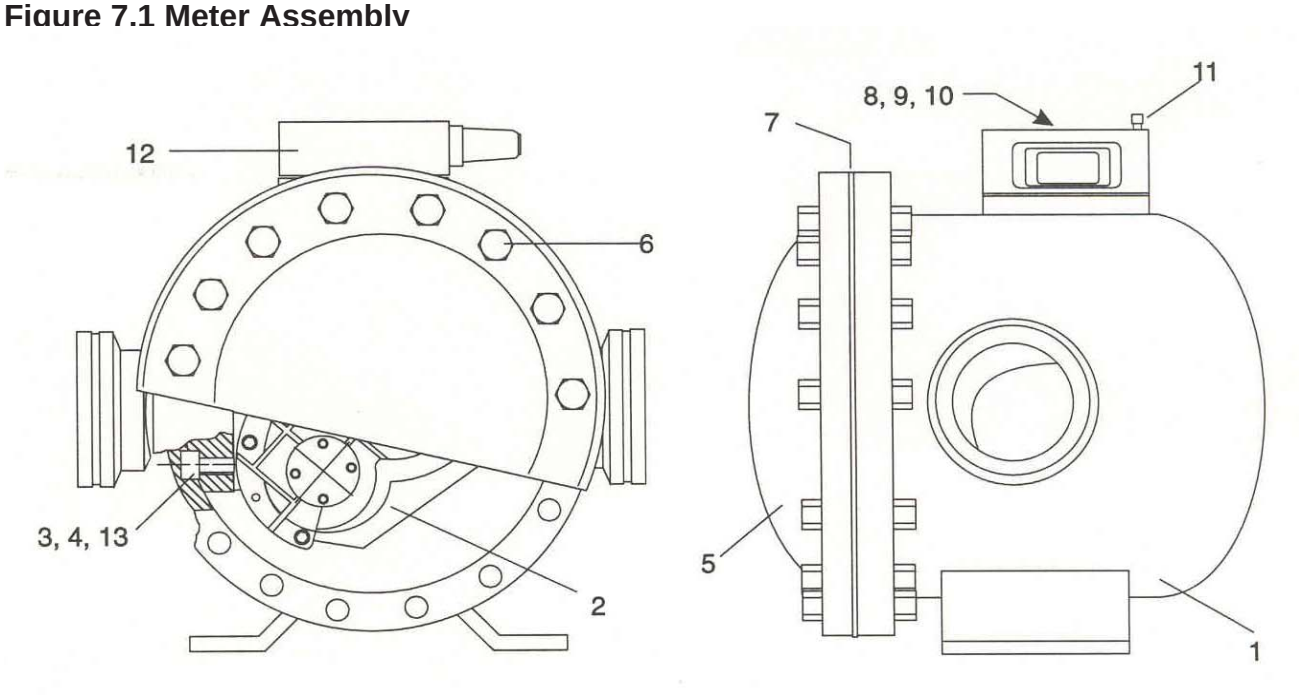


Table 7.1 Parts List - Complete Assembly

Item	Description	Part Number			Qty.
		B-60CAL	B-70CAL	B-80CAL	
1	Housing Assembly	60415-100	70615-200	80365-200	1
2	Measuring Unit Assembly	60205-100	72205-106	82205-106	1
3	Screw	150565	151026-019	151070	4
4	Stat-O-Seal	-----	152034	152033	4
5	Housing Cover	60430-100	70640-200	82890-200	1
6	Bolts or Cap Screws	150776M (24)	150803	150832	22
7	Gasket	60434	178709	82884	1
8	Counter Base Plate	60750-195	72750-100	72750-100	1
9	Counter Base Plate Gasket	51156	51156	51156	1
10	Screw	151253	151253	151253	9
11	Screw	150565	150565	150565	4
12	Adjustor	4000	4000	4000	1
13	Washer	152110	151882	151872	4
14	Adaptor or Gasket	60446	178709	52146	1
15	Nut	151589M	-----	-----	24
17	Gasket	61506-001	-----	-----	1

Figure 7.2 B60CAL Counter Base Plate

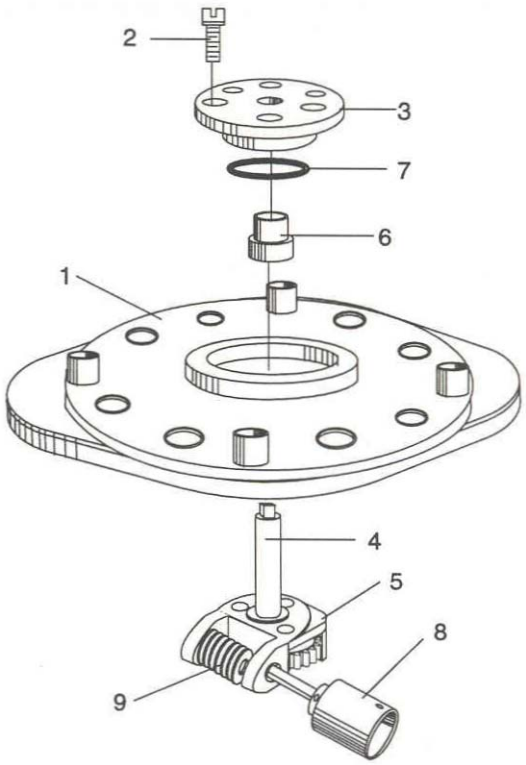


Figure 7.2 B70/B80CAL Counter Base Plate

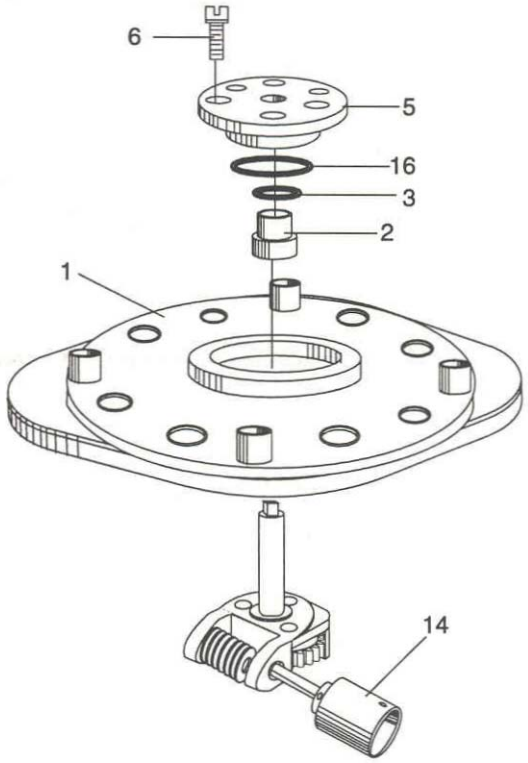


Table 7.2 Parts List - B60CAL Counter Base Plate Assembly

Item	Description	Part Number	Qty
1	Base Plate	51752	1
2	Screw	150472	2
3	Packing Shaft Gland	52153-100	1
4	Packing ShaftAssembly	60785-400	1
5	Worm Gear Bracket	60761	1
6	Spacer	52152	1
7	O-ring	152064-114	1
8	Coupling	51167-003	1
9	Worm Gear	72168-002	1

Table 7.3 Parts List - B70CAL/B80CAL Counter Base Plate Assembly

Item	Description	Part Number	Qty
1	Base Plate	72751	1
2	Spacer	52152	1
3	O-ring	152064	1
4	Gasket	52176	1
5	Gland	52153-100	1
6	Screws	156324	4
7	Worm Gear Bracket Assembly	72160-402	1

Figure 7.4 B60CAL Measuring Unit Assembly

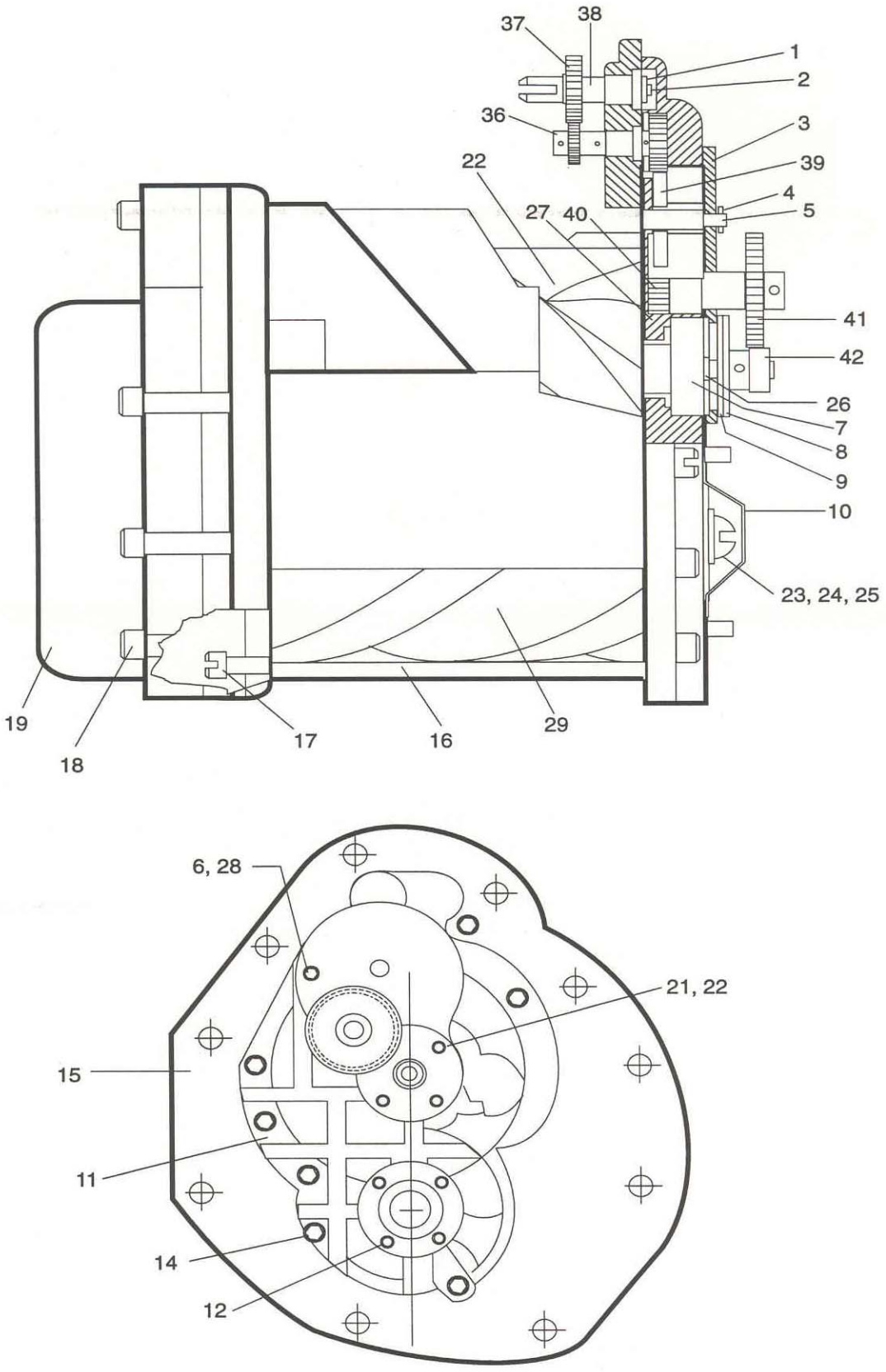


Table 7.4 Parts List - B60CAL Measuring Unit Assembly

Item	Description	Part Number	Qty
1	Washer	151854-019	1
2	Spring Clip	153942	1
3	Bearing PlateAss'y	60540-400	1
4	Cotter Pin	153905	1
5	Idler Shaft	51564	1
6	Screw	150524-019	3
7	Ball Bearing	155185	4
8	Bearing Retainer	60533	1
9	Ball Bearing Seal	60534	1
10	Bearing Retainer	60534	1
11	Front End Cover	60231-100	1
12	Allen Head Screw	151050-019	4
13	Groove Pin	153636-019	1
14	Allen Head Screw	151010-019	5
15	Meter Body	60211-100	1
16	Rear End Cover	60266-100	1
17	Dowel Screw	51567	4
18	Allen Head Screw	151033-019	8
19	Rear Gear Cover	61601	1
20	Allen Head Screw	151049-019	3
21	Lockwasher	152253-019	7
22	3 Tooth Rotor	60276	1
23	Bearing Key	60238	2
24	Screw	150156	1
25	Lockwasher	152270-019	1
26	Retaining Ring	153953-019	1
27	Roll Pin	153548	4
28	Lockwasher	152258-019	3
29	4 Tooth Rotor	60586	1
30	Drive Gear/4-T Rotor	60596	1
31	Spacer	60294	2
32	Locknut	60592	2
33	Lockwasher	51593	2
34	Drive Gear/3-T Rotor	60591	1
35	Stub Shaft	51579	1
36	Groove Pin	153707-019	2
37	Gear (18T)	51522	1
38	Bushing	155170	4
39	Bushing	155169	2
40	Compund Driven Gear	51552	1
41	Set Screw	150975-019	2
42	Drive Gear	51536	1

Figure 7.5 B70CAL/B80CAL Measuring Unit Assembly

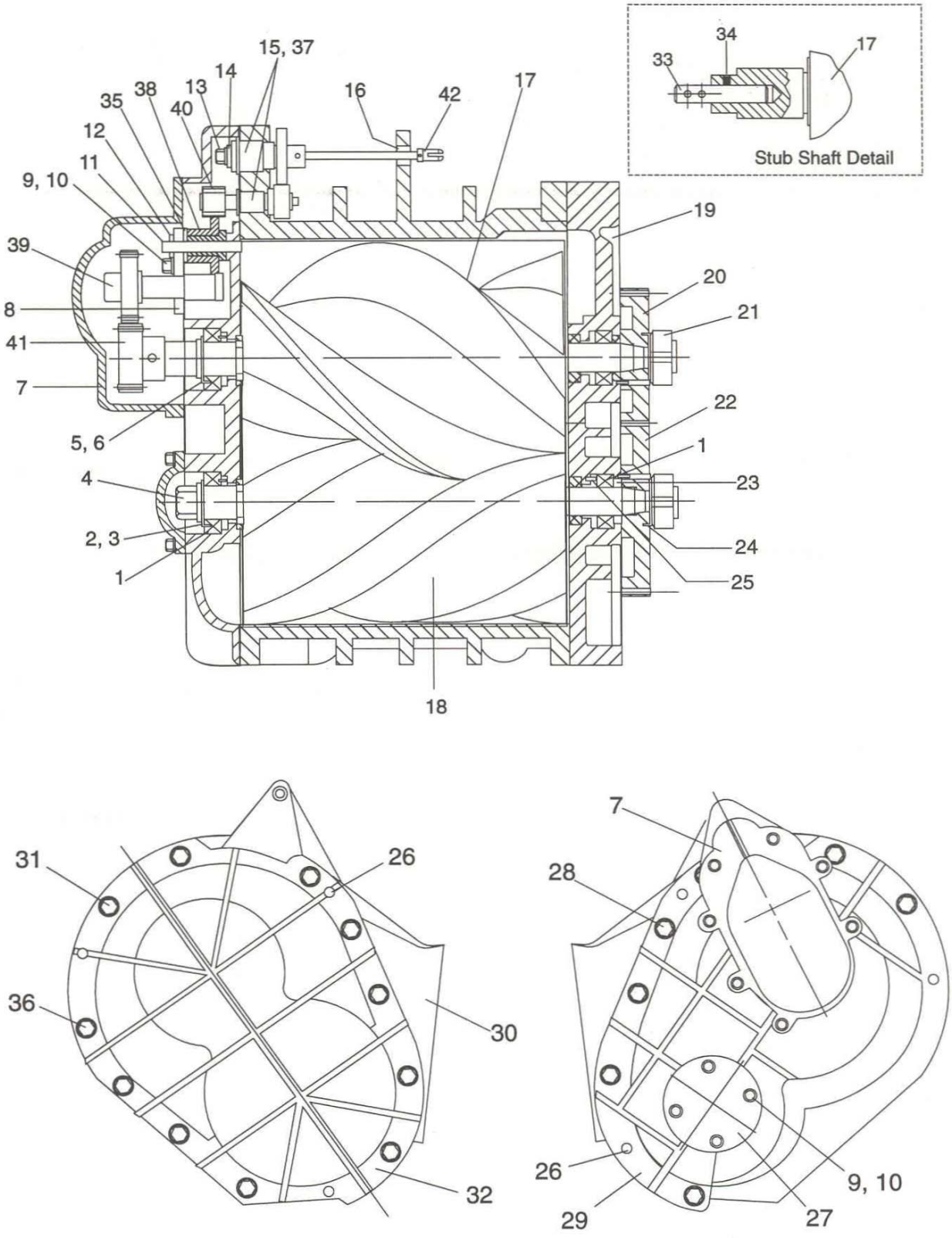


Table 7.5 Parts List - B70CAL/B80CAL Measuring Unit Assembly

Item	Description	Part Number		Qty.
		B-70CAL	B-80CAL	
1	Bearing	155186	155196	4
2	Lockwasher	152270-019	52110	1
3	Washer	151856	151883	1
4	Cap Screw	150156	151766	1
5	Snap Ring	----	156475	1
6	Bearing Key	72238	82238	2
7	Front Gear Cover	72233	82233	1
8	Bearing PlateAss'y	72240	82240	1
9	Lockwasher	152259-019 (14)	152259-019 (15)	-
10	Screw	71564	82564	1
11	Idler Gear	71564	82564	1
12	Cotter Pin	153903	153915	1
13	Snap Ring	156474	153953-019	1
14	Washer	151902	151856	1
15	Bearing Shell	71516	71516	2
16	Bushing	155150	92027	1
17	3-Tooth Rotor	72276-100	82276-100	1
18	4-Tooth Rotor	72286-100	82286-100	1
19	Rear End Cover	72270-100	82270-100	1
20	Drive Gear (3-T)	72291	82291	1
21	Gear Locknut	60592	82592	2
22	Drive Gear (4-T)	72296	82296-002	1
23	SpacerAssembly	72294	82295	2
24	Gear Retainer/Lockwasher	51593	82593-003	2
25	Bearing Dowel	153636	102268	4
26	Dowel Screw	51567(4)	92567 (6)	-
27	Front Bearing Cover	72239	82817	1
28	Screw	151037-019	151017-019	6
29	Front End CoverAss'y	72230-100	82230-100	1
30	Meter Body	72211-100	82211-100	1
31	Screw	----	151028-019	2
32	Rear Gear Cover	71601	82601	1
33	Stub Shaft	51579	92579	1
34	Screw	----	150975-019	1
35	RulonThrust Washer	----	155140	1
36	Screw	151038-019 (8)	151467-419 (9)	-
37	Bushing	155150	155150	4
38	Flanged Rulon Bushing	----	155147	1
39	Compound Driven Gear	71552	92552	1
40	Counter Drive Shaft	71526	92526	1
41	Set Screw	150975	150977-019	2
42	Reduction Gear	71522	92522	1

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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.

Brodie Meter Co., LLC: Manufacturers of BiRotors, Oval Gear Meters, and Control Valves

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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.

Brodie Meter Co., LLC: Manufacturers of BiRotors, Oval Gear Meters, and Control Valves

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