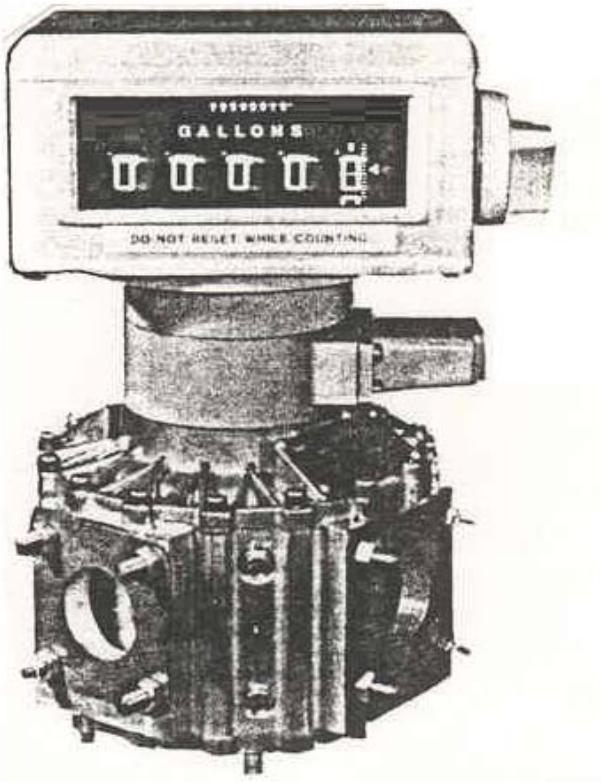
X-2200
Revision 01

Models 2200 & 2250 Cyclone Meter

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.
- 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 Cyclone Meter do not place adverse stresses on the Cyclone Meter. The design of the Cyclone 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 Cyclone 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 Cyclone 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 valve is placed in service. A strainer of proper size should be installed upstream of the meter to protect it from

Notice

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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.

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1.0 Introduction

1.1 Description

The Brodie Model 2200 and 2250 Cyclone Meter, hereafter called meter, is an accurate, high speed, positive displacement meter. It is designed for general purpose petroleum measurement in bulk terminal, platform, truck and aircraft refueling applications.

The standard meter, as supplied by Brodie Meter Co., LLC, consists of a measuring unit encased in a meter body, and a bidirectional mechanical adjustor. Optional mechanical and electro/mechanical accessories are available.

Remove the envelope containing the packing list. Carefully remove the equipment from the packing case. Make sure spare or replacement parts are not discarded with the packing material. Inspect for damaged or missing parts.

Operation is based on a Rotating Crescent principle. As liquid enters the input chamber of the measuring element, an internal cylinder containing two crescent shaped vanes is driven in a clockwise or counterclockwise direction (flow direction dependent). As the cylinder turns within the measuring element the vanes divide and transfer a discrete volume of product to the output port.

A mechanical coupling, attached centrally to the measuring unit, provides rotational mechanical energy necessary to drive registration equipment. As the measuring unit rotates, each revolution is transferred by mechanical output gearing to the adjustor. The adjusted output is then registered in exact engineering units.

1.2 Specifications

Caution

Do not operate meter 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

Non-ferrous Housing: Heat Treated Aluminum
Internal Wetted Parts: Non-Ferrous with Stainless Steel Shafts and Bearing
O-rings:
Buna N (Standard)
Viton, EPR, Teflon and Kalrez (Optional)

Maximum Working Temperature:

-40 to 150°F (-40 to 65°C)

Maximum Working Pressure:

150 psi (1034 kPa) at 150°F (65°C)

Flow Rate

Model 2200: 12 to 150 gpm (45 to 567 lpm)
Model 2250: 20 to 200 gpm (76 to 757 lpm)

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

Prior to installation of the meter the following items of general information and recommendations should be considered.

1. The meter should be mounted on a secure foundation.
2. Care should be taken to assure that the drain plug remains accessible.
   a. A valve may be installed on the drain line to facilitate draining water and sediment from the meter. It is recommended that a security (lock type) valve be used for this application to reduce the chance of accidental draining.
   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. 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 in order to protect it from excessive flow rates and to maintain adequate back pressure.
8. If required, an air eliminator may be installed up-stream of the meter.
9. Do not allow water to remain in the meter. If water enters the meter remove the inner Rotor Assembly and clean it with a light lubricating oil.
10. Facing the meter with the inlet and outlet connections at acute angles, standard flow is from left to right through the meter. The Model 4200 Adjustor is selectable for either direction. Reference Section 4-6 Meter Adjustment.
11. The bolt pattern on the meter adaptor, or Model 4200 Adjustor, allows meter accessories to be rotated in several different

positions. The required position should be determined prior to installing, or providing electrical service (if required) to the meter.

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.
13. It is recommended that all meters be protected by a strainer located directly upstream of the meter.

Figure 3.1 Recommended Strainer Mesh

Product	Strainer Mesh
Gasoline	80 Mesh
Diesel, Heat and Fuel Oils	60 Mesh

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 Starting Flow Through the Meter

1. If large volumes of debris are expected in the process piping during start-up it is recommended that a spool piece be installed as a temporary replacement for the meter until the lines are free of pipe scale, weld beads and other types of foreign materials. The strainer basket may be removed at this time to eliminate the possibility of rupturing.
2. Slowly introduce product into the meter. Open the upstream valve while the downstream valve remains closed.
3. Air may be bled from the system by partially opening the downstream valve and slowly running a quantity of 25 to 50 gallons (95 to 189 liters) of liquid through the meter.
4. Once all air has been eliminated, slowly open the downstream valve.
   a. Allow the meter to run at approximately 20 percent of the maximum rated flow for two minutes.
   b. Observe the rotation of the counter wheels to insure that the meter is operating smoothly.
   c. Continue opening the downstream valve until it is full open. Care should be taken to insure that the maximum flow rate of the meter is not exceeded.
   d. Confirm that the setting on the flow control valve is properly fixed and that it 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 to accessories while in operation. Once adjustor settings have been changed, a small batch of product 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. The meter should be proved 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 (audit trail) for the meter.

Brodie Meter Co., LLC has highly qualified service technicians who are available for start-up assistance. Contact your local Brodie Authorized Repair Center, or Brodie Meter Co., LLC, Statesboro, Georgia, 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 is dependent on such factors as: continuity of service, rate of flow, lubricating value of the product, and cleanliness of the product being metered. Frequently a meter's performance will depend, to a considerable extent, upon the proper functioning of the accessory equipment in service. The following conditions and factors that could influence meter performance should be considered.

1. A meter should be kept filled with the liquid it is measuring. Draining results in the formation of deposits and gums which increase mechanical friction. Any leaking valve that would permit the meter to drain should be repaired or replaced.
2. All petroleum meters should be kept free of water. Routine inspection and drainage of storage tanks should be sufficient protection.
3. The strainer basket should be inspected frequently.
4. Soft closing loading valves should be kept in good working condition.
5. The valves and operating mechanism of an air eliminator should receive routine examination to safeguard against corrosive and gumming conditions.
6. Care should be taken to protect the Counter/ Printer during extreme weather conditions.
7. Brodie Service information should be available for reference at all times.

In most cases it will not be necessary to completely disassemble the entire meter.

4.2 Disassembly Procedure for Removal of Large Dial Register, Adjustor, and Meter Output Gearing

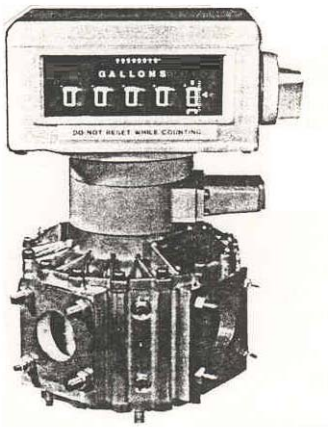
Caution

Before performing 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.

1. Remove the Seal Wire, retaining Screws and Washers connecting the meter Adapter to the Large Dial Register and remove the register (Figure 4.1).

NOTE: *Once the Seal Wires have been broken, 'Weights and Measures" requirements may demand recalibration. Check local, state and federal regulations pertinent to your application.*

Figure 4.1 Meter Assembly

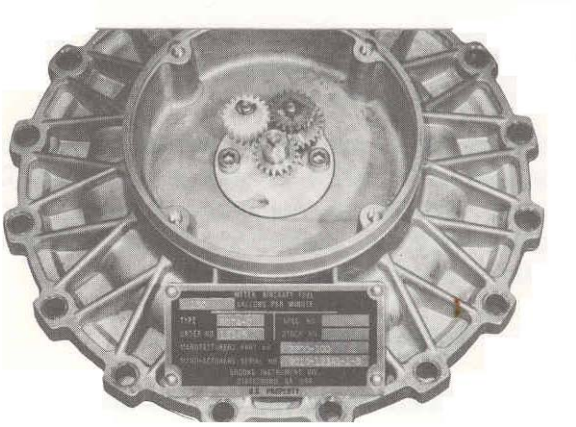


2. Lift out the Output Coupling and Adaptor Extension and reserve for reassembly.
3. To remove the Adaptor from the meter Housing remove the four retaining Screws and lift off.

4. Inspect all Gears for wear and/or damage and replace as required. Both the Compound and Reversing Gears will require the removal of Snap Rings before replacement can be made. Note the location of all Gears before removal. (Figures 4.2 and 4.3)
5. If removal of the Gland Plate is required, remove two retaining screws, lift out the plate and remove and inspect O-rings for wear and/or damage.

If all service and maintenance requirements have been met, proceed to reassembly instructions, Section 4-3. Should further disassembly be required see Section 4-4 Disassembly Procedure for Inspection and Maintenance of the Measuring Unit Rotor Assembly and Parts. Meter error experienced after reassembly could reflect changes in Adjustor Settings.

Figure 4.2 Output Gearing



4.3 Reassembly of Large Dial Register, Adjustor, and Meter Output Gearing

1. Replace O-rings and Gland Plate and secure with retaining Screws.
2. Secure the Adaptor to the Upper Cover of the meter using four Screws.
3. Position output Gears on the meter Shaft and secure Compound and Reversing Gears to their proper location as noted in disassembly. Secure with Snap Rings.
4. Return the Adjustor to its original position assuring that the adjustment apparatus is properly oriented and that a good mechanical coupling is achieved.
5. Insert the Output Coupling and Adaptor Extension into the Adjustor, align with the input Coupling of the Large Dial Register and secure the Register in place using four Washers and Screws.
6. Prove the meter and make all necessary adjustments. Replace Adjustor Cover and make all required security seals.

Figure 4.3 Gland Plate and Gears

4.4 Disassembly Procedure for Inspection, and Maintenance of the Measuring Unit Rotor

4.4.1 Assembly and Parts

Disassembly of the measuring unit and accompanying parts will require recalibration of the meter. To assure that proper Vane and Rotor Assembly clearances have been met, and to best expedite the efficient disassembly/reassembly of the meter, it is important that all procedures be followed as outlined and records kept as suggested.

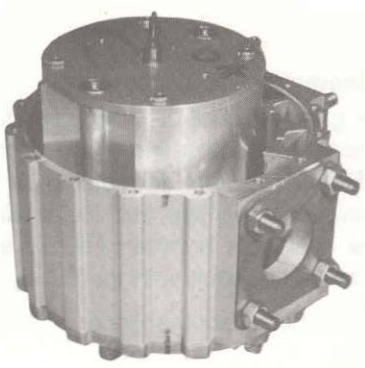
Caution

Before beginning any disassembly procedure, assure that all flow to the meter has been stopped and that pressure has been released from the process line and meter. Any safety precautions associated with the process fluid being measured must be exercised during disassembly and reassembly operations since contact is certain.

4.4.2 Meter Housing Disassembly

1. Using a grease pencil or other non-marring marking instrument, scribe a line at the junction of the Upper Cover and Housing and at the junction of the Lower Cover and Housing making sure that all parts are clearly marked. This will best facilitate reassembly (Figure 4.4).
2. Remove all retaining Screws from the Upper Cover and carefully remove.
3. Inspect O-ring for any possible wear and/or damage. Replace as required.
4. Remove Spring and Spring guide from meter output Shaft and reserve for reassembly.
5. Remove Bearings from Upper Cover as required.
6. Carefully lift the Rotor Assembly from the meter housing.

Figure 4.4 Meter Housing and Rotor Assembly



Caution

Care should be taken not to score or mar the surface of the Rotor Assembly, its component parts, and/or the interior of the Meter Housing as meter callbratlan could be affected.

7. If inspection or replacement of the bottom O-ring seal is required remove the retaining Screws that hold the Lower Cover to the meter Housing, separate the parts and inspect O-ring.
8. Inspect the Gear Base, located in the Bottom Cover, for wear or damage (Figure 4.5).

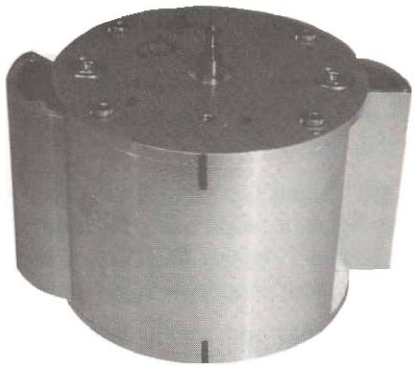
NOTE: *Shims at this location should be gauged using a micrometer and set aside for reassembly. It is important that these Shims be labeled as to thickness and location so as not to be confused with Shims used in other locations.*

Example: 0.002 Shim from Base Gear Assembly.

If all service and maintenance requirements have been met proceed to reassembly instructions, Section 4.5.2. Should further disassembly be required reference instructions below.

Figure 4.5 Housing Assembly and Gear Base

Figure 4.6 Rotor Assembly



4.4.3 Rotor Assembly - Disassembly

1. Using a grease pencil or other non-marring marking instrument scribe a line at the junction of the Upper Plate and Rotor Assembly and at the junction of the Bottom Plate and Rotor Assembly. At this time designate between RIGHT and LEFT Vanes and mark each with an “R” or an “L” (Figure 4.6).
2. Remove Screws from the Upper Plate of the Rotor Assembly.
3. While holding the Rotor Assembly against a firm, non-marring surface, gently tap the underside of the Upper Plate with a rubber or non-marring hammer alternately at both the inlet and outlet ports of the assembly until the plate can be removed by hand (Figure 4.7).

NOTE: *Both the Upper and Lower Plates of the Rotor Assembly are held in position by tightly fitting Pins and Bearings. Under no circumstances should excessive force be used in disassembly as serious damage to the equipment could result. Care should be taken not to damage the surface area between the Upper and Lower plates and the Rotor Assembly.*

4. Remove Bearings from the Upper Plate and inspect for wear.
5. Remove Shims from the left Vane. Measure the thickness of each Shim using a micrometer then label each as to the thickness, placement (Top or Bottom of Vane) and location. (Example: 0.002 Shim-Top-Left Vane). Inspect for wear or damage (replace as required) and set aside for reassembly. This information is vital to establishing proper Vane end clearance at time of reassembly.
6. Remove Shims from the right Vane and repeat the recording procedure outlined in step 5 above. Reserve for reassembly.
7. Turn the Rotor Assembly over to expose the bottom of the Lower Plate and visually inspect the Gears for wear or damage. Continue disassembly as required.
8. Note location of Gears. Timing Gear location, in relation to placement on the Vane Shaft, is critical and must be marked before further disassembly.
   a. Remove Snap Rings from Timing Gears. DO NOT REMOVE Gears at this time.
   b. Slide each Timing Gear to the end of the Vane shaft.
   c. Using a file or permanent, fine tip marker, score an off-center line across both the face of the Gear and the Vane Shaft. (This line will assure proper timing when reassembled). Reference Figure 4-10.
   d. Remove Timing Gears, record location as to placement on left or right Vane and hold for reassembly.
9. Remove Snap Rings and lift off Idler Gears.
10. Both the Left and Right Vanes may be removed at this time.
11. Remove Shims from the bottom of the left Vane. Measure the thickness of each Shim using a micrometer then label each as to the thickness, placement (Top or Bottom of Vane) and location. (Example: 0.003 Shim-Bottom-Left Vane). Inspect for wear or damage (replace as required) and set aside for reassembly.
12. Remove Shims from the bottom of the right Vane and repeat the recording procedure described in Step 11 above. Reserve for reassembly.
13. Carefully inspect all parts for wear or damage and clean in a light weight, non-abrasive cleaning solution compatible with the meter metallurgy and set aside.

Caution

At no time should surface areas be distorted in any way. Burrs or excessive scarring present on Vane surfaces can be removed using a fine grade hardware cloth; however care should be taken not to alter the overall surface area.

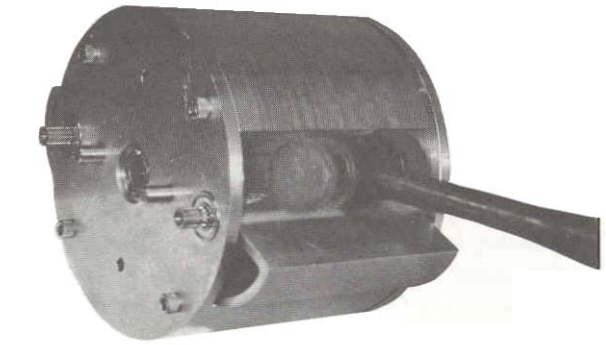
14. To dismantle the Bottom Plate from the Rotor Assembly remove the four retaining Screws and gently tap the interior Bottom Plate at both inlet and outlet ports (using a rubber or non-marring mallet) until the parts can be separated by hand. Care should be taken not to damage the surface area of the Upper and Lower Plates and the Rotor Assembly.
15. Remove Bearings and inspect for wear or

damage.

4.5 Reassembly Procedure for Complete Meter and Rotor Assembly

All parts subject to wear should be inspected and replaced as required. Thoroughly clean all parts in a cleaning solution compatible to the metallurgy of the meter and air dry. Do not remove any markings applied during disassembly procedures.

Figure 4.7 Rotor Assembly/Disassembly



4.5.1 Rotor Assembly

1. Line up the Lower Plate of the Rotor Assembly to the Rotor as previously marked in the disassembly procedure (Line to Line). Align the roll Pin with the drilled hole in the Lower Plate and tap in place using a Rubber or non-marring Mallet.
2. Secure with four retaining Screws.
3. Return Idler Gears to their original positions and secure with Snap Rings.
4: Press Bearings into the Lower Plate.
5. Referring to notes, replace Shims to their proper positions on the bottom of each of the left and right vanes and insert through the Bearings and Lower Plate of the Rotor Assembly.

> ***NOTE:*** *The long, grooved shaft of the Vanes face the bottom of the Rotor Assembly.*

6. Identify and return the Timing Gears to the assigned Vane.
7. Line up all markings to achieve exact timing, press onto the Vane shaft and secure with Snap Rings.
8. Referring to notes, reposition all upper Vane Shims (Left to Left, Right to Right).
9. Press Bearings into the Upper Plate of the Rotor Assembly and position over Rotor and Vanes. Previous markings should line up (top to bottom) with the Roll Pin in place. Gently tap the Upper Plate into position using a rubber or non-marring mallet and secure with retaining Screws.
10. Using a feeler gauge check the distance between the top and bottom Vane surfaces and the Upper and Lower Plates. A clearance of 0.003" (0.076 mm) is required between the Vane and Upper Plate. A minimum clearance of 0.004" (0.102 mm) is required between the Lower Plate and the Vane. All clearances are based on a level condition between the internal bearing surface and Upper and Lower Plates. Additional shimming may be required to make these surfaces flush.

4.5.2 Meter Assembly

1. Properly orient the slotted Gear Base to the inside Lower Cover and secure into position using the retaining Screw.
2. Position the bottom O-ring between the Lower Cover and the meter Housing and attach using the Screws previously removed.
3. Return the Gear Base Shims to their original position.
4. Lower the Rotor Assembly into the meter Housing and establish a good mechanical connection between the Idler Gears of the Rotor Assembly and the Gear Base. A clearance of 0.005" must be maintained between the Lower Lid of the Rotor Assembly (and Bearing), and the top surface of the Gear Base.
5. Rotate the Rotor Assembly several revolutions to assure smooth operation. If proper timing has been maintained, clearance between the Vanes and the Divider Plate will be 1/4 to 5/16" (6.35 to 7.94 mm) in all directions. Clearances other than stated indicate that timing has been disrupted and will require additional servicing. If timing has not been maintained:
   a. Check Timing Gear position in relation to grooved Vane Shaft. If marked and labeled (as previously recommended) an uninterrupted, scored line will extend across

the face of each. Remove the Snap Ring and reposition as required.

b. Once it is established that proper alignment has been made, secure Gears with Snap Rings and return the Rotor Assembly to the meter Housing.

c. Repeat Step 5 above.

d. If proper timing still has not been achieved further repositioning of the Timing Gears must take place. Working with one Vane at a time, remove the Snap Ring and reposition the Timing Gear approximately 180 degrees from the original position. Reassemble and repeat Step 5. Continue until proper timing is achieved.

6. Inspect O-ring on output shaft for nicks, cuts or wear and return to original position.
7. Return the Spring Guide to the output shaft of the Rotor Assembly, guide surface up.
8. Position Spring.
9. Press Bearings into the Upper Cover of the meter Housing and reposition O-ring.
10. Align the Housing and Upper Cover according to marks previously made (Top to Bottom) and secure with screws.
11. Using the screws removed during disassembly, attach the Adaptor, with gears in place, to the Upper Cover.
12. Position the small Gear on the meter output shaft assuring that a good mechanical gear coupling is made.
13. Place the Compound Gear (with Bushing) on the meter output shaft and assure mechanical gear contact.
14. PIace the Adjustor Input Coupling at the top of the meter output shaft.
15. Position the Adjustor within the Adaptor housing so that manual adjustment can be made through the open port. Insert the Output Coupling of the Adjustor and the Adaptor Extension into the fitted slot and turn until a positive fit is established with the Input Coupling. The Adjustor will drop into position. Secure using retaining Screws.
16. Position the Large Dial Register over the Adaptor Extension to assure a good mechanical coupling, rotate the Large Dial Register to the desired viewing position and lock into place using four Screws. Zero Register before use.

4.6 Meter Adjustment

Mechanical adjustment to output registration can be made externally through the Model 4200 Adjustor. This is accomplished by changing ratios between the meter output shaft and the counter input coupling.

The Model 4200 Adjustor: The Model 4200 Adjustor is a bidirectional mechanical gear assembly designed for use with a variety of Brodie Meters. This self contained unit mounts directly to the meter between the output shaft and the counter adapter. Changes in output registration is accomplished through both FINE and COARSE Adjustment Knobs located within a sealed security cover.

Once accessed, lift the locking plate and push the selected adjustment knob IN to DECREASE the counter reading or pull OUT to INCREASE the counter reading.

Each groove of the FINE adjustment equals:
- 0.05 (1/20) percent of the volume delivered
- 0.0005 gallons per gallon delivered
- 0.116 cubic inch (U.S.) per gallon delivered
- 0.064 ounce (U.S.) per gallon delivered
- 0.139 cubic inch (Br.lmp.) per gallon delivered
- 0.50 cc per liter delivered

Each groove of the COURSE adjustment equals:
- 0.60 (1/5) percent of the volume delivered
- 0.006 gallons per gallon delivered
- 1.386 cubic inch (U.S.) per gallon delivered
- 0.768 ounce (U.S.) per gallon delivered
- 1.665 cubic inch (Br.lmp.) per gallon delivered
- 6.0 cc per liter delivered

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 meter or adjustor and register.	Remove adjustor. If output shaft of Adjustor is not turning with metered fluid, replace coupling or Adjustor as required.
Meter runs but is noisy.	Meter not Timed Properly	Check vane and rotor assembly clearances. Reset clearances or time of meter.
	Damaged Rotor Assembly or Vanes	Remove rotor assembly. Inspect for scored or damaged parts. Replace or repair as required.
	Worn Bearings	Inspect all bearings following disassembly procedures and replace as required.
	Worn or Damaged Gears in Adjustor Gear Assembly	Disassemble meter down to the adjustor and inspect for worn or damaged gears. Replace as required.

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 Cyclone Meter. 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 Exploded View of Model 2200 and 2250 Cyclone Meter

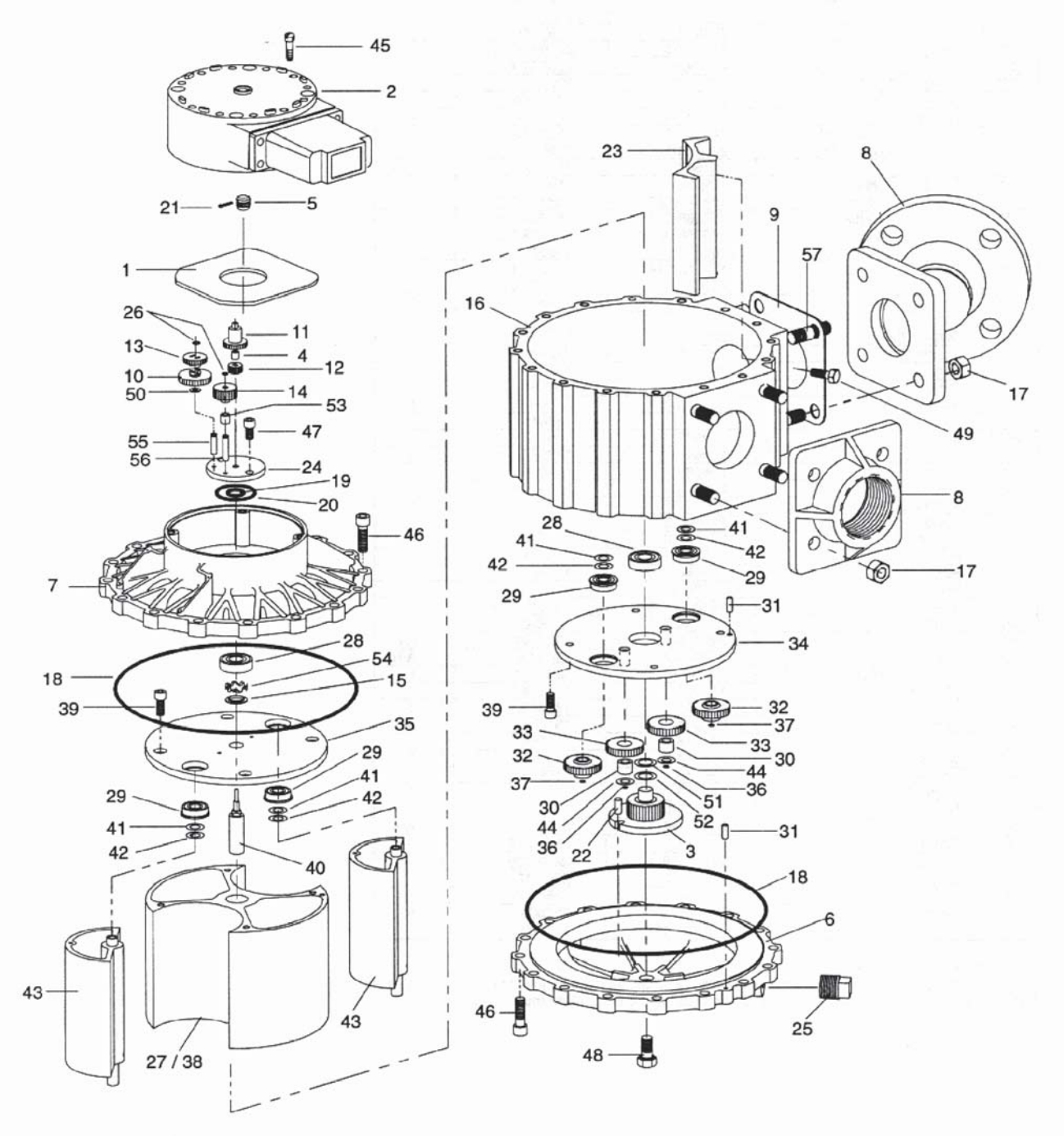


Table 7.1 Parts List - Complete Assembly

Item	Description	Part Number		Qty
		Model 2200	Model2250	
1	Locator Plate	2200-046	2200-046	1
2*	Adjustor: Model 4200	4200	4200	1
3	Base Gear	2200-037	2250-337	1
4	Rulon Bushing	159665	159665	1
5*	Input Coupling	4125	4125	1
6	Lower Cover	2200-009	2200-009	1
7	Upper Cover	2200-008	2200-008	1
8	Flange	C/F	C/F	2
9*	Flange Gasket : Military	51307-800	51307-800	2
	Brodie	51307	51307	
10**	Gear	2200-007	2250-007	1
11**	Gear	2200-033	2200-033	1
12**	Gear	2200-024	2250-024	1
13**	Compound Gear	2200-003	2250-003	1
14**	Reversing Gear	2200-002	2250-002	1
15	Spring Gear	2200-086	2200-086	1
16	Housing: Military Flg.	2200-001	2250-001	1
	Brodie Flg.	2200-101	2250-101	
17	Nut	151547	151547	8
18*	O-ring: Nitrile	159678	159678	2
	Viton	159678-022	159678-022	
19*	O-ring: Nitrile	157068-114	157068-114	2
	Viton	157068-022	157068-022	
	Teflon	159577	159577	
20*	O-ring: Buna	157012-114	157012-114	2
	Viton	157012-022	157012-022	
21	Pin	153901	153901	1
22	Pin	154083	154083	1
23	Divider Plate	2200-011	2250-011	1
24	Divider Gland	2200-013	2250-013	1
25	Plug	154715	154715	1
26	Ring	156484	156484	2
27	Rotor Assembly	2206-100	2206-100	1
28*	Bearing	159641	159641	2
29*	Bearing	159677	159677	4
30*	Bushing	159643	159677	2
31	Dowel	154086	154086	3
32	Gear	2200-038	2250-138	2
33	Idler Gear	2200-036	2250-036	2
34	Lower Plate	2200-022	2250-022	1
35	Upper Plate	2200-018	2200-018	1
36	Ring	153954	153954	2
37	Ring	159664	159664	2
38	Rotor	2200-006	2250-006	1
39	Screw	151010-019	151010-019	8
40	Shaft	2200-027	2200-027	1
41	Shim(.002)	2200-041	2200-041	A/R
42	Shim(.003)	2200-042	2200-042	A/R
43	Vane Assembly	2200-015	2250-015	1
44	Washer	151934	151934	2
45	Screw	150565	150565	4
46	Screw	151491	151491	32
47	Screw	151056	151056	2
48	Screw	159644	159644	1
49	Screw	159645	159645	2
50	Shim	152503	152503	1
51	Shim(.002)	2200-043	2200-043	A/R
52	Shim(.003)	2200-044	2200-044	A/R
53	Spacer	2200-017	2250-017	A/R
54	Spring	2200-039	2200-039	1
55	Stud	2200-012	2250-121	1
56	Stud	2200-021	2250-121	1
57	Stud: Short	151365	151365	8
	Long	151423-419	151423-419	

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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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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

X-2200 Addendum

Cyclone Meter, Model 2200

Instructions for Reversal of Output Shaft Turning Direction

Figure 4-2 and Figure 4-3 of Installation and Operation Instructions Manual No. X-2200 shows the output gearing of the Cyclone Meter.

Note: The center gear drives an off-center mounted gear. On top of this gear is located a third gear which in turn drives a fourth gear.

If it is desired to change the direction of the final output shaft in order to obtain the proper register reading, the following action is required.

1.) Remove the stack-up, including the adjustor.
2.) Remove the retainer clip on the third and fourth gears as shown is Fig 4-2 and Fig 4-3.
3.) Remove each gear from its respective shaft, turn each gear over and place back on the proper shaft.
4.) The third gear will engage snugly in the butterfly coupling of the second gear. The fourth gear will be idle, not engaging. Do not discard in case the direction will be changed at a later date.
5.) Replace the retainer clips
6.) Install the stack-up components
7.) Return the meter to operation and verify output direction.