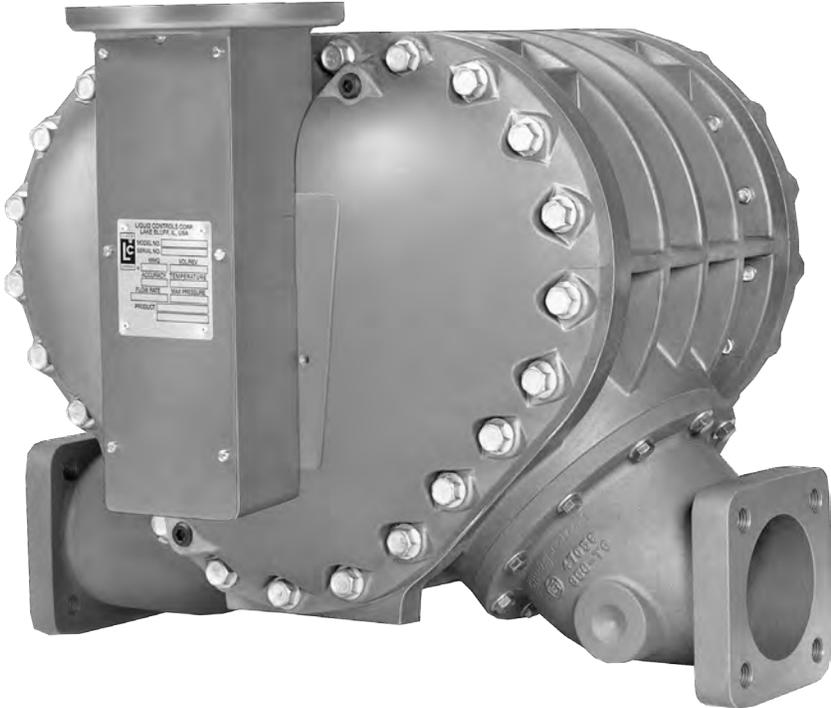


M/MA Meters

Installation & Setup Guide



LIQUID CONTROLS®

An IDEX Energy & Fuels Business

TABLE OF CONTENTS

INTRODUCTION

Safety Procedures.....	3
Owner's Information Packet.....	4
Serial Number Plate Locations.....	5
How LC Meters Work	6

INSTALLATION & OPERATION

Installation Requirements.....	7
Operation Requirements	8
Meter Start Up and Operation	9
Reversing the Meter Registration.....	10
Setting the Standard Adjuster	11

MAINTENANCE

Maintenance Requirements	12
Relieving Internal Pressure	13
Servicing the Drive Components.....	13
Removing the Dust Cover	13
Removing the Adjuster and Adjuster Drive Assembly	14
Servicing the Packing Gland.....	15
Packing Gland Retaining Plate	15
Disassembling the Meter.....	16
Removing Non-Corroded Rotor Gears.....	17
Removing Corroded Rotor Gears	17
Reassembling the Meter	18
Timing the Rotor Gears.....	19
Torque Chart	21
Wrench and Socket Size Chart.....	21
Troubleshooting.....	22
How to Order Replacement Parts	23

BILL OF MATERIALS

Bill of Materials.....	24
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Be Prepared

! WARNING

- Before using this product, read and understand the instructions.
- All work must be performed by qualified personnel trained in the proper application, installation, and maintenance of equipment and/or systems in accordance with all applicable codes and ordinances.
- When handling electronic components and boards, always use proper Electrostatic Discharge (ESD) equipment and follow the proper procedures
- Make sure that all necessary safety precautions have been taken.
- Provide for proper ventilation, temperature control, fire prevention, evacuation, and fire management.
- Provide easy access to the appropriate fire extinguishers for your product.
- Consult with your local fire department, state, and local codes to ensure adequate preparation.
- Read this manual as well as all the literature provided in your owner's packet.
- Save these instructions for future reference.
- Failure to follow the instructions set forth in this publication could result in property damage, personal injury, or death from fire and/or explosion, or other hazards that may be associated with this type of equipment.

Publication Updates and Translations

The most current English versions of all Liquid Controls publications are available on our web site, www.lcmeter.com. It is the responsibility of the local distributor to provide the most current version of LC manuals, instructions, and specification sheets in the required language of the country, or the language of the end user to which the products are shipping. If there are questions about the language of any LC manuals, instructions, or specification sheets, please contact your local distributor.

NOTICE

This manual provides warnings and procedures that are intended to inform the owner and/or operator of the hazards present when using the Liquid Controls Meter on LP-Gas and other products. The reading of these warnings and the avoidance of such hazards is strictly in the hands of the owner-operators of the equipment. Neglect of that responsibility is not within the control of the manufacturer of the meter.

Safely Evacuate Piping System

! WARNING

Before disassembly of any meter or accessory component:

- All internal pressures must be relieved and all liquid drained from the system in accordance with all applicable procedures.
- Pressure must be 0 (zero) psi.
- Close all liquid and vapor lines between the meter and liquid source.

For Safety Rules, refer to local authorities and relevant NFPA Codes.

Failure to follow this warning could result in property damage, personal injury, or death from **fire and/or explosion, or other hazards that may be associated with this type of equipment.**

In the Event of a Gas Fire



IN THE EVENT OF LARGE FIRES OR FIRES THAT ARE SPREADING

- Evacuate the building and notify your local fire department.
- Stop the leakage only if you can safely reach the equipment.

IN THE EVENT OF SMALL, CONTAINED FIRES THAT YOU CAN SAFELY CONTROL

- Stop the leakage if you can safely reach the equipment.
- Use the appropriate extinguisher: Class B fire extinguisher, water, fog, etc., depending on the materials.
- If in doubt, call your local fire department.

In the Event of a Gas Leak



IN THE EVENT OF A LARGE GAS LEAK

- Evacuate the area and notify the fire department.

IN THE EVENT OF A SMALL, CONTAINED GAS LEAK

- Stop the leak and prevent accidental ignition.
- Prevent the entrance of gas into other portions of the buildings. Some gases, such as LPG, seek lower levels, while other gases seek higher levels.
- Evacuate all people from the danger zone.
- See that the gas is dispersed before resuming business and operating motors. If in doubt, notify your local fire department.

OWNER'S INFORMATION PACKET

Inquires, Orders, and Service

Please have the following information available when you make inquires, order replacement parts, or schedule service. If a specific meter accessory is involved, please provide the model and serial number of the accessory in question.

Your Meter's Serial Number: _____

Your Full-Service Distributor: _____

Your Full-Service Distributor's Telephone Number: _____

Owner's Information Packet

1. CHECK YOUR OWNER'S INFORMATION PACKET

LC meters come in many variations. The information sent to you depends on the accessories you have ordered with your meter. Make an inventory of your red Owner's Information Packet. First, find your LC packing slip with the computer printout. Locate the serial number and the meter model number on this printout. Cross reference the packing slip number with the actual meter numbers. The illustration on following page will help you locate the Specification and Serial Number Plates on the meter and its accessories.

2. RECORD YOUR METER SERIAL NUMBER

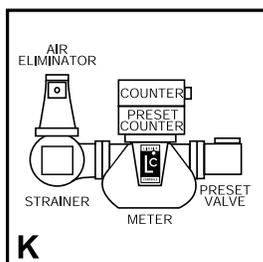
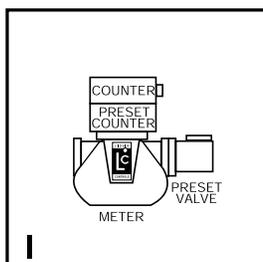
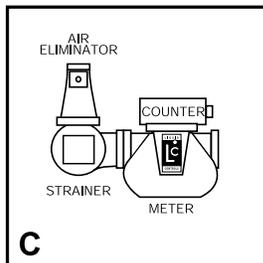
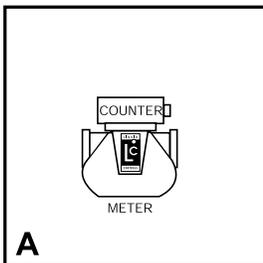
Record your meter serial number and your full-service distributor's name and telephone number in the space provided above. Save this information and keep it handy. When calling for service or parts, you will need to supply your meter serial number and model number. See *How to Order Replacement Parts* on page 23 for more information.

3. IDENTIFY YOUR METER'S MODEL-ACCESSORY LETTER.

Use the diagrams below to familiarize yourself with meter accessories. Find the meter and letter on the diagram which represents your meter system, then check with the chart below to see that your red owner's information packet is complete. Not all accessory levels are available for every model of LC meter.

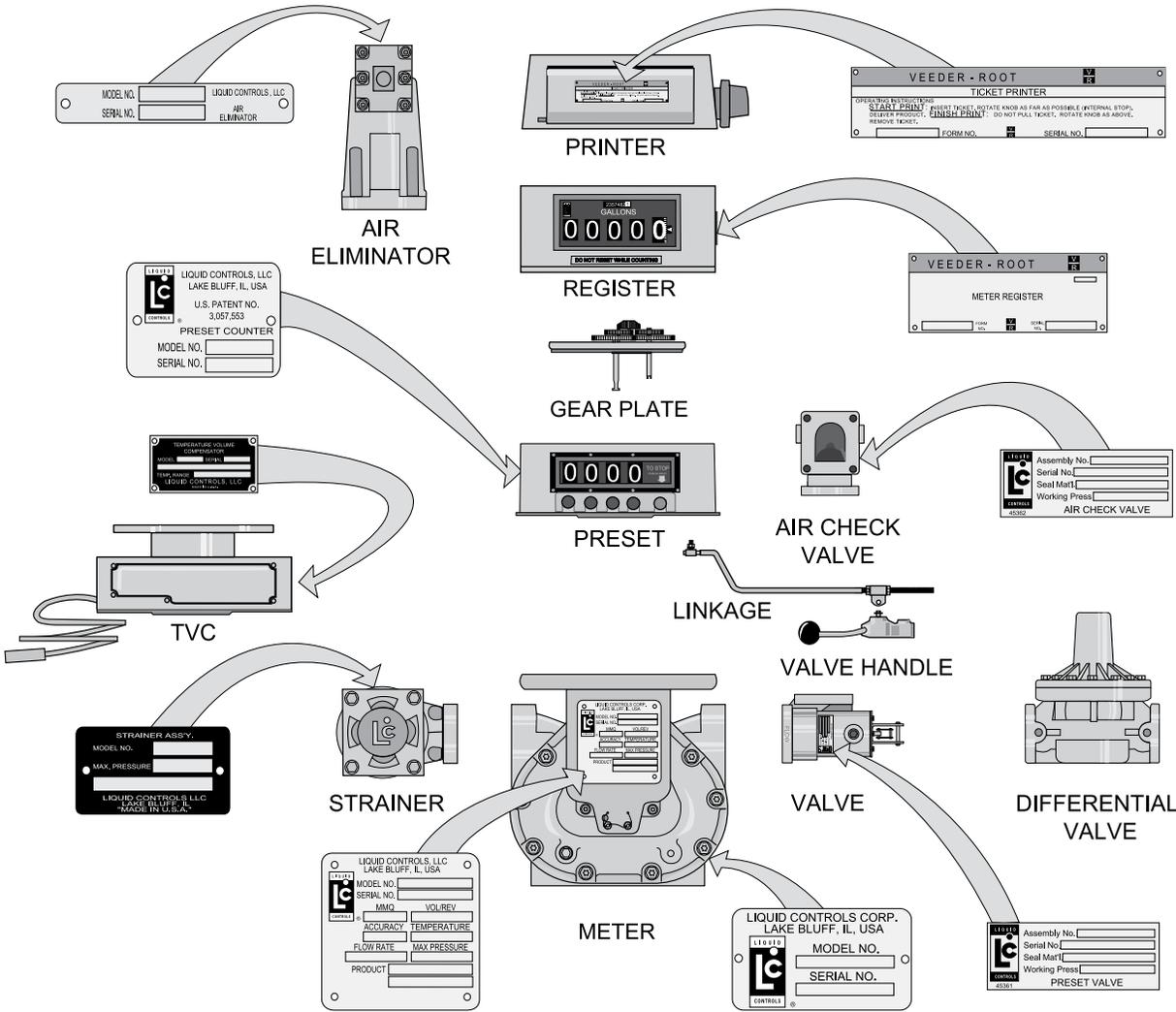
4. MAKE SURE ALL DOCUMENTATION IS INCLUDED WITH YOUR METER

Check your red Owner's Information Packet against the diagrams below to make sure that all the documentation needed for your meter and accessories is included in your packet. If documentation is missing, contact your full-service distributor or Liquid Controls or visit www.lcmeter.com where you can find the most up-to-date LC literature.



LITERATURE DESCRIPTION	ACCESSORY MODEL			
	A	C	I	K
LC PACKING LIST (COMPUTER PRINTOUT)	✓	✓	✓	✓
CUSTOMER RESPONSE CARD	✓	✓	✓	✓
M/MA METER MANUAL	✓	✓	✓	✓
"Your Meter" SUPPORT AND PARTS MANUAL	✓	✓	✓	✓
AIR ELIMINATOR MANUAL		✓		✓
STRAINER MANUAL		✓		✓
PRINTER MANUAL				
COUNTER MANUAL	✓	✓	✓	✓
PRESET COUNTER MANUAL			✓	✓
PRESET VALVE MANUAL			✓	✓
OTHER ACCESSORIES				

SERIAL NUMBER PLATE LOCATIONS



Specification and Serial Number Plate Locations for Mechanical Meter System Components

For components not pictured, refer to the components' manual if you can not find the Serial Number Plate on the component.

HOW LC METERS WORK

Liquid Controls meters are positive displacement meters. They are designed for liquid measurement in both custody transfer and process control applications. They can be installed in pump or gravity flow systems. Because of their simple design, they are easy to maintain, and easy to adapt to a variety of systems.

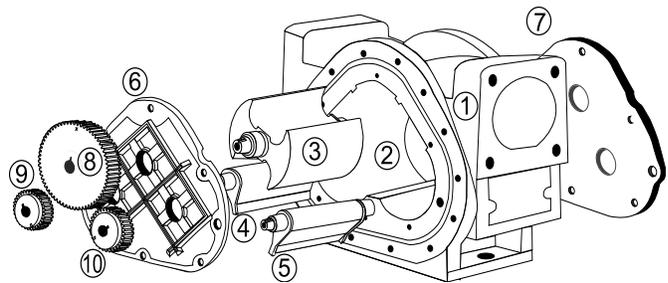
The meter housing (1) is designed with three cylindrical bores (2). Three rotors, the blocking rotor (3) and two displacement rotors (4, 5), turn in synchronized relationship within the bores. The three rotors are supported by bearing plates (6, 7). The ends of the rotors protrude through the bearing plates. The blocking rotor gear (8) is placed on the end of the blocking rotor. The displacement rotor gears (9, 10) are placed on the ends of the displacement rotors. These gears create the synchronized timed relationship between the three rotors.

As fluid moves through the meter housing, the rotor assembly turns. The liquid is broken into uniform sections by the turning rotors. Fluid displacement occurs simultaneously. As fluid enters, another portion of the fluid is being partitioned and measured. At the same time, the fluid ahead of it is displaced out of the meter and into the discharge line. Since the volume of the bores is known, and the same amount of fluid passes through the meter during each revolution of the blocking rotor, the exact volume of liquid that has passed through the meter can be determined with a high degree of accuracy.

This true rotary motion is transmitted through the packing gland, the face gear, the adjuster drive shaft, and the adjuster to the register stack and counter. True rotary motion output means consistent accuracy since the register indication is in precise agreement with the actual volume throughput at any given instant.

At any position in the cycle, the meter body, the blocking rotor, and at least one of the displacement rotors form a continuous capillary seal between the unmetere upstream product and the metered downstream product.

Because the product is separated by the capillary seal,



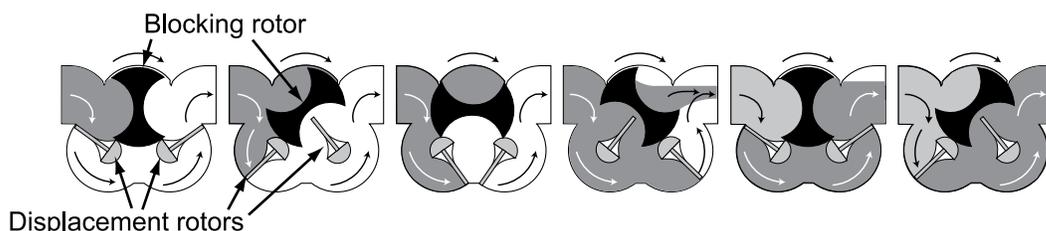
Meter Element Exploded Line Drawing

no metal-to-metal contact is required within the metering element. This means no wear. No wear means no increase in slippage, and no increase in slippage means no deterioration in accuracy.

Throughout the metering element, the mating surfaces are either flat surfaces or cylindrical faces and sections that are accurately machined. These relatively simple machining operations, plus the fact that there is no oscillating or reciprocating motion within the device, permits extremely close and consistent tolerances within the LC meter.

The product flowing through the meter exerts a dynamic force that is at right angles to the faces of the displacement rotors. The meter is designed so that the rotor shafts are always in a horizontal plane. These two facts result in no axial thrust; therefore, LC meters do not need thrust washers or thrust bearings, the rotors automatically seek the center of the stream between the two bearing plates, eliminating wear between the ends of the rotors and the bearing plates. Once again, no wear results in no metal fatigue and no friction.

Liquid Controls meters are made of a variety of materials to suit a variety of products. Because of their no-wear design, capillary seals, and unique rotary metering, LC meters provide unequalled accuracy, long operating life, and unusual dependability.



INSTALLATION REQUIREMENTS

- **TAKE ALL NECESSARY SAFETY PRECAUTIONS**

Make sure that all necessary safety precautions have been taken. Provide for proper ventilation, temperature control, fire prevention, evacuation and fire management.

- **PROVIDE ACCESS FOR FIRE EXTINGUISHERS**

Provide easy access to the appropriate fire extinguishers for your product. Consult with your local fire department and state and local codes to make sure that you are adequately prepared.

- **READ PROVIDED LITERATURE**

Read this manual as well as all the literature provided in your red Owner's Information Packet. If you have any questions, consult with your full-service distributor or call the Service Department at Liquid Controls.

- **CONFORM TO ALL CODES**

Install the meter and accessories in conformance with applicable state and federal construction, electrical and safety codes.

- **LEAVE THREAD CAPS IN PLACE**

Before shipment, protective thread caps are placed in all meter and accessory openings. They should remain in place until you are ready to attach piping.

- **FLUSH PIPING**

Prior to meter installation, the entire piping system should be thoroughly flushed of all debris with a liquid that is compatible with the construction of the meter.

- **KEEP EXTERNAL SURFACES OF THE METER CLEAN**

- **MOUNT METER SECURELY**

The meter must always be securely bolted to a platform or supporting member, regardless of the mounting position of the meter. Never "hang" a meter on the connecting piping.

- **PREVENT PIPE STRAIN OR STRESS**

Prevent pipe strain or stress from occurring when making meter or accessory repairs. Pipe strain and stress occurs when the pipes are not supported or are not aligned correctly to the meter. The weight of the pipes must always be supported independent of the meter. This means that the meter and accessories can be easily removed without affecting the pipes or the pipe alignment. Never leave any of the pipes hanging.

- **INSTALL METER ONLY ON THE DISCHARGE SIDE (DOWNSTREAM) OF THE SYSTEM PUMP**

- **APPLY PIPE COMPOUND TO MALE THREADS ONLY**

- **LEAVE SPACE FOR FUTURE MAINTENANCE**

Position the meter with service in mind. Provide ample work space. Removing covers can be difficult when work space is not available. Always supply a platform or support for the meter mounting.

- **USE METER ONLY WITH SPECIFIED LIQUIDS**

A meter is metallurgically designed to be physically compatible with the type of liquid originally specified by the customer, and as indicated on the Serial Number Plate. A meter should not be used with a liquid different from the liquid originally specified, unless the physical characteristics and pH rating are similar and the application has been checked with LC Sales and Engineering through your full-service distributor.

! WARNING

Under normal operation, do not expose any portion of the LP-Gas system to pressures in excess of rated working pressures without an automatic safety valve to vent the over pressure discharge to a place of safety away from the operator and other people.

Failure to provide such a safety relief may result in leakage or rupture of one or more of the components in the system. This can result in injury of death from the **gas, a fire, or pieces of flying debris** from the rupture.

Class 10 LPG Meters - Codes

Class 10 LPG meters must be installed in accordance with the requirements of ANSI-NFPA 58 in addition to all other state and local codes.

- **INSTALL A STRAINER**

Install a strainer on the meter inlet to avoid damage from foreign matter, such as weld slag, from entering the system. The strainer must always be located on the inlet side.

- **TAG FLOW DIRECTION**

All meters are tagged identifying their direction of flow. Meters are set with a flow direction of left to right as standard. However, when a meter is ordered, the customer can specify that the flow be set from either direction. If the meter register counts in reverse, the meter is reading the direction of flow in reverse. If this occurs, the meter registration must be reset. For mechanical output meters, see *Reversing the Meter Registration* on page 10. For electrical output meters, such as meters equipped with a pulser or an electronic register, refer to the manual of the electronic component.

- **USE CURRENT ENGINEERING DRAWINGS**

Always request up-to-date, engineering approved, dimensional drawings before starting any construction. Do not rely on catalog pictures or drawings. They are for reference only. After receiving prints, check to see that all equipment ordered is shown and that any extra pressure taps, plugs, etc. are noted and their size specified.

OPERATION REQUIREMENTS

- **THE METER MUST REMAIN FULL OF PRODUCT AT ALL TIMES.**

An easy way to accomplish this is to put the meter assembly in the line below the piping center-line (a sumped position). This requires adding elbows and flanges prior to installing the meter. The meter should be installed in a bypass loop, below the pipe center-line, with block valves upstream and downstream of the meter inside the bypass loop. A block valve should be located in the main pipeline and labeled as the bypass valve.

- **PIPING PRESSURE RELIEF**

Any portion of pipe system that might isolate or block flow should be provided with a pressure relief to prevent damage from thermal expansion. There are excellent benefits to this type of installation. First, the meter is kept full. Second, this type of installation allows the meter to be isolated for servicing and calibration while continuing flow through the bypass valve.

- **MAINTAIN UPSTREAM LINES**

Upstream lines must be maintained full to prevent air from entering the meter. If upstream or inlet lines are constructed in a manner which allows reverse flow, foot valves, or back checks must be installed.

- **UNDERGROUND TANKS, SUBMERSIBLE PUMPS**

Underground tanks that are furnished with a submersible pump will eliminate many problems that occur with positive displacement pumps (suction pumps) when suction piping is incorrectly sized or when the lift is too great.

- **API MANUAL OF PETROLEUM MEASUREMENT STANDARDS**

Every meter should be calibrated under actual service and installation conditions per the API Manual of Petroleum Measurement Standards:

The following chapters of the API Manual of Petroleum Measurement Standards supersedes the API standard 1101.

Chapter 4 - Proving Systems

Chapter 5 - Metering

Chapter 6 - Metering Assemblies

Chapter 11 Section 2.3 - Water Calibration of Volumetric Provers

Chapter 12 Section 2 - Calculation of Petroleum Quantities

- **PROVIDE A MEANS OF CONVENIENTLY DIVERTING LIQUID FOR CALIBRATION PURPOSES**

- **EVALUATE PUMPING EQUIPMENT**

Give careful attention to your system's pumping equipment and piping. Because of their influence on liquid being measured as it enters the metering assembly, systems should be made free of conditions that cause or introduce entrained air or vapor.

- **FOLLOW THE MANUFACTURER'S RECOMMENDATION FULLY WHEN INSTALLING PUMPS**

Give particular attention to factors like: use of foot valves, pipe size to the inlet, and conformance to net positive suction head (NPSH) conditions when suction pumping is required. Follow the manufacturer's recommendations to minimize air and vapor elimination problems.

- **LIGHT HYDROCARBONS AND SIMILAR LIQUIDS**

For liquids such as light hydrocarbons that tend to flash or vaporize easily at higher ambient temperatures, it is advantageous to use flooded suctions and piping sized larger than the nominal pump size.

- **VEHICLE TANK INSTALLATIONS**

On vehicle tank installations, the layout of the system's piping is crucial in preventing problems with split compartment test conformance. Piping should slope away from a positive displacement pump to prevent resurgent re-priming of the pump due to drain back.

- **AVOID HYDRAULIC SHOCK**

Hydraulic shock is harmful to all the components of an operating system, including the valves, the meter, and the pump. Because of the high precision with which they measure products, meters, in particular, must be protected against hydraulic shock. The best protection against hydraulic shock is to prevent it from occurring. To prevent hydraulic shock, adjust the closing rate of the valve until shock does not occur.

- **AVOID THERMAL EXPANSION**

Thermal expansion, like hydraulic shock, can easily damage meters and other components in the system. When designing the system, include pressure relief valves in any portion or branch of the system that might be closed off when an operating or block valve is closed.

METER START UP AND OPERATION

Prior to meter start up, use extreme caution. Make sure that:

1. The meter is properly secured
2. All connections are tight
3. All valves are in the closed position

PLACING YOUR METER IN OPERATION

When placing your meter in operation, the meter and system must be filled slowly with liquid and be free of air prior to start-up. Extreme care must be taken to avoid damaging the meter during this time. When filling the system with liquid for the first time, gravity filling is the preferred method of filling the system with liquid. Gravity filling uses positive head pressure from product storage above the inlet port of the meter to fill the system. If necessary, systems can be filled with the pump.

Dead Head Pressure - Pumps

Make sure that your pump can operate against a dead head pressure. If not, consult the factory for assistance.

Prime the Pump First

Prime the pump before using it to fill the system. Consult the pump manufacturer for proper pump priming.

To fill the meter and system with liquid:

1. Make sure all valves (upstream and downstream of the meter) in the system are closed.
2. Open the valve located at the storage tank a small amount. Provided there is not a valve between the tank and the meter inlet, the meter's register/counter will start to move and then stop. If there is another valve between the tank and meter, repeat this process with each valve until the meter is exposed to the liquid.
3. Once you are assured that the meter has registered some volume and stopped, continue to open the tank valve until it is completely open.
4. With the valve(s) open between the tank and the meter, slowly open the downstream valve until the meter's register/counter starts to move. Do not run the meter any faster than 25% of its rated flow during start-up. Once the product is flowing out of the end of your system, the outlet valve can be opened all the way, provided that the system is designed not to exceed the flow rate marked on the meter.

If the valves are not manual, consult the valve manufacturer for slow flow start-up.

- **NEVER OPERATE THE METER OR SYSTEM WHEN PARTIALLY FILLED WITH LIQUID, OR WITH POCKETS OF COMPRESSED AIR OR VAPOR PRESENT.**

If these conditions cannot be avoided, air and vapor elimination systems may be required. If you cannot fill the meter slowly by gravity or by using a valve to throttle back the flow, consult the factory.

- **DO NOT OPERATE THE METER ABOVE THE MAXIMUM PRESSURE LISTED ON THE SERIAL NUMBER PLATE.**

Under any and all pressure producing circumstances (for instance, thermal expansion and hydraulic shock) the working pressure must not exceed the maximum pressure indicated on the Serial Number Plate.

- **DO NOT OPERATE THE METER ABOVE THE MAXIMUM FLOWRATE LISTED ON THE SERIAL NUMBER PLATE**

If the meter is operated at a rate greater than the maximum recommended GPM, excessive wear and premature failure may occur.

- **THE METER CAN BE CALIBRATED FOR FLOWS BELOW MINIMUM RATINGS**

If the flow remains constant and varies within narrow limits or if the product is viscous, the meter can be calibrated for flows below minimum ratings. If the meter is installed in a custody transfer application (for financial transactions), the flow rate must fall within flow rate range indicated on the serial number plate. A meter should never be run beyond the maximum flow rate determined for that class meter and/or liquid measured.

! WARNING

Before disassembly of any meter or accessory component:

- All internal pressures must be relieved and all liquid drained from the system in accordance with all applicable procedures.
- Pressure must be 0 (zero) psi.
- Close all liquid and vapor lines between the meter and liquid source.

For Safety Rules, refer to local authorities and relevant NFPA Codes.

Failure to follow this warning could result in property damage, personal injury, or death from **fire and/or explosion, or other hazards that may be associated with this type of equipment.**

REVERSING THE METER REGISTRATION

The direction of flow is specified by the customer when the meter is ordered. The standard direction of flow, facing the front of the meter, from left to right. A red tag labelled "inlet", affixed to the meter before shipment, indicates the inlet side of the meter.

If the meter is equipped with a strainer, air eliminator, and/or valve, each component must be moved to the correct side of the meter when reversing the direction of flow. The strainer and air eliminator should always be located on the inlet side of the meter. Valves should always be located on the outlet side of the meter. Some parts of the valve may require repositioning. See the valve's manual for more information.

When the meter is first installed, check the register. If the register counts down, meaning that the register numbers decrease rather than increase, you must reverse the position of the adjuster drive gear.

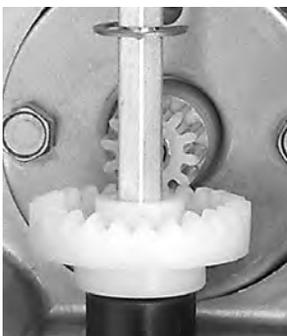
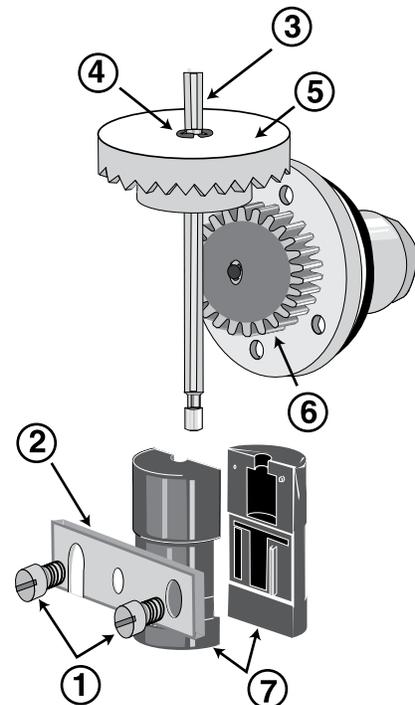
To reverse the drive to the register, the position of the adjuster drive gear relative to the pinion gear of the packing gland must be flipped.

To reverse the meter registration:

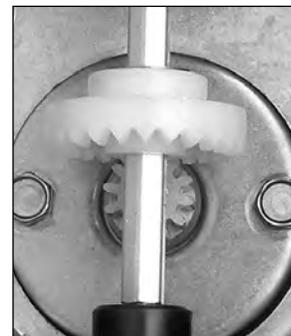
1. Remove the dust cover. See *Removing the Dust Cover* on page 13.
2. Remove the retaining ring (4) with a screwdriver or pliers.
3. Remove the two retaining spring screws (1) with a standard screwdriver.
4. Remove the retaining spring (2).

For M-15°, M-25°, M-30°, and M-40° models, loosen the single set screw.

5. Remove the drive shaft (3) with the adjuster drive gear assembly including (4) Retaining Ring and (5) Adjuster Drive Gear.
6. Remove the adjuster drive gear (5) and turn it 180° so that it is upside down from the original installation position. The bushing (7) supports the adjuster drive gear in the lower position. The retaining ring (4) supports the adjuster drive gear in the upper position.
7. Reassemble the parts in reverse order. Make sure that the adjuster drive gear meshes with the packing gland's pinion gear (6) without being too tight. There should be a little play in the gear teeth. The retaining ring (4) should be placed in the groove provided on the drive shaft (3), regardless of the adjuster drive gear position. The packing gland pinion gear to adjuster drive gear ratio is either 1:1 or 2:1. In the 2:1 ratio, the pinion of the packing gland is smaller in diameter.



Adjuster drive gear engaged at bottom



Adjuster drive gear engaged at top

SETTING THE STANDARD ADJUSTER

To set the standard adjuster:

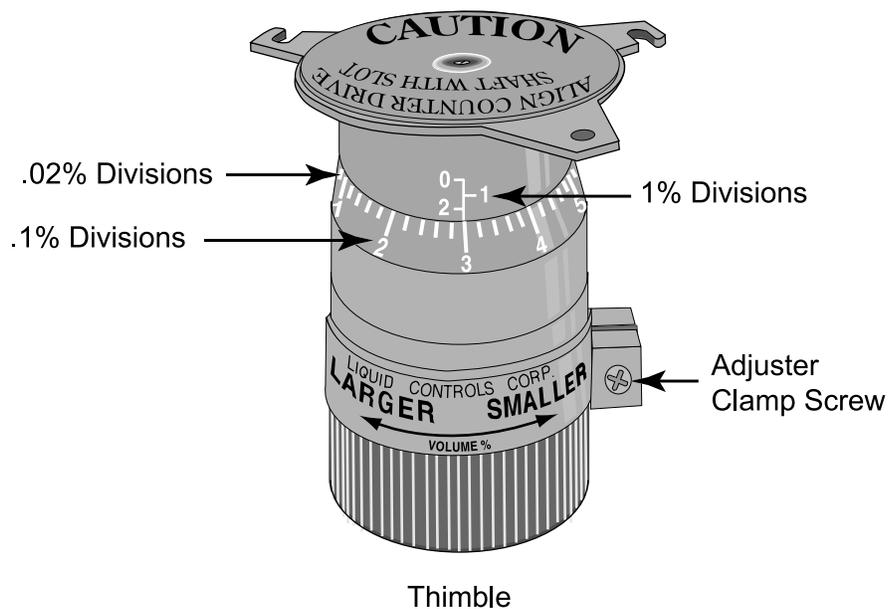
1. Remove the dust cover. See *Removing the Dust Cover* on page 13.
2. Check meter registration by delivering product to a reliable, accurate prover. Perform multiple delivery tests to verify the meter repeatability.
3. Record the setting indicated on the adjuster:
4. Note the difference between the volume of the prover and the volume indicated on the meter counter. Calculate the % correction required using the formula below.

$$\% \text{ Correction} = \frac{\text{Volume in prover} - \text{Volume on meter counter}}{\text{Volume in prover}} \times 100$$

5. Loosen the adjuster clamp screw.
6. When the prover volume is less than the meter counter volume, add the percentage to the original adjuster setting by turning the thimble towards the arrow marked larger (volume). Correct the original setting by approaching the number desired from the next larger number. For example, if the desired adjuster setting is 2.4, turn the adjuster thimble to the left to number 5, then to the right to obtain the 2.4 setting. Adjuster is currently set at 2.3 in the illustration below.
7. When the prover volume is more than the meter counter volume, subtract the percentage from the original adjuster setting by turning the thimble in the direction of the arrow marked smaller volume percent.
8. Retighten the adjuster clamp screw. Run product through the meter to allow the adjuster to take a set. Then make several prover runs to check for accuracy

Mechanical Instructions Only

These instructions apply to meters equipped with mechanical output accessories only. If your meter is equipped with an electrical output (i.e., electronic pulser), refer to the manual for the electrical component your Owner's Information Packet.



MAINTENANCE REQUIREMENTS

! WARNING

Before disassembly of any meter or accessory component:

- All internal pressures must be relieved and all liquid drained from the system in accordance with all applicable procedures.
- Pressure must be 0 (zero) psi.
- Close all liquid and vapor lines between the meter and liquid source.

For Safety Rules, refer to local authorities and relevant NFPA Codes.

Failure to follow this warning could result in property damage, personal injury, or death from **fire and/or explosion, or other hazards that may be associated with this type of equipment.**

▪ PREVENT PIPE STRAIN OR STRESS

Prevent pipe strain or stress from occurring when making meter or accessory repairs. Pipe strain and stress occurs when the pipes are not supported or are not aligned correctly to the meter. The weight of the pipes must always be supported independent of the meter. This means that the meter and accessories can be easily removed without affecting the pipes or the pipe alignment. Never leave any of the pipes hanging.

▪ SEASONAL METER STORAGE

If the meter is used for seasonal work, the meter should be removed from the system and thoroughly flushed with a compatible liquid at the end of each season. To flush the meter, remove the drain plug on the front and rear covers. Then flush the product from the front and rear covers. If flushing with water, extra care should be taken to drain the meter completely and dry all internal parts. Refill the meter immediately with a compatible liquid (or oil misting). Refilling is essential to preventing corrosion and ice damage that can result from any moisture that was overlooked after flushing and drying.

▪ DO NOT MAR OR SCRATCH

Do not mar or scratch any of the precision machined surfaces by prying or sanding parts.

▪ TORQUE ALL FASTENERS

Torque all fasteners such as screws and bolts in accordance with specifications listed in the *Torque Chart* on page 21.

▪ STONE THE MACHINED SURFACES

Stone the machined surfaces when reassembling the meter to assure that the machined surfaces are free of burrs and mars.

▪ REPAIR PULLED THREADS

Repair pulled threads with threaded insert fasteners. These can be used in many instances. Contact your full-service distributor for advice if this occurs.

▪ COAT THREADS WITH ANTI-SEIZE

Coat threads with anti-seize when removing and replacing bolts and castings in the meter.

▪ REMOVING FLANGE GASKETS

Remove flange gaskets when removing the flange assembly, always carefully scrape off the flange gaskets. Make sure that the flange surface has been scraped clean. Discard the old flange gasket and install a new flange gasket. Never reuse old flange gaskets.

▪ EXAMINE ALL FASTENERS

Examine all fasteners to make sure they are not bent, rusted, or have pulled threads. The threads should all appear evenly placed. If the bolts are bent, check the housing and cover for flatness. Use a straight edge to determine flatness.

▪ LOOK FOR GAPS

Look for gaps when disassembling a meter. Use a feeler gauge to check for gaps between the bearing plate and housing. If you do find gaps, check the bearing plates for flatness with a straight edge. Gaps can be caused by shock problems. If shock problems exist, they must be resolved. Contact your full-service distributor for assistance if this occurs.

▪ CHECK THE O-RINGS

Check the O-rings for damage. Cracked, rough, or worn O-rings should be replaced. However, a more serious problem of shock may be indicated if the O-rings look nibbled. Shock problems must be verified and resolved. Contact your full-service distributor for assistance if this occurs.

▪ CHECK THE BEARING PLATES

Check the bearing plates for flatness. Use a straight edge. Warped bearing plates can be caused by shock problems. If shock problems exist, they must be resolved. Contact your full-service distributor for assistance if this occurs.

▪ CHECK WITH REGULATORY AGENCY

Check with regulatory agency that governs Weights & Measures in your area. Removing the dust cover seal wire or other maintenance procedures may require Weights & Measures recalibration.

DISCLAIMER

Liquid Controls disclaims all liability for damage to meter or accessories because of corrosion, salting out of product, or separation of chemicals whether occurring during periods of use or storage.

SERVICING THE DRIVE COMPONENTS

! WARNING

Relieving Internal Pressure

All internal pressure must be relieved to zero pressure before disassembly or inspection of the strainer, vapor eliminator, any valves in the system, the packing gland, and the front or rear covers.

Serious injury or death from fire or explosion could result in performing maintenance on an improperly depressurized and evacuated system.

Relieving Internal Pressure Procedure for LPG and NH₃ Meters

1. Close the belly valve of the supply tank.
2. Close the valve on the vapor return line.
3. Close the manual valve in the supply line on the inlet side of the meter. If no manual valve exists on the inlet side, consult the truck manufacturer for procedures to depressurize the system.
4. Slowly open the valve/nozzle at the end of the supply line.
5. After product has bled off, close the valve/nozzle at the end of the supply line.
6. Slowly crack the fitting on top of the differential valve to relieve product pressure in the system. Product will drain from the meter system.
7. As product is bleeding from the differential valve, slowly reopen and close the valve/nozzle on the discharge line. Repeat this step until the product stops draining from the differential valve and discharge line valve/nozzle.
8. Leave the discharge line valve/nozzle open while working on the system.

Removing the Dust Cover

To remove the dust cover:

1. Cut the dust cover seal wire with side cutters.
2. Remove the dust cover screws with a 5/16" wrench or slotted screwdriver.
3. Remove the dust cover.

See Relieving Internal Pressure above and the safety procedures on page 3.



SERVICING THE DRIVE COMPONENTS

Servicing the Adjuster and Adjuster Drive Assembly

To remove the adjuster and adjuster drive assembly:

1. Record the adjuster micrometer setting and note the adjuster drive gear position.

Reassemble to the Original Position

Make sure to return the adjuster drive gear to its original position when reinstalling or the meter counter will run backwards. The gear will be set either below or above the packing gland pinion.

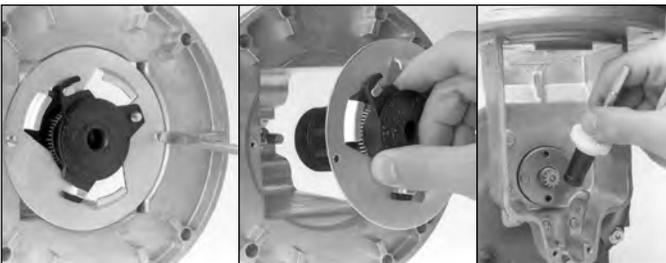
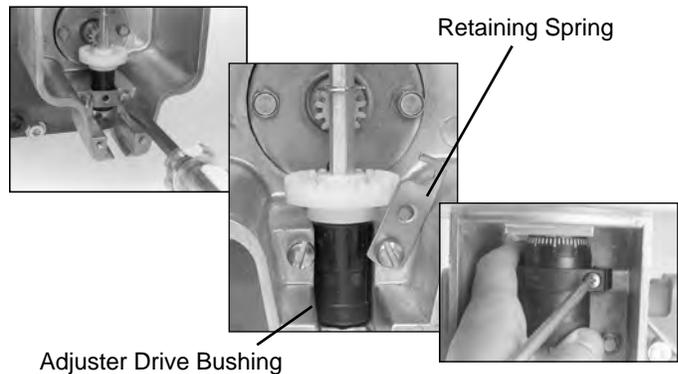
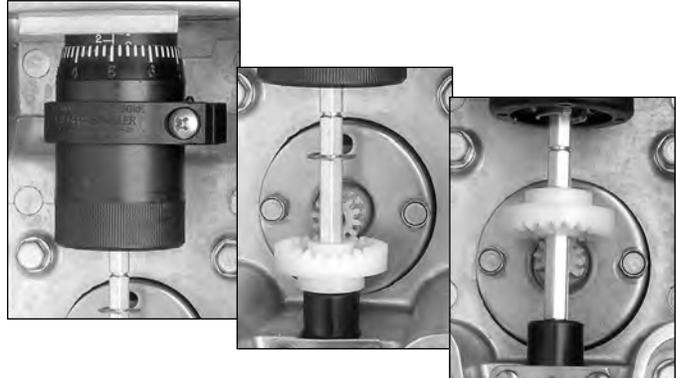
2. Use a standard screwdriver to loosen (or remove) the two retaining spring screws.
3. Swing the retaining spring off the adjuster drive bushing.
4. Loosen the adjuster mounting clamp screw with a phillips head screwdriver.

5a. Removing the adjuster from the top of the meter.

1. Remove screws that secure adjuster mounting plate to counter adapter.
2. Lift adjuster mounting bracket with the adjuster out of the counter adapter.
3. Remove the adjuster drive assembly from the housing.

5b. Removing the adjuster from the front of the meter.

1. Remove the adjuster drive assembly from the adapter and from the housing.
2. Remove the slotted head screw that secures the adjuster to the mounting plate.
3. Slowly pull the adjuster out through the front of the meter, rotating it from left to right to clear the adjuster mounting plate.
4. Pull the adjuster down to remove from the meter.



Removing the adjuster from the top

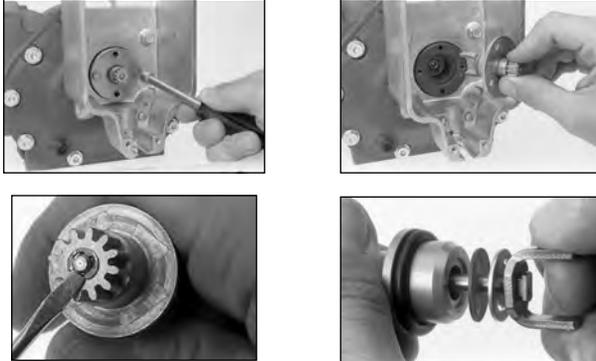


Removing the adjuster from the front

SERVICING THE DRIVE COMPONENTS

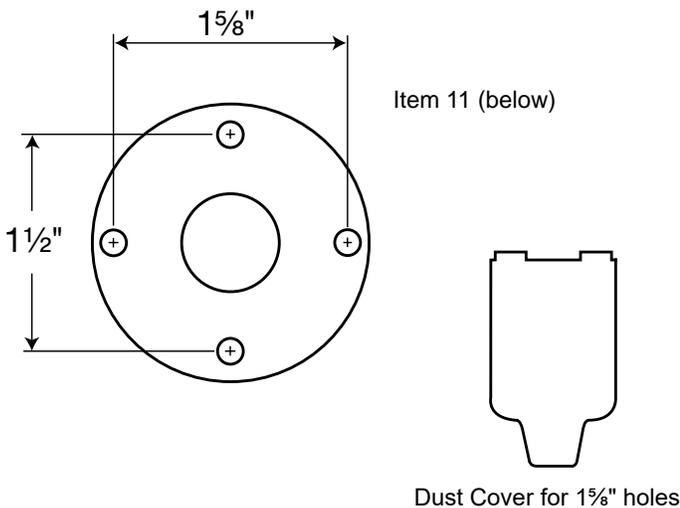
Servicing the Packing Gland

After prolonged use, the packing gland may show leakage from the metering chamber. Leakage is a sign of wear, resulting from the type of product being metered, the operating temperature, and other system conditions. If the packing gland shows leakage, it should be replaced or repaired. The packing gland can be serviced in the field.



To remove the packing gland:

1. Remove the two screws on the packing gland retaining plate with a 5/16" socket and ratchet drive extension or 5/16" nut driver.
2. Pull out the packing gland.
3. Pry off the retaining ring with a standard screwdriver.
4. Pull the driver out from the assembly.



PACKING GLAND RETAINING PLATE

The retaining plate for the packing gland has four holes: two drilled 1 1/2" holes on center and two drilled 1 5/8" holes on center. If your meter has a counter adapter dust cover (item 0366) shaped like the illustration on the left, mount the retaining plate using the two 1 5/8" holes. If your meter does not have the counter adapter dust cover like the illustration on the left, mount the retaining plate using the two 1 1/2" holes.

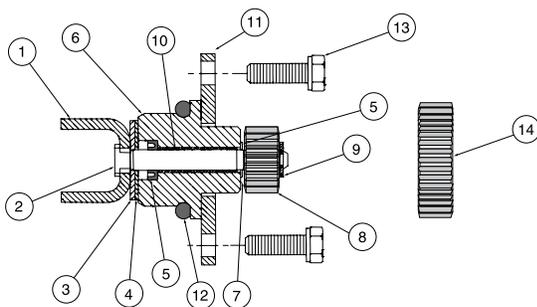
! WARNING

Relieving Internal Pressure

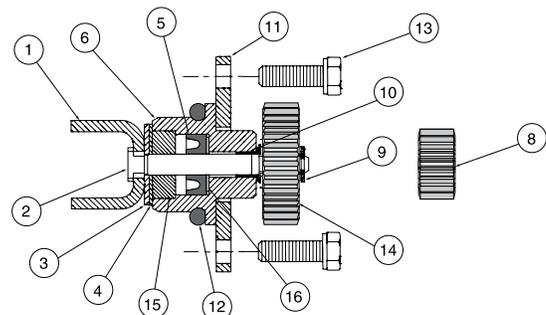
All internal pressure must be relieved to zero pressure before disassembly or inspection of the strainer, vapor eliminator, any valves in the system, the packing gland, and the front or rear covers. See the *Relieving Internal Pressure* warning on page 13.

Packing Gland Components

- | | |
|----------------------------------|--------------------------------|
| 1. Driver | 9. Retaining ring |
| 2. Shaft | 10. Bushing |
| 3. Stainless steel thrust washer | 11. Retaining plate |
| 4. Rulon thrust washer | 12. Buna/Viton/PTFE O-ring |
| 5. Buna/Viton/PTFE "U" Cup | 13. Two retaining plate screws |
| 6. Aluminum/stainless housing | 14. Output gear 1:1 |
| 7. Washer - Nylon | 15. Carbon Guide Bearing |
| 8. Output gear 2:1 | 16. Washer - Stainless Steel |



Standard Packing Gland



LPG Packing Gland

DISASSEMBLING THE METER

Disassembling Mechanical Output Meters

1. Remove the counter bracket screws with a box wrench or socket driver. The counter bracket can be removed with or without removing the adjuster assembly.
2. Turn the meter on either the inlet or outlet side. Let it stand to allow the product to drain from the meter chamber.
3. Locate the drain plugs on the front and rear covers. Remove the drain plugs using an allen wrench. Let the meter stand to allow product to drain from the front and rear covers.
4. Use a socket wrench or box end wrench to remove the screws securing the front cover. Remove the screws that hold the rear cover. *The number of screws will vary depending on meter size.*
5. Remove the front and rear covers.

MA-4°, M-5°, and MA-5° old style models, M-60° and M-80° current models have a driven reduction gear attached with a shoulder bolt to the center of the front

6. Carefully remove the O-rings / flat gaskets from front and rear of the housing.

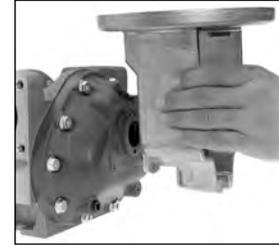
O-rings & Flat Gasket Replacement

Undamaged Buna or Viton O-rings may be reused. Flat gaskets and PTFE O-rings should always be replaced and never reused.

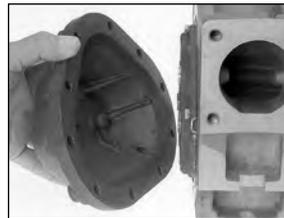
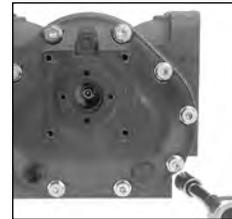
7. Use the rotor gear wrench (or a socket driver) to remove the right displacement rotor gear screw and washer. Hold a spare displacement rotor gear between the right displacement rotor gear and the blocking rotor gear to keep them from turning (if unavailable, use a shop rag between gear teeth).

MA-4°, M-5°, and MA-5° old style models, M-60° and M-80° current models have rotor gears on the meter back. All other models have rotor gears are on the front.

8. Use the rotor gear wrench (or a socket driver) to remove the blocking rotor screw and the packing gland driver held by the screw. Hold the spare gear between the left displacement rotor gear and blocking rotor gear.
9. Use the rotor gear wrench (or a socket driver) to remove the left displacement rotor gear screw and washer. Hold the spare gear between the right displacement rotor gear and the blocking rotor gear.



Drain Plug

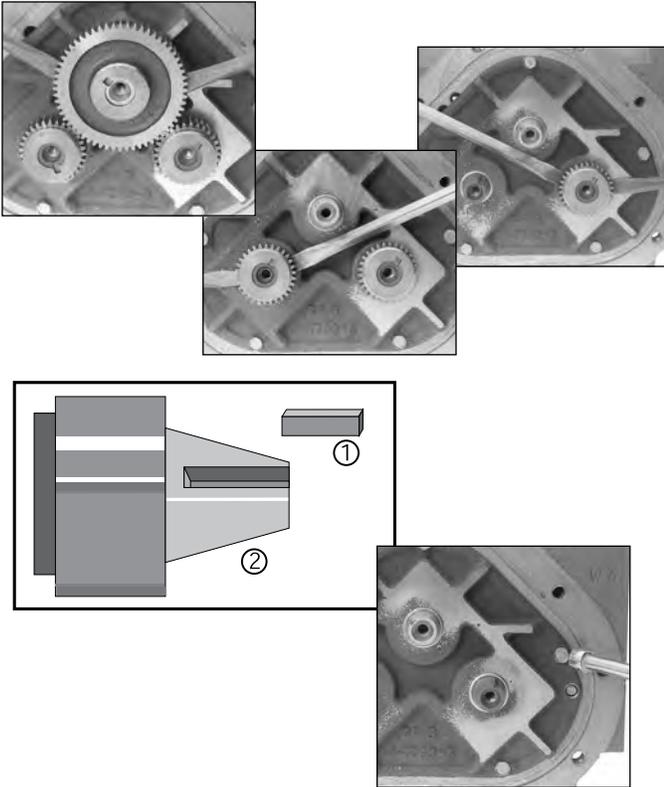


DISASSEMBLING THE METER

Disassembling Mechanical Output Meters

To remove non-corroded rotor gears:

1. Insert two standard screwdrivers behind the blocking rotor gear: Gently pry the gear off its rotor tapered end. If the gears show signs of corrosion, or do not pry off easily, see *To remove corroded rotor gears:* below.
2. Use the same method to remove the left rotor gear and the right rotor gear. If the gears show signs of corrosion, or do not pry off easily, see *To remove corroded rotor gears:* below.
3. As each gear comes off the rotor remove the key (1) from the rotor keyway (2). Save the key to use when reassembling the meter.
4. Use the bearing plate wrench (or a socket driver) to remove the screws that hold the front bearing plate to the meter housing.
5. Remove the screws that hold the rear bearing plate to the housing.

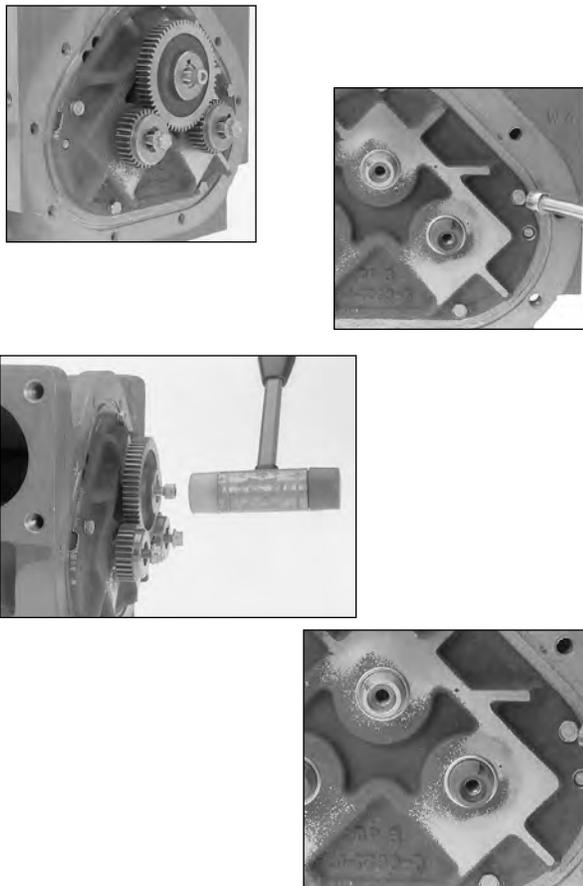


To remove corroded rotor gears:

1. On the back of the meter housing, remove the screws that hold the rear bearing plate to the housing using the bearing plate wrench (or a socket driver). *The number of screws will vary depending on meter size.*
2. Replace all three rotor gear screws, without washers. Screw them halfway onto each of the rotor ends.
3. With a plastic or non-metallic mallet, tap on the heads of the screws on the rotor ends lightly and equally, slowly driving the rotors off of the rotor gears. As you tap on the screws, the rear bearing plate and the rotor assembly will separate from the housing.

For carbon insert bearing plates, remove the rear plate first and then each rotor as it is hand supported.

4. Use the bearing plate wrench (or a socket driver) to remove the screws that hold the front bearing plate to the meter housing. *The number of screws will vary depending on meter size.*



DISASSEMBLING THE METER / REASSEMBLING THE METER

Disassembling Mechanical Output Meters

To remove the bearing plates and rotors:

1. Insert a screwdriver into each of the two notches near the dowel pins. Gently pry the front bearing plate off the dowel pins.

Be Careful

Be careful not to mar any of the surfaces.

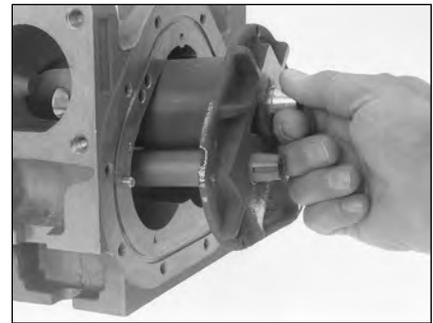
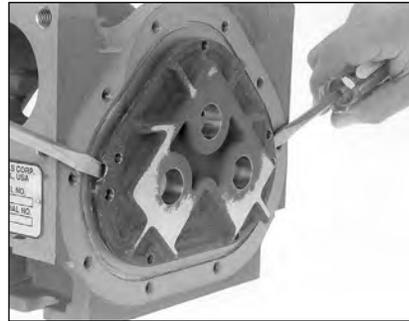
2. Grab the end of the blocking rotor extending out from the front bearing plate, and pull the front bearing plate and rotor assembly straight out from the housing.

For MA-4°, M-5°, and MA-5° old style models, M-60° and M-80° current models, pull rotor assembly with the rear bearing plate from the housing. This will also remove the drive reduction gear which is attached to the blocking rotor.

3. Remove the remaining bearing plate. Insert a screwdriver into each of the two notches near the dowel pins. Gently pry the front bearing plate off the dowel pins.

MA-4°, M-5°, and MA-5° old style models, M-60° and M-80° current models have a driven reduction gear attached by a shoulder bolt in the center of the front

4. Inspect and clean all critical surfaces: gear teeth, rotors, and internal housing faces.
 - Remove any crystalline formations using fine emery cloth or a fine wire brush.
 - Remove nicks and burrs on metal parts with a stone.
 - Remove all grit and other foreign particles.
 - Replace all parts that appear worn or damaged.



Be Careful

Be careful not to mar or alter the shape of any of the parts. Changing the shape of the parts may interfere with their operation.

Reassembling the Meter

To reassemble the bearing plates and rotors:

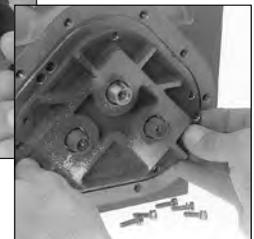
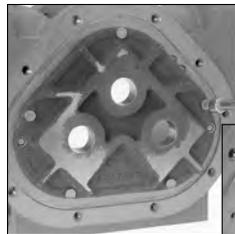
1. Replace the non-rotor gear bearing plate to the housing with the bearing plate screws.

The rotor gears are on the rear bearing plate of MA-4°, M-5°, and MA-5° old style models, M-60° and M-80° current models. On all other models, the rotor gears are on the front bearing

2. Insert the non-tapered ends of the three rotors into the housing and onto its respective bore of the installed bearing plate.

For MA-4°, M-5°, and MA-5° old style models, M-60° and M-80° current models, make sure that the teeth of the driving reduction gear mesh with the teeth of the driven reduction gear.

3. Place the remaining bearing plate over the three tapered rotor ends and fasten it to the housing with the bearing plate screws.



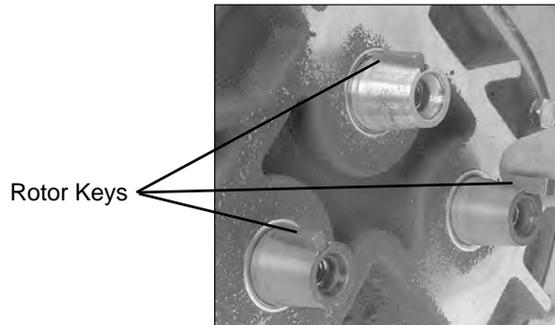
REASSEMBLING THE METER

Reassembling the Meter

To reassemble the bearing plates and rotors:

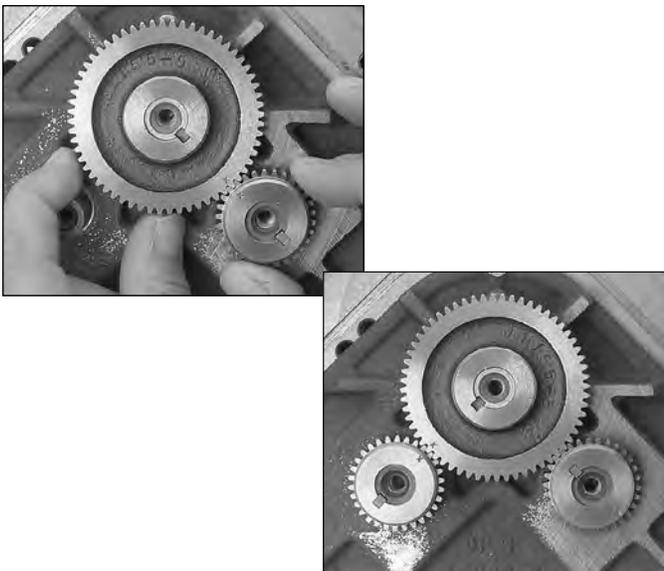
continued from following page

4. The rotors should have a small amount of end-play and be easy to turn. Test each rotor, one at a time. Turn the rotors to make sure that they revolve freely. Jog the rotors from end to end to check for end-play. If they do not move easily in both tests, remove the rotors and check for burrs and corrosion deposits. Clean them thoroughly and repeat steps 2, 3 and 4.
5. Each rotor has a notch, or "keyway", to hold a rotor key. The rotor key is a small wedge of metal. Press a rotor key into the keyway of each rotor with your thumb and forefinger.



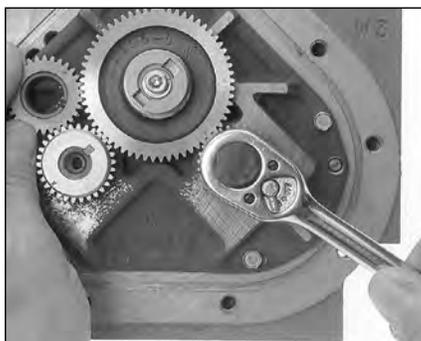
TIMING THE ROTOR GEARS

Before putting the meter into service, the rotors must be timed. Rotors are timed by lining up timing marks stamped onto the face of the gears. The timing mark on the blocking rotor gear is stamped on a gear tooth. The timing mark on the displacement rotor gears is stamped on a space between two gear teeth. You may need to remove the gears and reposition them several times to line up the timing marks correctly.



Torque the Gear Screw

Tighten the gear screws to the torque specification listed in the Torque Chart on page 22.



To time the rotor gears:

1. Slide the blocking rotor gear over the tapered blocking rotor end and turn it until the timing mark is in position to line up with the timing mark on the right displacement rotor gear. Slide the right displacement rotor gear over the tapered end of the rotor so that the timing mark lines up with the blocking rotor gear timing mark.
2. Turn the blocking rotor gear (turn the right displacement rotor gear with it) until the timing mark is in position to line up with the timing mark on the left displacement rotor gear. Slide the left displacement rotor gear over the tapered end of the rotor so that the timing mark lines up with the blocking rotor gear timing mark.
3. Position the spare displacement rotor gear between the left displacement rotor gear and the blocking rotor gear to prevent the gears from moving. Attach the right displacement gear washer and screw using the rotor gear wrench.
4. Keep the spare displacement rotor gear positioned by the left displacement rotor gear. Attach the left displacement gear washer and screw using the rotor gear wrench.
5. Position the spare displacement rotor gear between the right displacement rotor gear and the blocking rotor gear. Attach the blocking rotor gear with the packing gland driver and screw using the rotor gear wrench.
6. Rotate the gears to make sure that the rotors turn freely. Burrs, foreign material, or marred surfaces can restrict the rotor movements. If the rotors do not turn freely, remove the gears and rotors and deburr and clean the surfaces again.

REASSEMBLING THE METER

Reassembling the Meter

To complete meter reassembly:

1. Push the O-ring (1) into the groove (2) on the front of the meter housing.

M-60® and M-80® models use a flat gasket.

2. Fasten the front cover (3) to the housing with the cover screws (4) using the cover socket or open end/box end wrench.

Tightening Front and Rear Covers

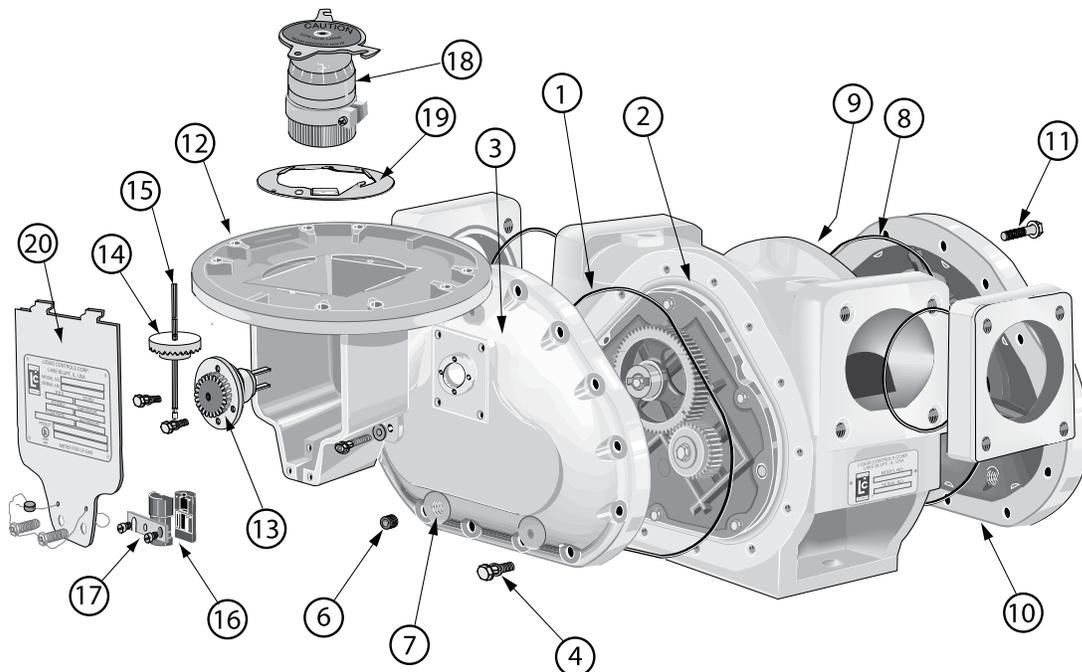
LC recommends tightening the front and rear cover screws in a criss-cross or "star" pattern with a minimum of two passes. First pass should be at half-torque. Final pass(es) should be at full torque. This method will ensure uniform seal compression on cover O-ring or gasket. See page 21.

3. Screw the front drain plug (6) into the front drain plug hole (7) using the drain plug allen wrench.
4. Push the O-ring (8) into the groove (9) on the rear of the meter housing.

M-60® and M-80® models use a flat gasket.

5. Fasten the rear cover (10) with the cover screws (11) using the cover socket or open end/box end wrench.
6. Screw the rear drain plug (not shown) into the rear drain plug hole using the drain plug allen wrench.

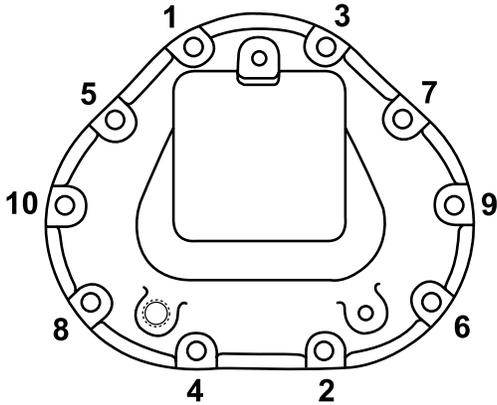
7. Screw the counter bracket (12) onto the front cover using the counter bracket screws.
8. Insert the packing gland assembly (13) through the counter bracket and into the cover plate. Make sure the forks of the packing gland drive are in the slots of the packing gland driver attached to the blocking rotor gear.
9. Screw the packing gland retaining plate onto the counter bracket using the two retaining plate screws. See *Servicing the Packing Gland* on page 15 for more information.
10. Return the adjuster drive gear (14), the adjuster drive shaft (15), and the drive shaft bushing (16) to the inside of the counter bracket. Make sure the drive gear is in its original position. See *Reversing the Meter Registration* on page 10 for more information.
11. Screw the retaining spring (17) over the drive shaft bushing and slide the retaining ring back into the slot on the drive shaft.
12. Screw the standard adjuster (18) onto the adjuster mounting plate (19).
13. Insert the standard adjuster and adjuster mounting plate through the top of the counter bracket and onto the adjuster drive shaft. Screw the mounting plate onto the counter bracket.
14. Screw the dust cover onto the counter bracket using the dust cover screws.



Meter Assembly Exploded View

REASSEMBLING THE METER

TORQUE PATTERN M-7® COVERS



Torque Chart

Grade 5 Fasteners		
Bolt Size	Foot-Pounds NOMINAL*	Newton-Meter NOMINAL*
#8 (.164) - 32 UNC-2A	2.54 (30.5 in/lb)	3.4
#10 (.190) - 24 UNC-2A	3.75 (45 in/lb)	5.1
1/4" (.250) - 20 UNC-2A	7.3	9.9
5/16" (.3125) - 18 UNC-2A	15.3	20.7
3/8" (.375) - 16 UNC-2A	27	37
7/16" (.4375) - 14 UNC-2A	43	58
1/2" (.500) - 13 UNC-2A	66	90
5/8" (.625) - 11 UNC-2A	132	179
3/4" (.750) - 10 UNC-2A	233	316

*Torque Tolerance is ± 10%

Wrench and Socket Size Chart

	MA-4® M-5® MA-5®	M-7® MA-7® M-10®	M-15® M-25®	MA-15®	M-30® M-40®	M-60® M-80®
Dust Cover Screws	5/16" hex wrench	5/16" hex wrench	slotted screwdriver	slotted screwdriver	slotted screwdriver	slotted screwdriver
Drain Plug	1/4" Allen wrench	1/4" Allen wrench	3/8" Allen wrench	3/8" Allen wrench	3/8" Allen wrench	3/8" Allen wrench
Meter Cover Screws	1/2" hex wrench/ socket	1/2" hex wrench/ socket	1/4" Allen or 1/2" hex wrench/ socket	1/4" Allen or 1/2" hex wrench/ socket	9/16" hex wrench/ socket	3/4" hex wrench/ socket
Counter Bracket Screws	3/8" hex wrench/ socket	3/8" hex wrench/ socket	N/A	3/8" hex wrench/ socket	N/A	3/8" hex wrench/ socket
Bearing Plate Screws	5/16" hex wrench/ socket	5/16" hex wrench/ socket	5/16" hex wrench/ socket	5/16" hex wrench/ socket	7/16" hex wrench/ socket	1/2" hex wrench/ socket
Rotor Gear Screws	5/16" hex wrench/ socket	3/8" hex wrench/ socket	3/16" Allen wrench	3/16" Allen wrench	3/16" Allen wrench	3/16" Allen wrench

ROTOR GEAR SCREWS

Please apply these techniques when repairing meters in the field.

1. Prior to installation, apply a small amount of Locquic Primer N764 to each screw.
2. Apply a light coat of Loctite 242 in three even strokes to each screw. The Loctite and Locquic primer are not to be applied to the female connection in the rotor.

TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE & SOLUTION
<p>Leakage past packing gland drive shaft housing from internal metering chamber</p>	<p>Internal seal of packing gland assembly is worn. Replace packing gland and O-ring seal.</p> <p>OPERATING NOTE Two common causes of packing gland leakage are thermal expansion and hydraulic shock.</p> <p>Thermal expansion can occur when two valves in a piping system, on either side of the meter, are closed at the same time and the temperature in the system rises. As little as a 1°F increase in temperature can drive the system pressure to a point that exceeds the maximum working pressure rating of the meter. To avoid any damage caused by thermal expansion, a pressure-relief valve of some kind must be installed in the system.</p> <p>Hydraulic shock occurs when a large volume (mass) of liquid is flowing through the system and a valve suddenly closes. When the flow is stopped, the entire mass of the liquid in the piping system rams into the components within the meter. The greater the length of line (more line length equals more liquid mass) and the greater the velocity of the liquid, the greater the hydraulic shock. Since the valve is usually located at the meter outlet, the meter housing, packing gland and the meter internal are subject to the full impact of such hydraulic shock. To prevent hydraulic shock, a slow closing two-stage valve should be used with the meter. On systems where mass length of line and velocity are of a magnitude that preclude the elimination of hydraulic shock with the use of a two-stage slow closing valve, an impact-absorbing air cushioning device can be added to further dampen hydraulic shock.</p>
<p>Leakage from the cover gasket</p>	<p>Gasket has been damaged due to shock pressure or cover bolts have not been tightened sufficiently. Replace gasket and tighten cover bolts correctly.</p>
<p>Product flows through meter but the register does not operate</p>	<p>A. Check packing gland, and gear train.</p> <p>B. If all meter parts are moving then problem is in register. Faulty register should be checked and repaired by trained mechanic.</p> <p>C. Remove register from meter. If all meter parts are moving but output shaft of adjuster assembly is not, adjuster is worn and must be replaced.</p> <p>D. If totalizer numerals (small numbers) on register are recording, but the big numerals are not moving, register needs repair.</p> <p>E. Packing gland gear not turning. Replace the packing gland. This may be caused by starting the flow too rapidly. For M-60® and M-80® meters, the drive blade may be sheared.</p>
<p>Breaking teeth on timing gears</p>	<p>A. Starting or stopping flow in meter too rapidly.</p> <p>B. Pump bypass not adjusted properly.</p>

TROUBLESHOOTING & REPLACEMENT PARTS

PROBLEM	PROBABLE CAUSE & SOLUTION
Product flows through meter but register does not record correctly	A. Adjuster not properly calibrated. B. Incorrect gear plate or gear ratio has been installed. C. Air is in the system.
No flow through meter	A. Faulty non-functioning pump. B. Valve not open or not functioning. C. Meter “frozen” due to build-up of chemical “salts” or foreign material inside metering chamber. Clean the meter and inspect for damage.
Meter runs too slowly	A. Valve internal mechanism faulty. Valve does not open fully. B. Meter gears or rotors partially “salted” enough to slow up rotation of parts. Clean the meter. C. Downstream restriction. D. Clogged strainer basket.
The meter counts down in reverse (the meter numbers decrease)	Reverse the direction of flow by reversing the adjuster drive gear. See Reversing the Meter Registration on page 10.

How to Order Replacement Parts

1. Refer to the exploded view drawings on pages 24-27. Find the four-digit item number of the part that needs replaced. Item numbers are listed on the exploded drawings.
2. In the red Owner’s Information Packet supplied with the meter, you will find a computer printout titled *Parts List*. The *Parts List* lists each item number alongside a five-digit part number. The part number identifies the specific individual piece, kit, or complete assembly used to assemble that particular meter.
3. Contact your distributor and give them the five-digit part number. Your distributor will use it to find the correct component for your meter.

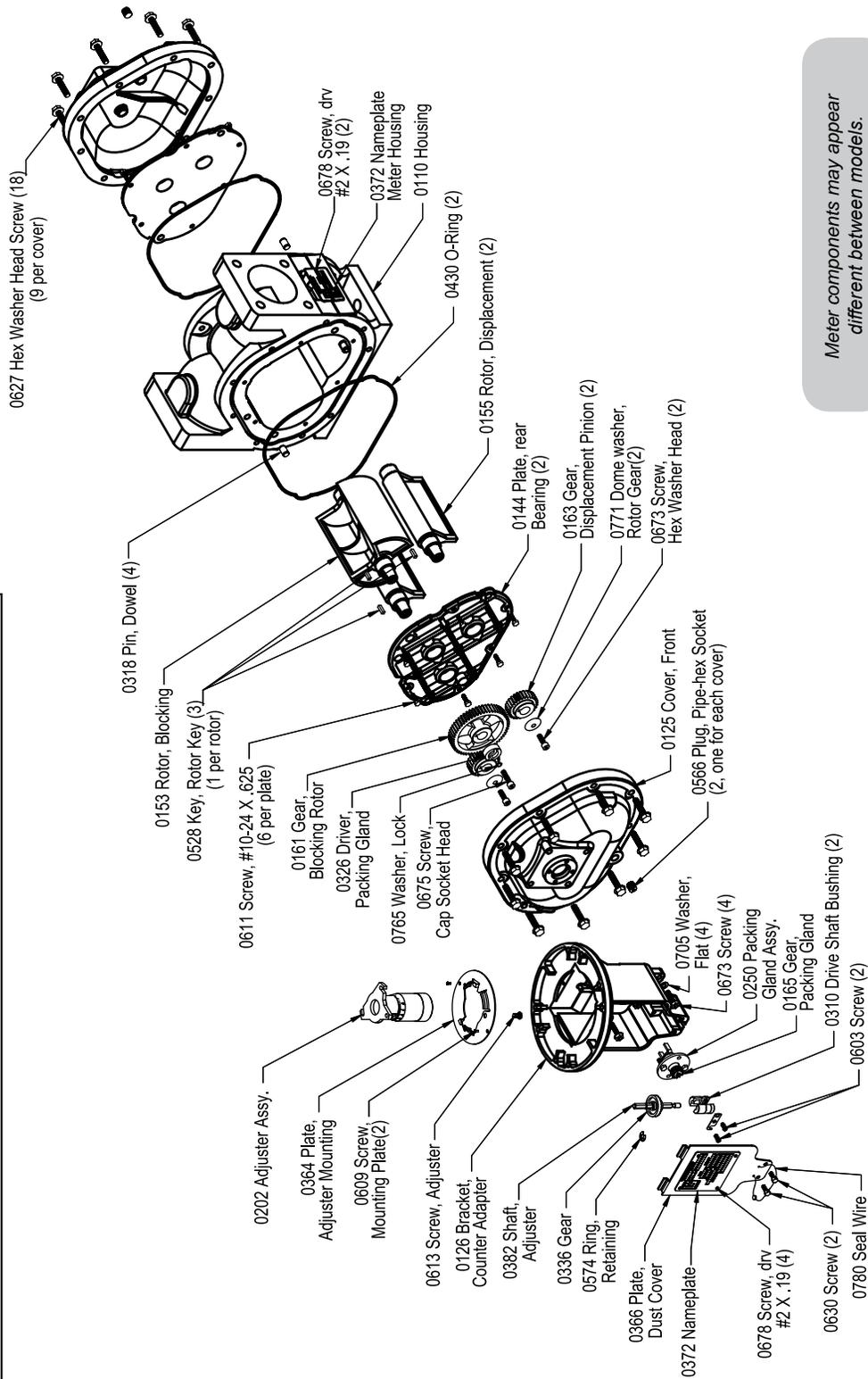
Always check www.lcmeter.com for the most current version of manual M610 - Bill of Materials for LC meters.

BILL OF MATERIALS

M-5[®] THROUGH M-25[®] METERS (INCLUDING MA METERS)

Item Numbers and Part Numbers

Numbers shown are item numbers, not part numbers. Refer to the Bill of Materials M610 supplied in the red Owner's Information Packet to locate the part number associated with these item numbers.

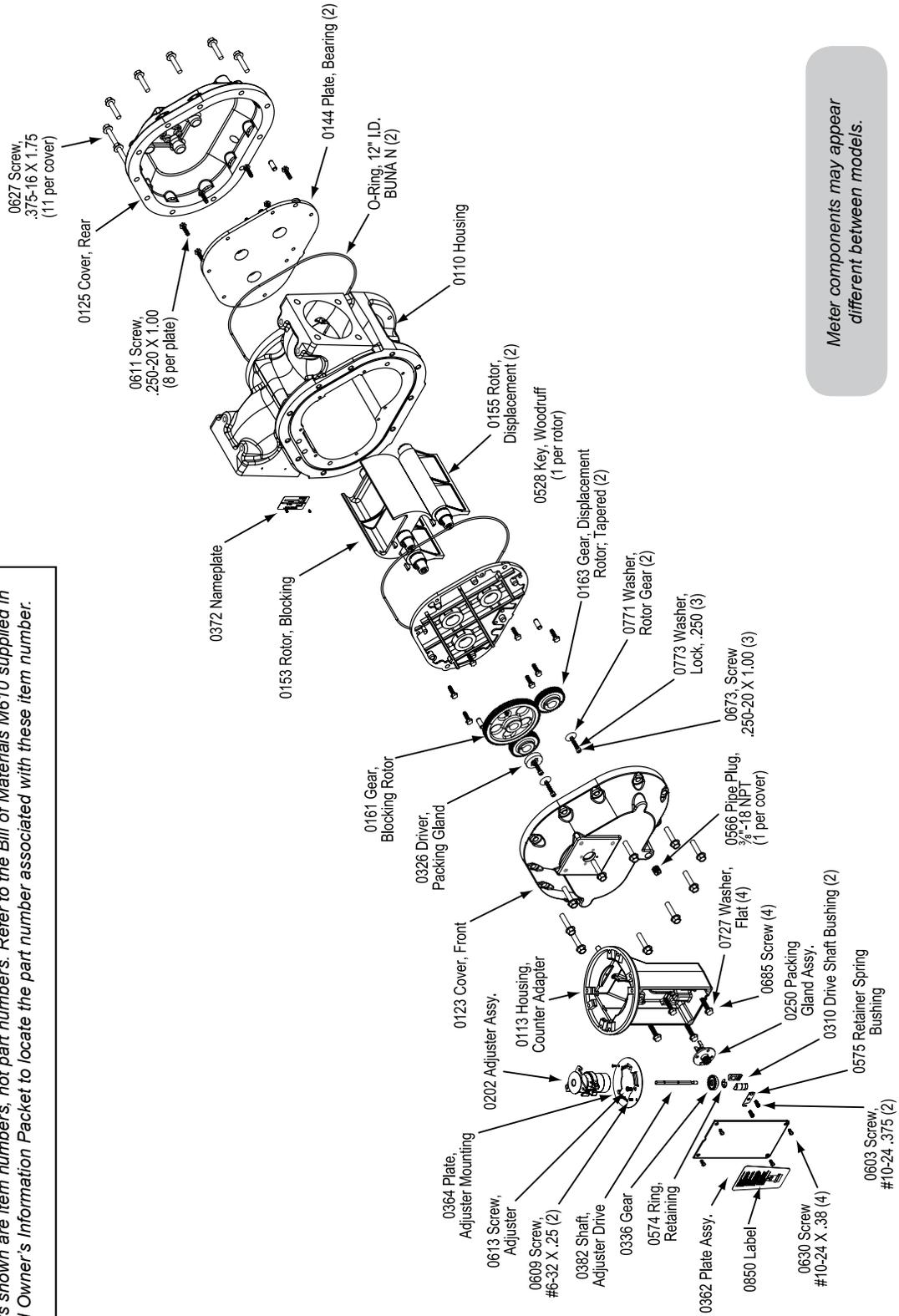


Meter components may appear different between models.

M-30®, M-40® METERS

Item Numbers and Part Numbers

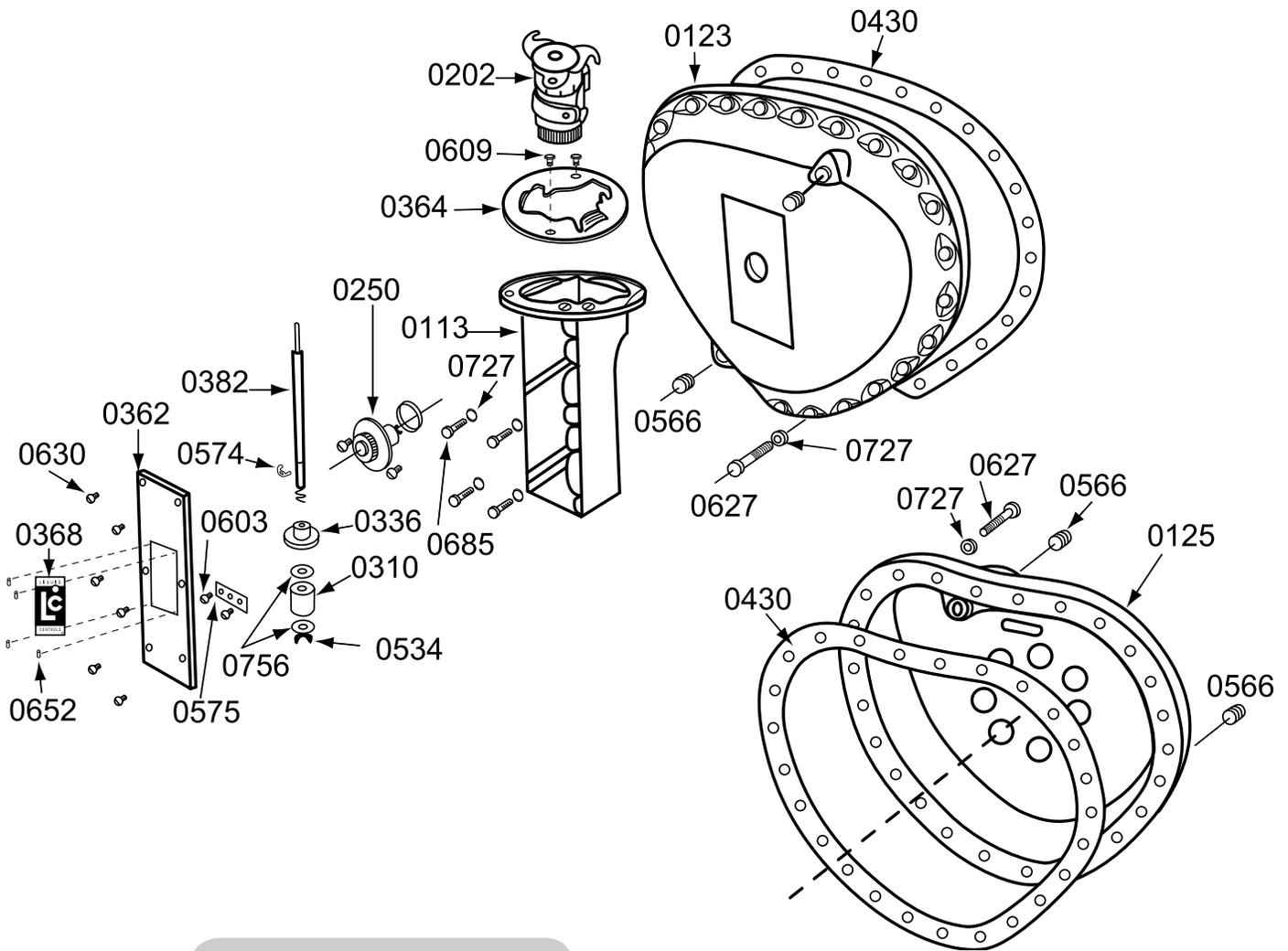
Numbers shown are item numbers, not part numbers. Refer to the Bill of Materials M610 supplied in the red Owner's Information Packet to locate the part number associated with these item numbers.



Meter components may appear different between models.

BILL OF MATERIALS

M-60®, M-80® **METER COVER**

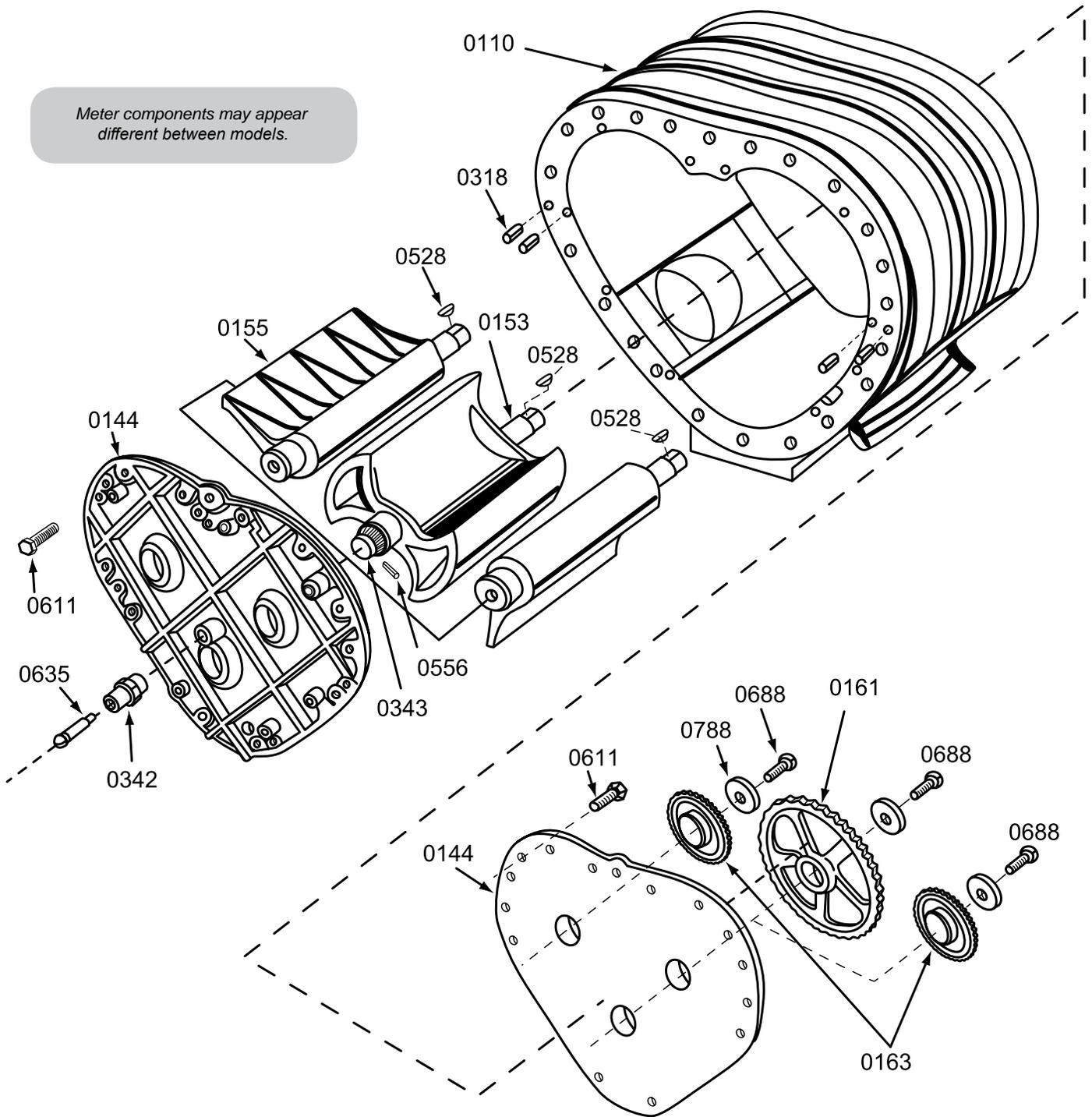


Meter components may appear different between models.

Item Numbers and Part Numbers
Numbers shown are item numbers, not part numbers. Refer to the Bill of Materials M610 supplied in the red Owner's Information Packet to locate the part number associated with these item number.

M-60®, M-80® **METER ELEMENT**

Meter components may appear different between models.



Item Numbers and Part Numbers
 Numbers shown are item numbers, not part numbers. Refer to the Bill of Materials M610 supplied in the red Owner's Information Packet to locate the part number associated with these item number.



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