

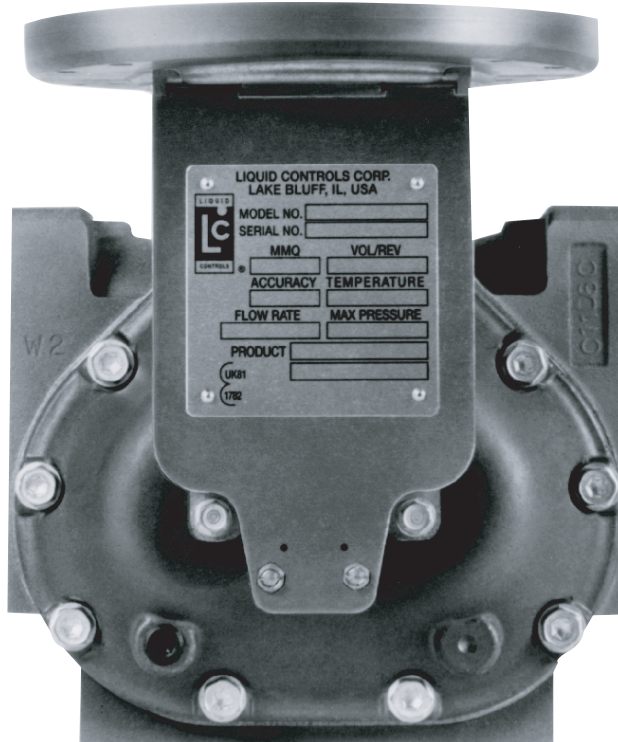


Installation & Parts Manual

M/MA Meters

**LIQUID
CONTROLS**
A Unit of IDEX Corporation

IDEX
IDEX CORPORATION



Installation: M100-10

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Please have the following information available when you make inquiries, 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 (see page 4).

Your Meter's Serial Number: _____

Your Full-Service Distributor: _____

Your Full-Service Distributor's
Telephone Number: _____

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.

Publication Updates and Translations

The most current English versions of all Liquid Controls publications are available on our website, 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.

⚠ WARNING

- Before using this product, read and understand the instructions.
- Save these instructions for future reference.
- 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.
- 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.

Safety Procedures

⚠ 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 Regarding LPG**, refer to **NFPA Pamphlet 58** and local authorities.

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.

Be Prepared

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 and state and local codes to make sure that you are adequately prepared.

Read this manual as well as all the literature provided in your owner's packet.

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:

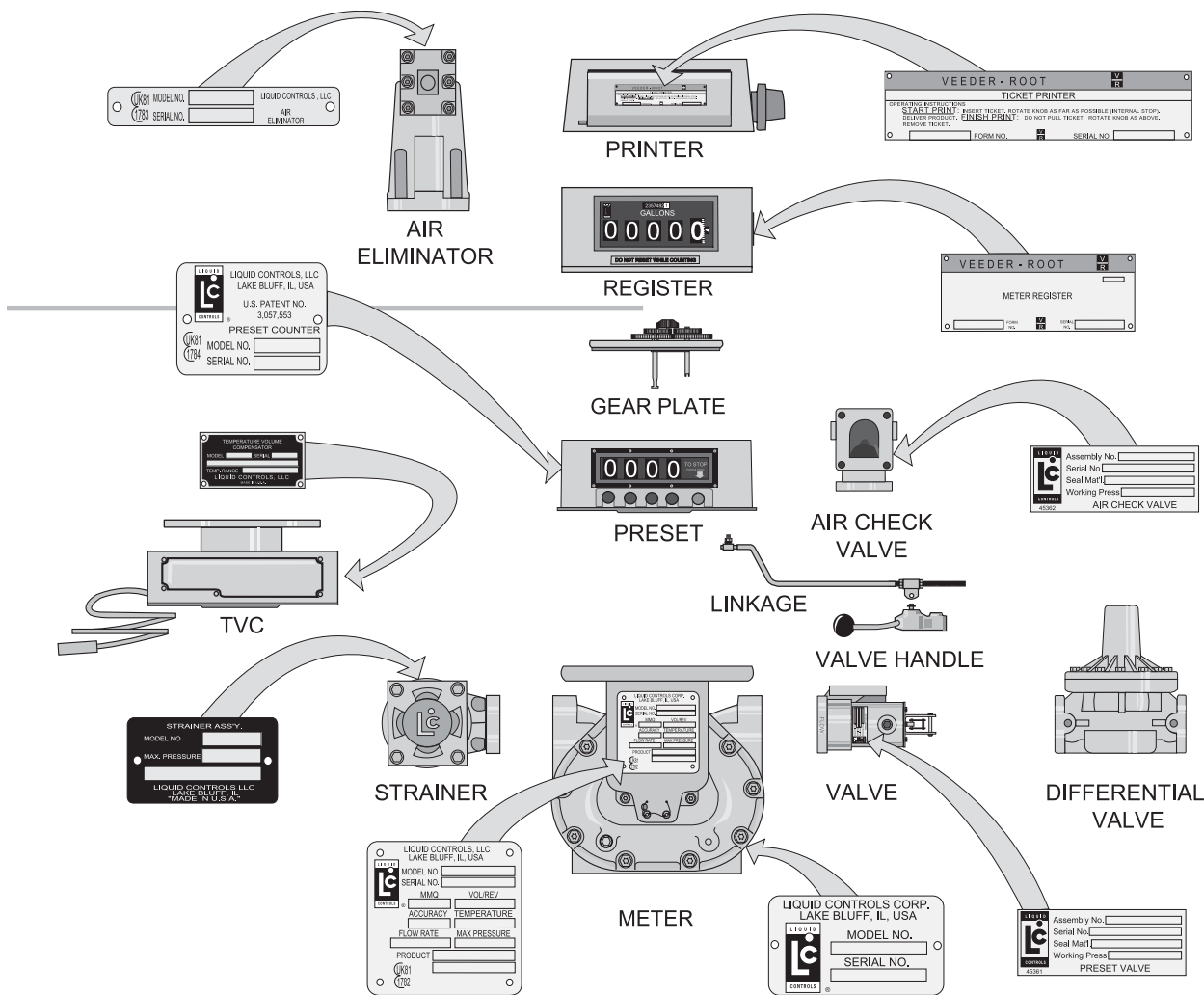
1. Stop the leak and prevent accidental ignition.
2. Prevent the entrance of gas into other portions of the buildings. Some gases, such as LPG, seek lower levels, while other gases seek higher levels.
3. Evacuate all people from the danger zone.
4. See that the gas is dispersed before resuming business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

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. Then use the appropriate extinguisher: Class B fire extinguisher, water, fog, etc., depending on the materials. If in doubt, call your local fire department.

Owner's Information Packet



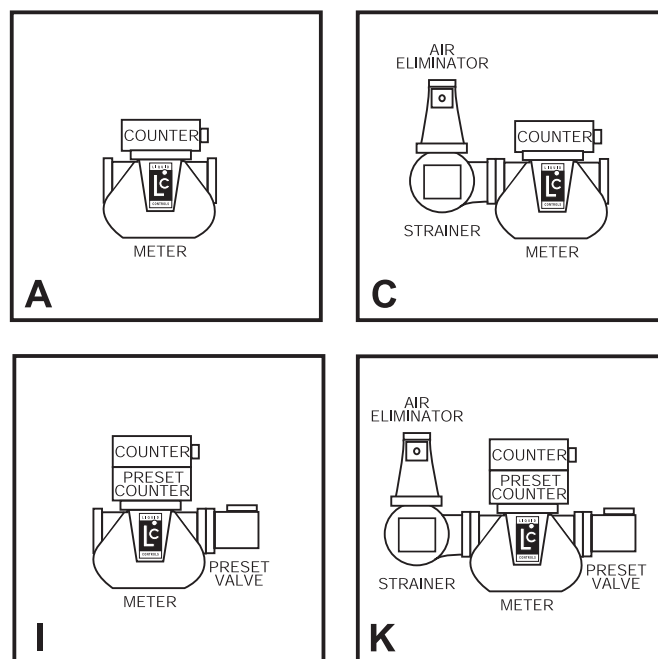
Specification and Serial Number Plate Location

NOTE: Meter and accessories are not drawn to scale. Data on the Specification and Serial Number Plates: Model No., Element No., Serial No., Flow Rate, Minimum Measured Quantity, etc., are subject to change.

- 1. Is all your documentation included with your meter?** 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 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 this page will help you locate the Specification and Serial Number Plates on the meter and its accessories.
- 2. Record your meter serial number** in the space provided on the inside cover of this manual. The inside cover also provides a space for your full-service distributor's name and telephone number. Fill in this information and keep it handy. You will always need your meter serial number and model number when calling for service or parts! See 'How to Order Replacement Parts' in this manual.

Owner's Information Packet

3. **Identify your meter's model-accessory letter.** Use the charts shown above to familiarize yourself with meter accessories. Find the meter and letter on the chart which represents your meter, 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. **Check your owner's information packet** with the chart shown above to make sure that all the documentation needed for your meter and accessories is in your red information packet. If documentation is missing, call your full-service distributor or Liquid Controls for replacement materials.

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				

How LC Meters Work

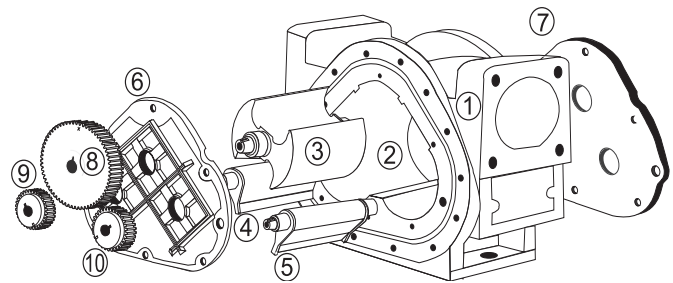
Liquid Controls meters are positive displacement meters. They are designed for liquid measurement in both custody transfer and process control applications. They can be installed in pump or gravity flow systems. Because of their simple design, they are easy to maintain, and easy to adapt to a variety 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. Blocking rotor gear (8) is placed on the end of the blocking rotor. 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 happens simultaneously. As fluid enters, another portion of the fluid is being partitioned and measured. At the same time, the fluid ahead of it is being 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 accurately determined.

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 un-metered upstream product and the metered downstream product.



Meter Element Exploded Line Drawing

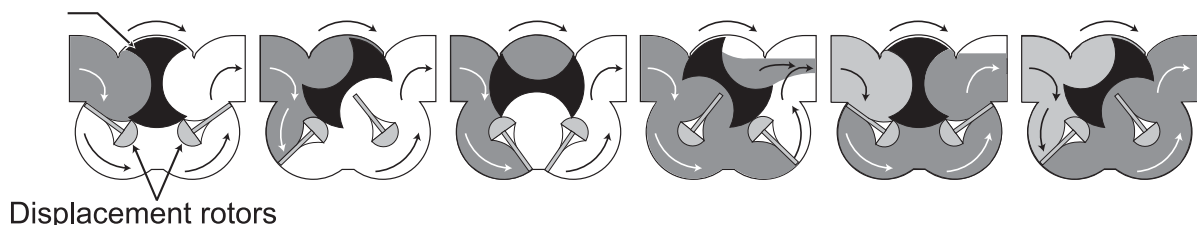
Capillary seals mean no metal-to-metal contact within the metering element. This means no wear. No wear means no increase in slippage, and no increase in slippage means no deterioration in accuracy.

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, with no need for 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.

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

Blocking rotor



Meter Maintenance and repeatability.

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, at the end of each season the meter should be removed from the system and thoroughly flushed with a compatible liquid. This includes removing the drain on the front and rear covers. Then flush the product from the front and rear covers. If flushing with water is preferred, extra care should be taken to drain the meter completely and dry all internal parts. Immediate refilling with a compatible liquid (or oil misting) is essential to prevent corrosion as well as ice damage to parts from moisture that was overlooked after flushing and drying.

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

Torque all fasteners such as screws and bolts in accordance with specifications listed in the 'Torque Chart' in this manual (page 22).

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

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 when removing and replacing bolts and castings in a meter.

Removing 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 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 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 that must be resolved. Contact your full-service distributor for assistance if this occurs.

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

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.

⚠ WARNING

Relieving Internal Pressure

All internal pressure must be relieved to zero pressure before disassembly or inspection of the strainer, air 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 from maintenance of an improperly depressurized and evacuated system.

Procedure for Non-LPG Meters

1. Turn off pump pressure to the system.
2. Close valves before and after the meter.
3. Remove pressure by removing the drain plugs and draining the meter.

Procedure for LPG 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.

Installation Requirements

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 and state and local codes to make sure that you are adequately prepared.

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

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

NOTE: 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.

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 or death from the gas, a fire, or pieces of flying debris from the rupture.

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

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.

Install meter only on the discharge side (downstream) of the system pump.

Apply pipe compound to male threads only.

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.

A meter is metallurgically designed to be physically compatible with a given type of liquid, as 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.

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.

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. See 'Reversing the Meter Registration' in this manual for mechanical output meters. Refer to your accessory manual for electrical output meters (such as meters equipped with a pulser).

NOTE

Always request up-to-date, engineering approved, dimensional drawings before starting any construction. Do not rely on catalog pictures or drawings which 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.

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 sump 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. A block valve should be located in the mainstream, labeled as the bypass valve.

Caution: 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.

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 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.

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

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

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

Provide a means of conveniently diverting liquid for calibration purposes.

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. Following the manufacturer's recommendations will minimize air and vapor elimination problems.

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

On systems such as vehicle tank installations, piping layout is important in preventing problems with split compartment test conformance. Piping should slope away from a P.D. pump to prevent resurgent re-priming of the pump due to drain back.

Hydraulic shock is harmful to all components of an operating system including valves, meter and the pump. In particular, meters must be afforded protection from shock because of their need to measure with high precision. Generally the best protection is prevention, which can be readily accomplished by adjusting valve closing rates in such a manner that shock does not occur.

Thermal expansion like hydraulic shock is a phenomenon that can easily damage meters and systems in general. Care should be taken in designing the system to include pressure relief valves in any portion or branch of the system that might be closed off by closure of operating valves or block valves.

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. The system may be filled by gravity (preferred) or by use of the pump (if required) when filling the system with liquid for the first time.

Gravity filling - systems with positive head pressure from product storage *above* the inlet port of the meter.

1. Make sure all valves (up stream and down stream of the meter) in the system are closed.
2. Crack open the valve located at the storage tank. The meter's register/counter will start to move and then stop, provided there is not a valve between the tank and the meter inlet. 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 fully open the tank valve.
4. With the valve(s) open between the tank and the meter, now go to the valve located down stream of the meter. Open the down stream valve slowly 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 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.

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

Filling the system with a pump - Consult the pump manufacturer for proper pump priming. Once the pump is primed with product, proceed as follows:

NOTE

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

- Follow steps one through four above for proper meter 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 at a pressure exceeding that marked 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 indicated maximum.

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. 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 Regarding LPG**, refer to **NFPA Pamphlet 58** and local authorities.

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

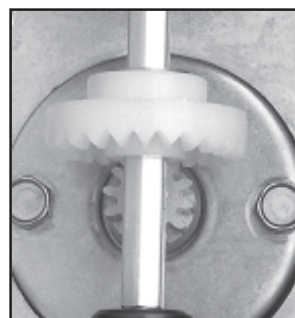
The direction of flow is specified by the customer when the meter is ordered. The standard direction of flow is from left to right when facing the front of the meter. A red pressure sensitive label indicating inlet is affixed to the meter at time of shipment.

If the meter is equipped with a strainer and/or valve, the strainer (and/or valve) **MUST** be moved when reversing the direction of flow through the meter. **The strainer should always be located on the inlet side of the meter.** When the meter is equipped with a valve, it is moved to the outlet side of the meter. Some repositioning of the valve components may be required. See the Valve Manual in the Owner's Information Packet.

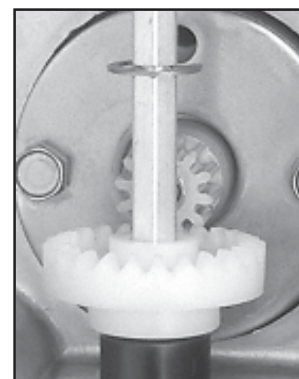
When the meter is first installed, check the register. If the register counts **DOWN**, meaning that the register numbers decrease rather than increase, you must reverse the direction of registration by reversing the position of the adjuster drive gear.

Reversing the drive to the register is accomplished by reversing the position of the adjuster drive gear relative to the pinion gear of the packing gland, as shown to the left. See below for step-by-step instructions.

1. Refer to "Servicing the Drive Components", Step 1 to remove the dust cover (page 12).
2. Remove the retaining ring (4) with a screwdriver or pliers.
3. Remove the two retaining spring screws (1) with a standard screwdriver. **Note: For M-15, M-25, M-30, and M-40 models** loosen the single set screw.
4. Remove the retaining spring (2).
5. Remove the drive shaft (3) mounted 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.

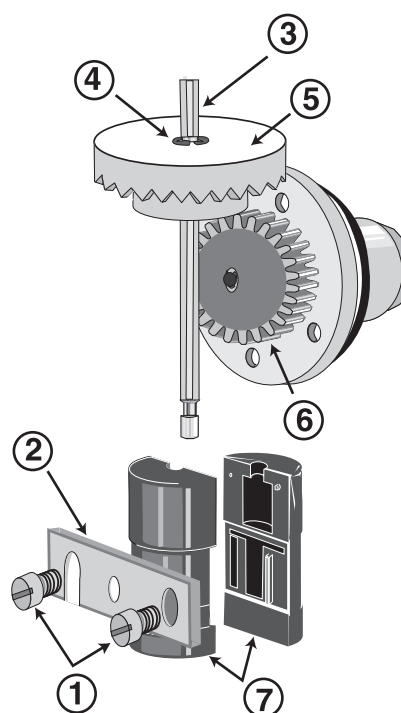


Adjuster drive gear engaged from the top.



Adjuster drive gear engaged from the bottom.

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. Make sure there is 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.

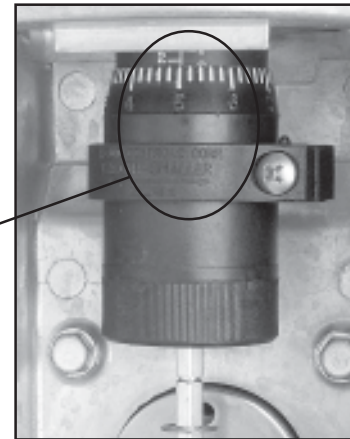


Packing Gland

Setting the Standard Adjuster

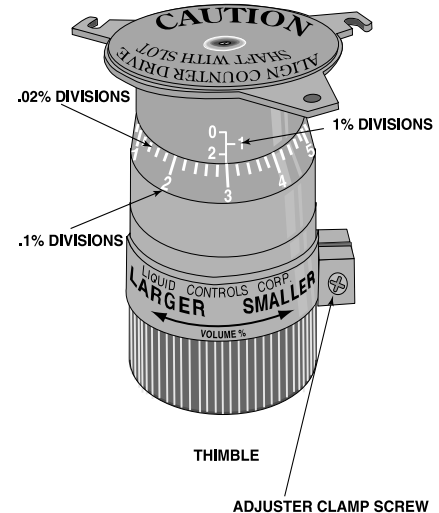
NOTE: These instructions apply to meters equipped with mechanical output accessories only. If your meter is equipped with an electrical output (i.e., electronic pulser) refer to your accessory manual, such as the Pulser Manual supplied in your owner's information packet.

1. Refer to "Servicing the Drive Components", Step 1 to remove the dust cover (page 12).
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, as follows:



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

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 to the right.
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



⚠ WARNING

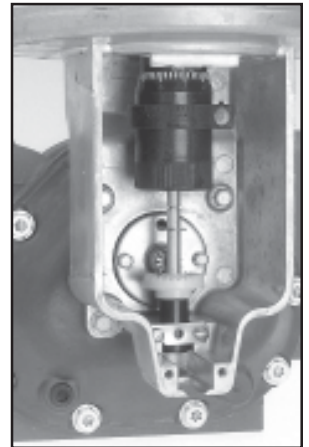
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For **Safety Rules Regarding LPG**, refer to **NFPA Pamphlet 58** and local authorities.

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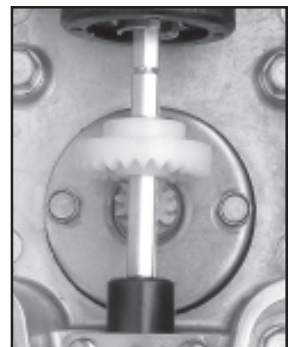
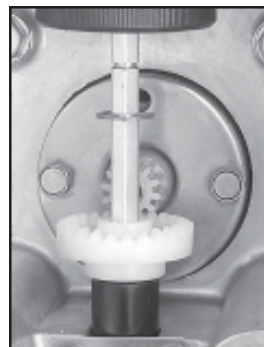
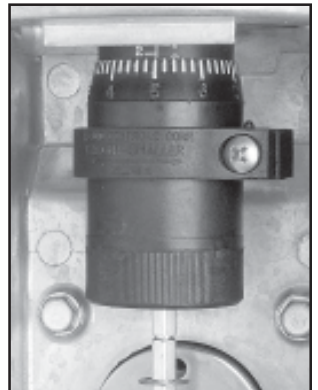
Removing the Dust Cover

1. Cut the dust cover seal wire with a side cutters. Remove the dust cover screws with a 5/16" wrench or slotted screwdriver and then remove the dust cover. See **"Relieving Internal Pressure"** and **"Regulatory Agency"** in the 'Meter Maintenance' section (page 7) of this manual.



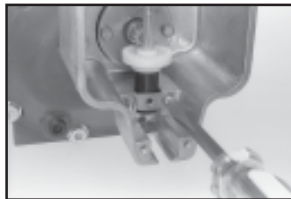
Removing the Adjuster and Adjuster Drive Assembly

1. Record the adjuster micrometer setting.
2. Carefully note the adjuster drive gear position. The gear engages the packing gland pinion from below or above. This gear must be reinstalled in its original position or the meter counter will run backwards.



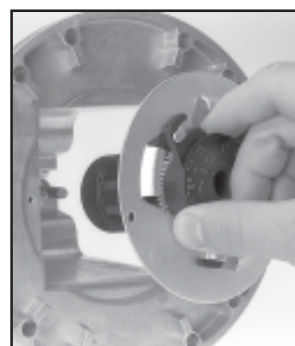
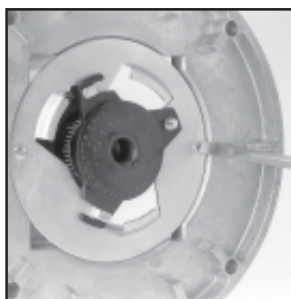
Servicing the Drive Components

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



Removing the adjuster from the top of the meter when top access is easiest. Front access instructions are on the next page.

6. Remove screws that secure adjuster mounting plate to counter adapter.
7. Lift adjuster mounting bracket with adjuster out of the counter adapter.
8. Remove the adjuster drive assembly from the housing.



Removing the adjuster from the front of the meter when front access is easiest. Top access instructions are on the previous page.

9. Remove the adjuster drive assembly from the housing.
10. Remove the slotted head screw that secures the adjuster to the mounting plate.
11. Bring the adjuster out through the front of the meter by rotating it from left to right to clear the adjuster mounting plate and then pull down to remove from the meter.

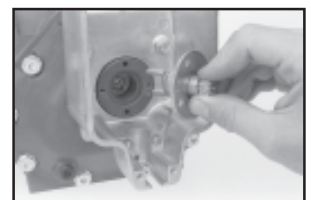
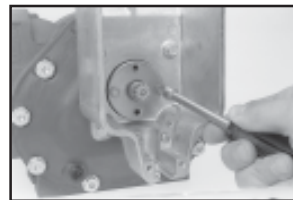
⚠ WARNING

All internal pressures must be relieved before disassembly or inspection of the strainer, air eliminator, any valves in the system, the packing gland, and the front or rear covers. See "Relieving Internal Pressure" (page 7).

Servicing the Packing Gland

The packing gland is affected by the liquid being metered, the operating temperature, and other system conditions. After prolonged use, the gland may show leakage from the metering chamber. This is a sign of wear. The gland should be replaced or repaired if this occurs. It can be serviced in the field.

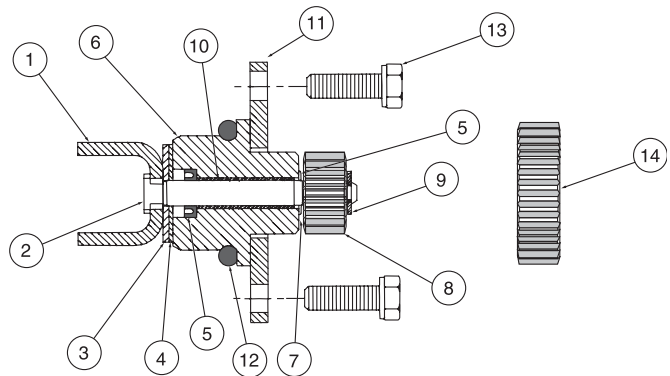
1. Remove the two packing gland retaining plate screws with a 5/16" socket and ratchet drive extension or 5/16" nut driver.
2. Pull out the packing gland.
3. Take apart the packing gland by gently prying off the retaining ring with a standard screwdriver.
4. Pull the driver out from the assembly.



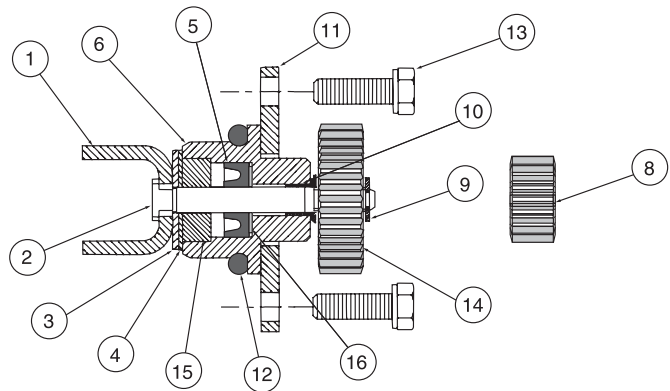
Buna/Viton/Teflon Packing Gland

Packing Gland Components

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



Standard Packing Gland

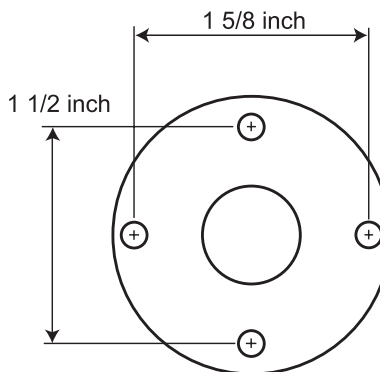


LPG Packing Gland

Packing Gland Retaining Plate

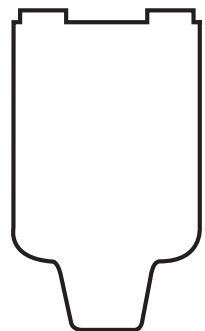
The retaining plate has four holes: two that are drilled 1-1/2" on center and two that are drilled 1-5/8" on center. If your meter has a counter adapter dust cover (Item #0366) shaped like the illustration shown below, use the holes drilled 1- 5/8" on center to mount the packing gland retaining plate.

If your meter does **not** have the counter adapter dust cover shaped like the illustration shown on the right, use the two holes drilled 1-1/2" on center to mount the packing gland retaining plate.



Item 11 (above)

Adapter Dust Cover for holes drilled 1-5/8" on center



⚠ 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 Regarding LPG**, refer to **NFPA Pamphlet 58** and local authorities.

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.

Mechanical Output Meters*

⚠ WARNING

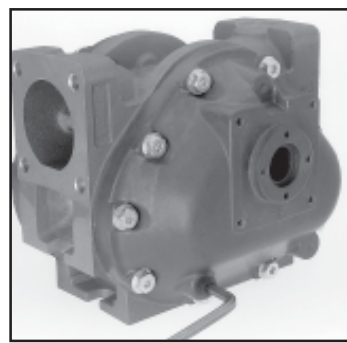
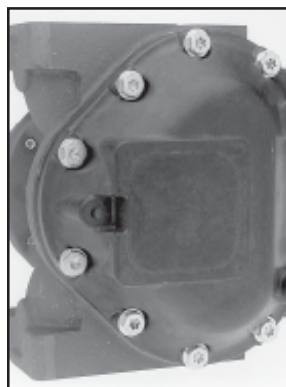
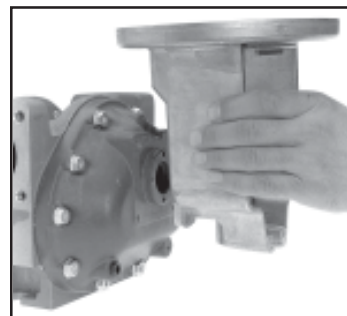
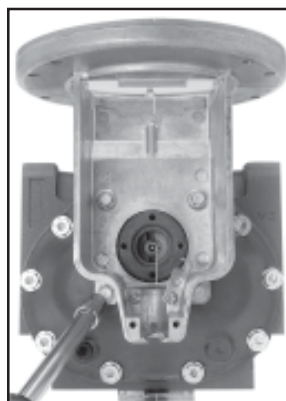
All internal pressures must be relieved before disassembly or inspection of the strainer, air eliminator, any valves in the system, the packing gland, and the front or rear covers. See “Relieving Internal Pressure” (page 7).

* For electrical output meters refer to the Pulser Manual supplied in your owner’s information packet.

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.

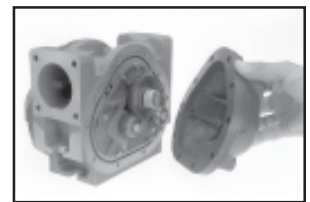
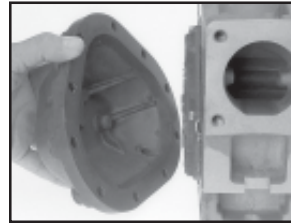
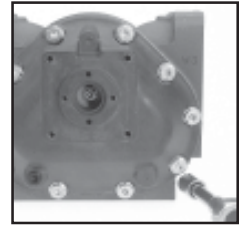
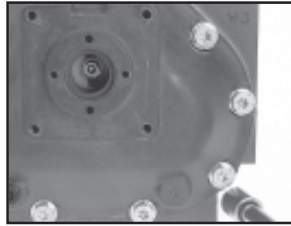
NOTE: For Aluminum M-30 and M-40 models the counter bracket and front cover are one piece. Go to step 2.

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.

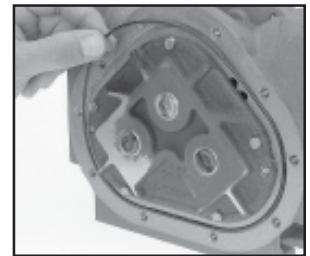
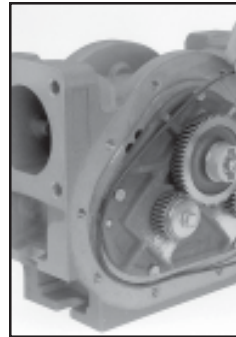


Disassembling the Meter

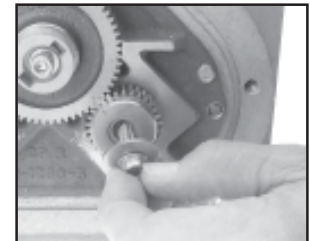
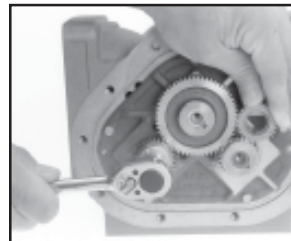
4. Use a socket wrench or box end wrench to remove the screws securing the front cover. Remove the screws that hold the rear cover. The number of screws will vary depending on meter size.
5. Remove the front and rear covers. **MA-4, M-5, and MA-5 old style models, M-60 and M-80 current models** have a driven reduction gear attached with a shoulder bolt to the center of the front bearing plate.



6. Carefully remove the O-rings / flat gaskets from front and rear of the housing. Undamaged Buna or Viton O-rings may be reused. Flat gaskets and Teflon O-rings should always be replaced and never reused.



7. 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). Use the rotor gear wrench or socket to remove the right displacement rotor gear screw and washer.



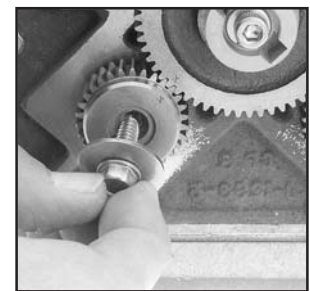
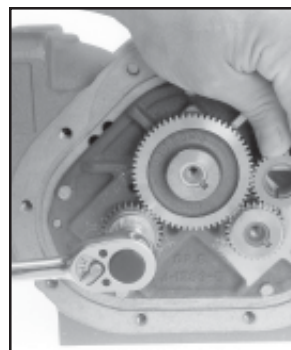
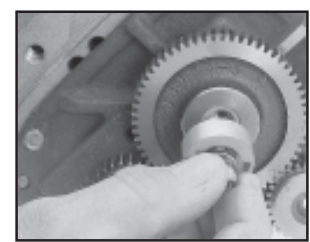
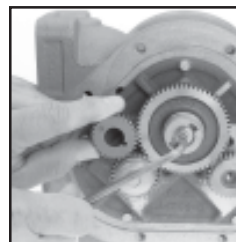
MA-4, M-5, and MA-5 old style models, M-60 and M-80 current models:

Rotor gears are on the meter back.

All other models:

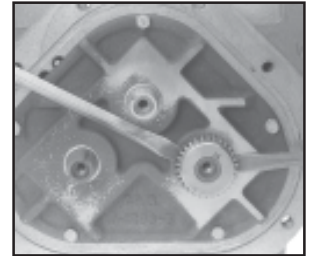
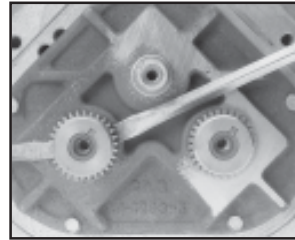
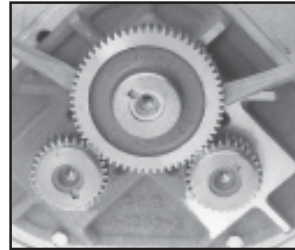
Rotor gears are on the front.

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

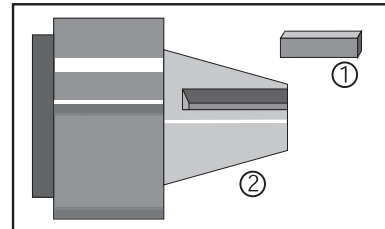


Removing Non-Corroded Rotor Gears

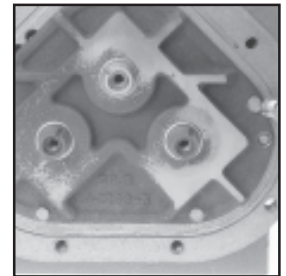
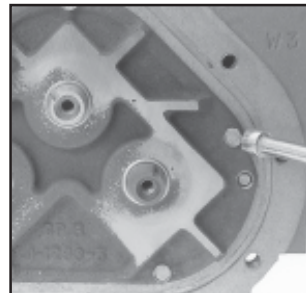
1. Insert two standard screwdrivers behind the blocking rotor gear: Gently pry the gear off its rotor tapered end. If the gears show signs of corrosion, or do not pry off easily, use the alternative method described in steps 5-8.
2. Use the same method to remove the left rotor gear and the right rotor gear. Remember, if the gear does not pry off easily, or feels stuck, use the alternative method described in steps 5-8.



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.

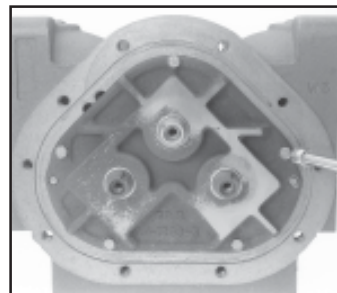
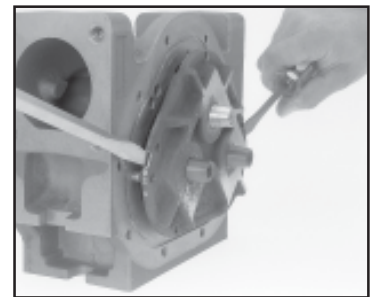
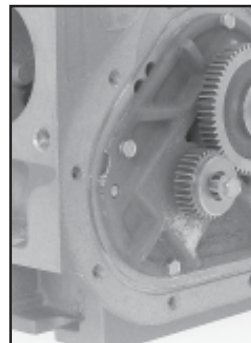


4. Use the bearing plate wrench to remove the screws that hold the front bearing plate to the meter housing. On the back of the meter housing, remove the screws that hold the rear bearing plate to the housing. Go to step 1, Removing the Bearing Plates.



Removing Corroded Rotor Gears

5. Replace all three rotor gear screws, without washers, halfway onto each of the rotor ends.
6. 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 socket. The number of screws varies with the size of meter.

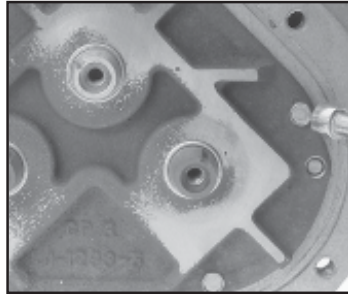
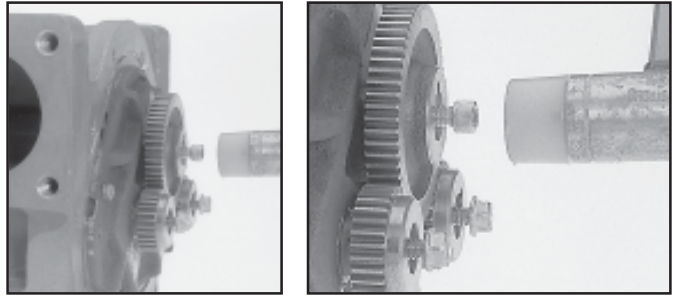


Disassembling the Meter

7. With a plastic or non-metallic mallet, tap on the heads of the screws lightly and equally. As you tap on the screw heads, the gears are driven off the rotors. As the rotors are driven in, the rear bearing plate and the rotor assembly are pushed away from the housing.

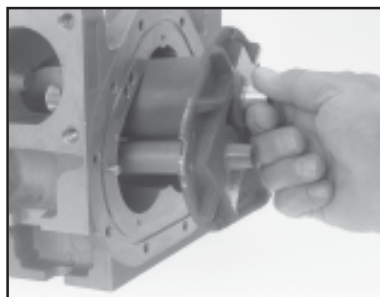
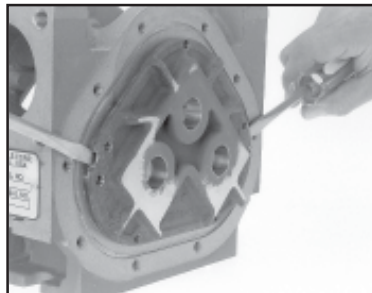
NOTE: For carbon insert bearing plates, remove the rear plate first and then each rotor as it is hand supported.

8. Use the bearing plate wrench or socket to remove the screws that hold the front bearing plate to the meter housing. The number of screws varies between different meter sizes.



Removing the Bearing Plates and Rotors

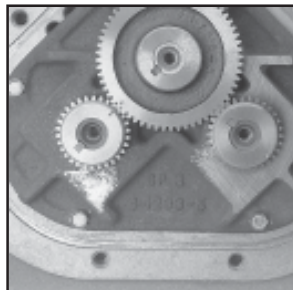
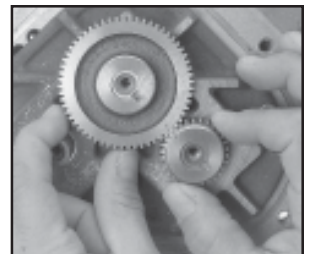
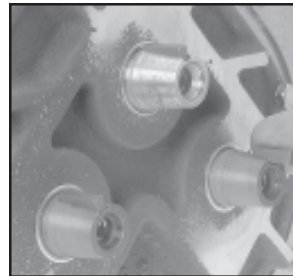
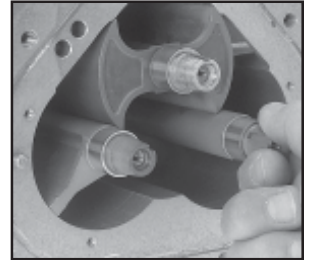
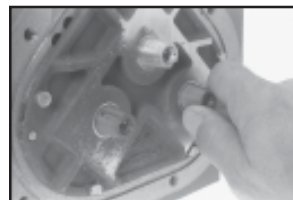
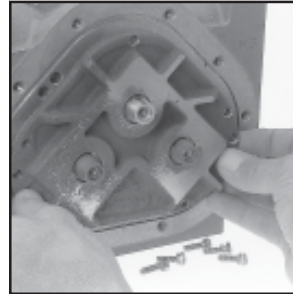
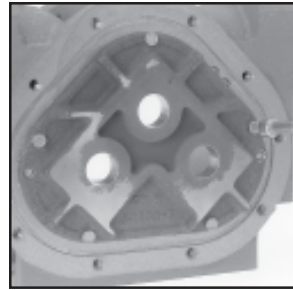
1. Insert a screwdriver into each of the two notches near the dowel pins. Be careful not to mar any of the surfaces. Gently pry the front bearing plate off the dowel pins.
2. Remove the front bearing plate and rotor assembly by pulling a rotor straight out from the housing. Be careful not to mar any of the surfaces. **MA-4, M-5, and MA-5 old style models, M-60 and M-80 current models:** Pull the rotor from the rear bearing plate. This will also remove the drive reduction gear which is attached to the blocking rotor.
3. Remove the remaining bearing plate from the other side by inserting a screwdriver into each of the two notches near the dowel pins. Be careful not to mar any surfaces. Gently pry the front bearing plate off the dowel pins. **NOTE: MA-4, M-5, and MA-5 old style models, M-60 and M-80 current models** have a driven reduction gear in attached with a shoulder bolt to the center of the front bearing plate.
4. Inspect and clean all critical surfaces like gear teeth, rotors and internal housing faces. Remove any crystalline formations using fine emery cloth or a fine wire brush. 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. Remove nicks and burrs on metal parts with a stone. Remove all grit and other foreign particles. These may also damage parts and interfere with proper operation. Replace all parts that appear worn or damaged.



1. **MA-4, M-5, and MA-5 old style models, M-60 and M-80 current models:** Rotor gears are on the rear bearing plate. All other models: Rotor gears are on the front bearing plate. Install the non-rotor gear bearing plate using the bearing plate screws and wrench.
2. Insert the non-tapered ends on the three rotors into the housing. Place each rotor into its respective bore in the installed bearing plate. **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 with the bearing plate screws. Use the bearing plate wrench. The number of screws varies with meter size.
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.

Repeat Steps 2, 3 and 4.

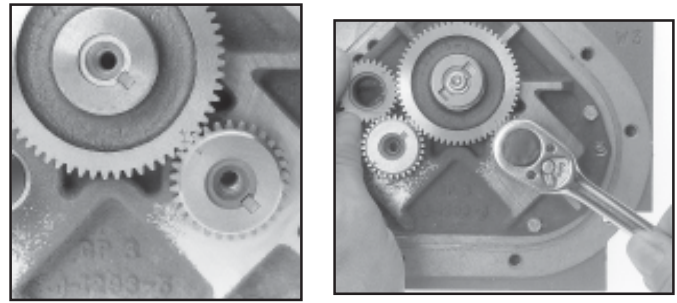
5. The rotor key is a small wedge of metal. Each rotor has a notch, or "keyway", to hold a key. Position a key into each one of the three rotors. Press the keys into the rotor keyways with your thumb and forefinger.
6. Slide the blocking rotor gear on its tapered rotor end. Slide the right displacement rotor gear on its tapered rotor end so that the timing marks line up between the two gears. See 'Timing the Rotor Gears' on the next page. Hint: Before you place the right displacement rotor gear on its tapered end, hold the right rotor gear in position. Turn the blocking rotor gear. Try to line up the timing marks before you place the right displacement rotor gear on its tapered rotor end.
7. Position the left displacement rotor gear on its tapered rotor end so that its timing mark lines up with the blocking rotor gear. See 'Timing the Rotor Gears'.



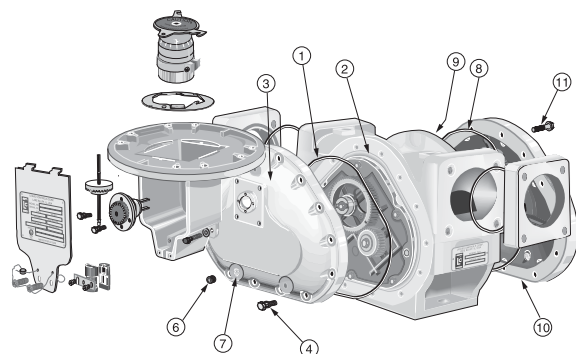
Reassembling the Meter

Timing the Rotor Gears

Rotor gears are timed by lining up the timing marks. The blocking rotor gear has a tooth **directly in front** of its timing mark. On the displacement rotor gears, the timing mark falls **in front of the space between** two gear teeth. Make sure that the tooth in front of the timing mark on the blocking rotor gear connects with the space in front of the timing mark on the displacement rotor gear. You may need to remove the gears and reposition them several times on their rotor ends in order to get the timing marks to line up correctly. For more information, See 'Troubleshooting'.

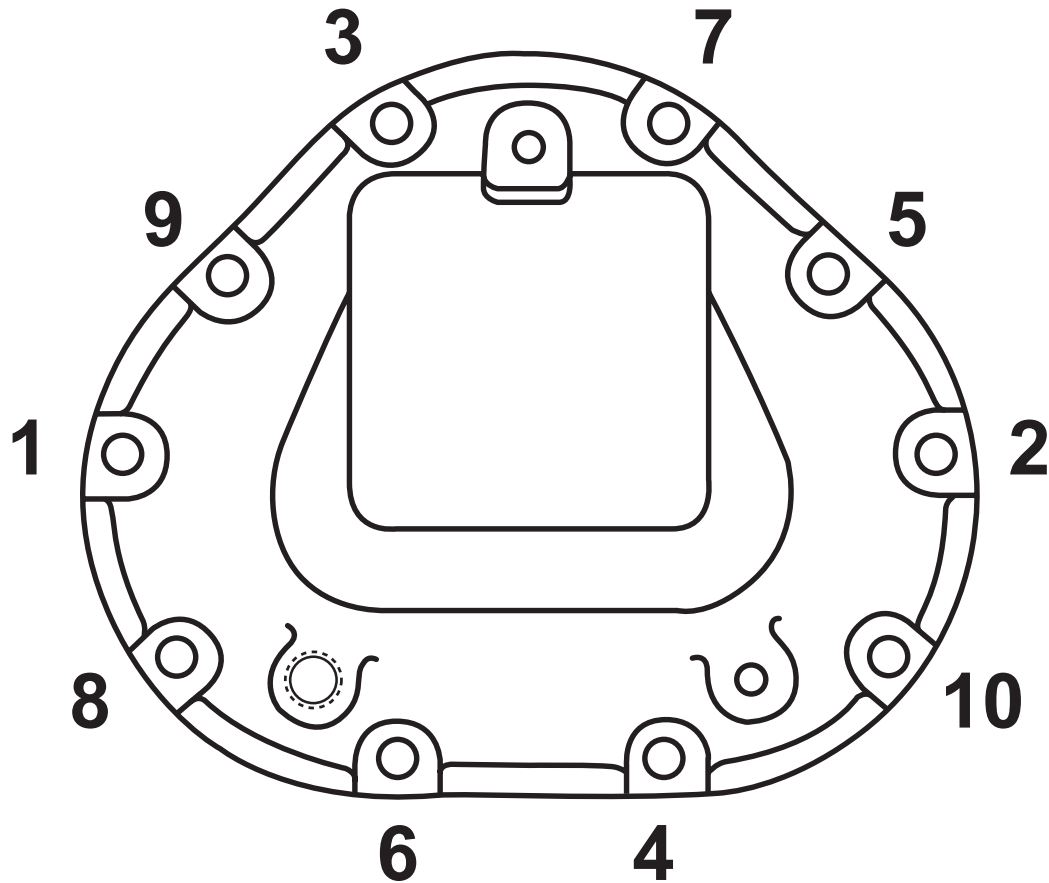


1. Position the spare displacement rotor gear between the left displacement rotor gear and the blocking rotor gear to prevent the gears from moving. Attach the right displacement gear washer and screw using the rotor gear wrench. Tighten the screw to the torque specification listed in the Torque Chart (page 22).
2. 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. Tighten the screw to the torque specification listed in the Torque Chart.
3. 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. Tighten the screw to the torque specification listed in the Torque Chart.
4. Rotate the gears to make sure that the rotors turn freely. Burrs, foreign material, or marred surfaces can restrict the rotor movements. It may be necessary to remove the gears and rotors and deburr and clean the surfaces again.
5. Install an O-ring (1) into the groove (2) on the front of the meter housing. The **M-60 and M-80 models** use a flat gasket.
6. Fasten the front cover (3) with the cover screws (4) using the cover socket or open end/box end wrench.
NOTE: 6A. LC recommends tightening the front cover screws in a criss-cross or "star" pattern with a minimum of two passes. First pass should be at half-torque, with final pass(es) at full torque. This will ensure uniform seal compression on cover O-ring or gasket. See M-7 pattern on page 22 for reference.
7. Install the front drain plug (6) in the front drain plug hole (7) using the drain plug allen wrench.
8. Install an O-ring (8) into the groove (9) on the rear of the meter housing. The **M-60 and M-80 models** use a flat gasket.
9. Fasten the rear cover (10) with the cover screws (11) using the cover socket or open end/box end wrench.
NOTE: 9A. LC recommends tightening the rear cover screws in a criss-cross or "star" pattern with a minimum of two passes. First pass should be at half torque, with final pass(es) at full torque. This will ensure uniform seal compression on cover O-ring or gasket. See M-7 pattern on page 22 reference.
10. Install the rear drain plug (12) in the rear drain plug hole (13) using the drain plug allen wrench.
11. If your meter is equipped with an electrical output accessory, such as a digital pulser, reinstall it according to the instructions outlined under 'Reinstalling...' in your accessory manual, such as the Pulser Installation, Operation and Maintenance Manual supplied in your owner's information packet. Install the front drain plug (6) in the front drain plug hole (7) using the drain plug allen wrench.



Meter Assembly Exploded View

TORQUE PATTERN M-7 COVERS



Torque Chart

Grade 5 Fasteners		
Bolt Size	Foot-Pounds	Newton-Meter
	NOMINAL*	NOMINAL*
#8 (.164) - 32 UNC-2A	42	4.8
#10 (.190) - 24 UNC-2A	63	7.1
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 $\pm 10\%$

Wrench and Socket Size Chart

Meter Element	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

NOTE: FOR 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.

⚠ 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 Regarding LPG**, refer to **NFPA Pamphlet 58** and local authorities.

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.

PROBLEM:

Leakage past packing gland drive shaft housing from internal metering chamber.

PROBABLE CAUSE AND SOLUTION:

Internal seal of packing gland assembly is worn. Replace packing gland and O-ring seal.

OPERATING NOTE:

Two common causes of packing gland leakage are thermal expansion and hydraulic shock. If two valves in a piping system (on either side of the meter) are closed at one time, and if the temperature rises as little as 1°F in the system, it could result in a rise in pressure within the system that would exceed the working pressure rating of the meter. To avoid this hazard caused by thermal expansion, a pressure-relief valve of some kind must be installed in the system. Hydraulic shock occurs when a large volume (mass) of liquid is moving through a pipe line at some flow rate and a valve is suddenly closed. When the flow is stopped, the entire mass of the liquid in the piping system acts as a battering ram causing a shock effect within the meter. The greater the mass length of line and/or velocity, the greater the hydraulic shock. Since the valve is usually located at the meter outlet, the meter housing, packing gland and the meter internal members receive the full impact of such hydraulic shock. To prevent this hazard a slow closing two-stage valve should be used with the meter. On those systems where mass length of line, etc. are of such magnitude as to preclude the elimination of hydraulic shock with the use of a two-stage slow closing valve, an impact-absorbing air cushioning device should be used.

PROBLEM:

Leakage from the cover gasket.

PROBABLE CAUSE AND SOLUTION:

Gasket has been damaged due to shock pressure or cover bolts have not been tightened sufficiently.

PROBLEM:

Product flows through meter but the register does not operate.

PROBABLE CAUSE AND SOLUTION:

- A. Check packing gland, and gear train.
- B. If all meter parts are moving then problem is in register. Faulty register should be checked and repaired by trained mechanic.
- 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.
- D. If totalizer numerals (small numbers) on register are recording, but the big numerals are not moving, register needs repair.
- E. Packing gland gear not turning. For M-60 and M-80 meters, the drive blade may be sheared. Replace the packing gland. This may be caused by starting the flow too rapidly.

Troubleshooting

PROBLEM:

Breaking teeth on timing gears.

PROBABLE CAUSE AND SOLUTION:

- A. Starting or stopping flow in meter too rapidly.
 - B. Pump bypass not adjusted properly.
-

PROBLEM:

Product flows through meter but register does not record correctly.

PROBABLE CAUSE AND SOLUTION:

- A. Adjuster not properly calibrated.
 - B. Incorrect gear plate or gear ratio has been installed.
 - C. Air is in the system.
-

PROBLEM:

No flow through meter.

PROBABLE CAUSE AND SOLUTION:

- 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. To correct, clean the meter and inspect for damage.
-

PROBLEM:

Meter runs too slowly.

PROBABLE CAUSE AND SOLUTION:

- A. Valve internal mechanism faulty. Valve does not open fully.
 - B. Meter gears or rotors partially “salted” enough to slow up rotation of parts. To correct, clean the meter.
 - C. Downstream restriction.
 - D. Clogged strainer basket.
-

PROBLEM:

The meter counts down in reverse (the meter numbers decrease).

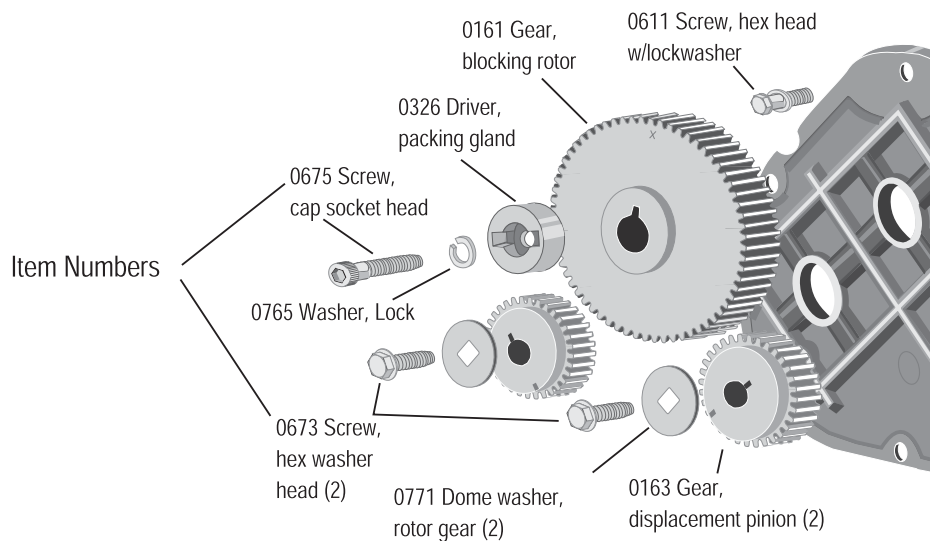
PROBABLE CAUSE AND SOLUTION:

It is necessary to reverse the direction of flow by reversing the adjuster drive gear. See ‘M-7/MA-7 Meter Start Up and Operation: Reversing the Meter Registration’ in this manual.

How to Order Replacement Parts

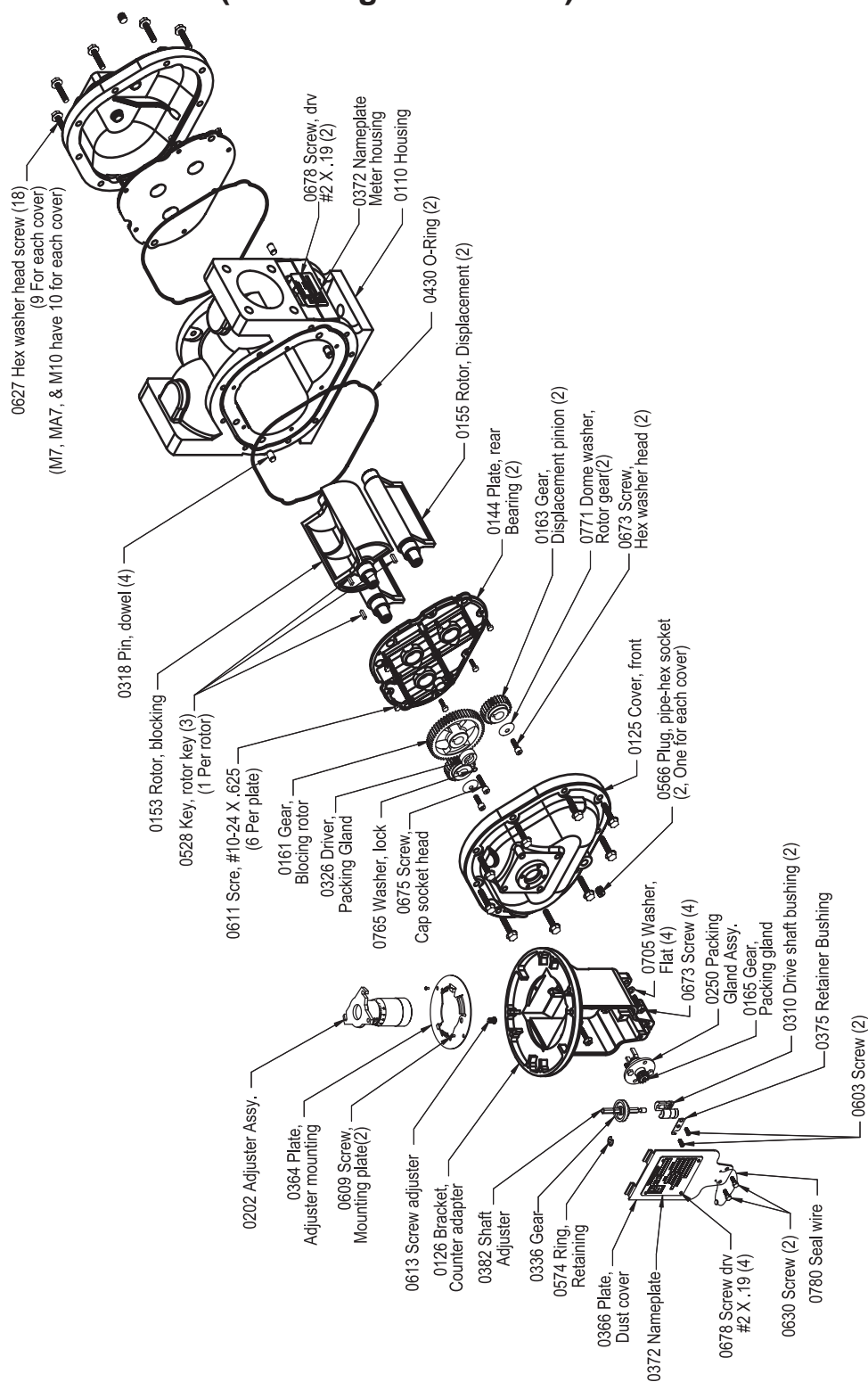
1. Refer to the exploded view drawings on Pages 27-31. Find the four digit item number for the part you want to order. The item numbers are listed on the exploded drawings.
2. Find the computer printout titled Parts List that has been inserted in the Owner's Information Packet which was shipped with your order. Look up the item number on the Parts List. The Parts List shows each item number with a corresponding part number. Find the corresponding five digit part number for the item you want to order. The part number represents an individual piece, a kit, or a complete assembly.
3. Inform your distributor of the part number that you need. The part number is the only number that allows the distributor to find the correct component for your meter.

The Bills of Material for most meter classes are on the LC public website. Always check the website for the most current BOM.



Illustrated Parts Breakdown

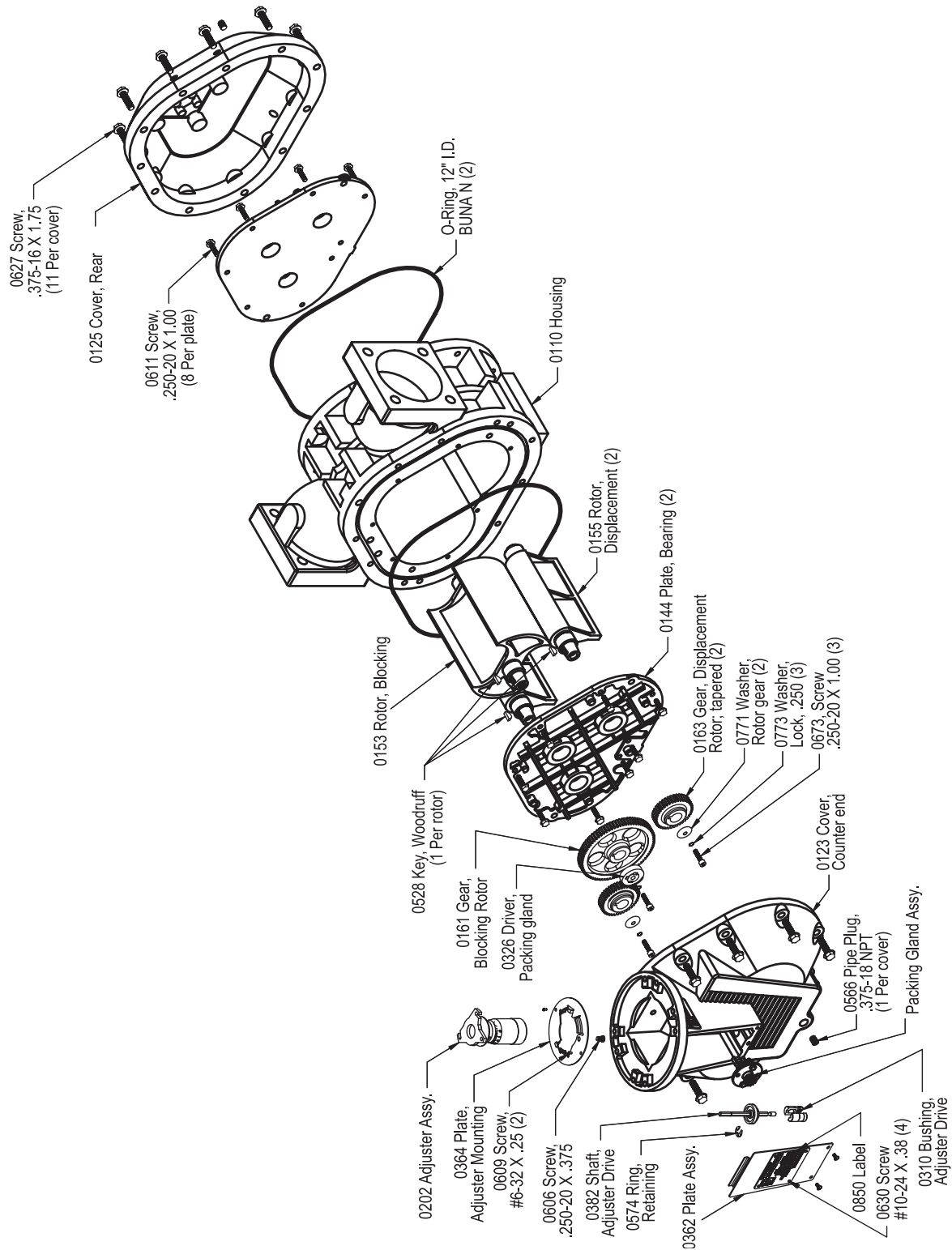
M5 through M25 Meters (including MA Meters)



NOTE: Numbers shown are **ITEM** numbers, not Part Numbers. Refer to the Bill of Materials supplied in the red Owner's Information Packet to locate the **PART NUMBER** associated with these **ITEM NUMBERS**.

NOTE: Meter components may appear different between models.

M30, M40 Meters

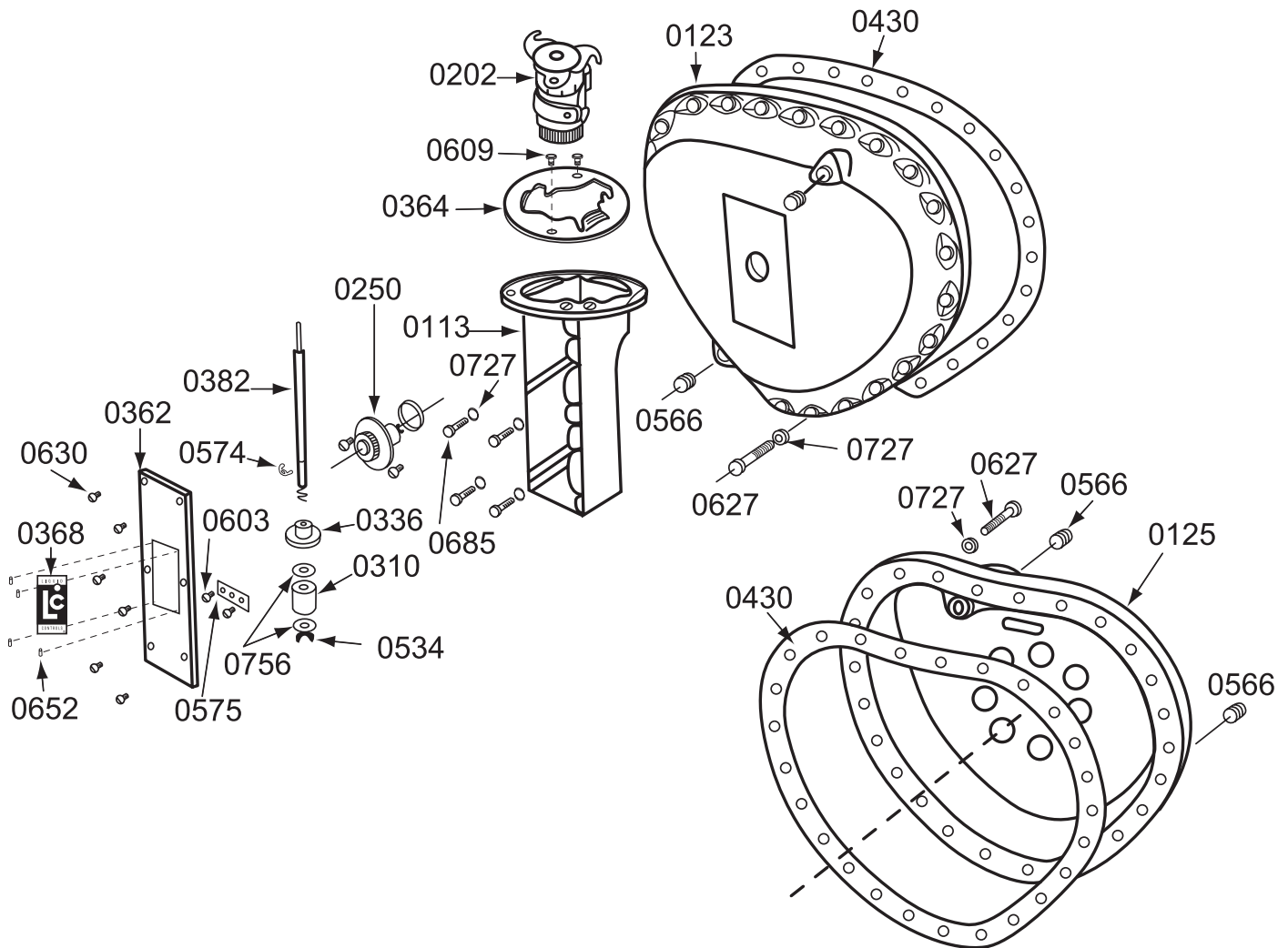


NOTE: Numbers shown are **ITEM** numbers, not Part Numbers. Refer to the Bill of Materials supplied in the red Owner's Information Packet to locate the **PART NUMBER** associated with these **ITEM NUMBERS**.

NOTE: Meter components may appear different between models.

Illustrated Parts Breakdown

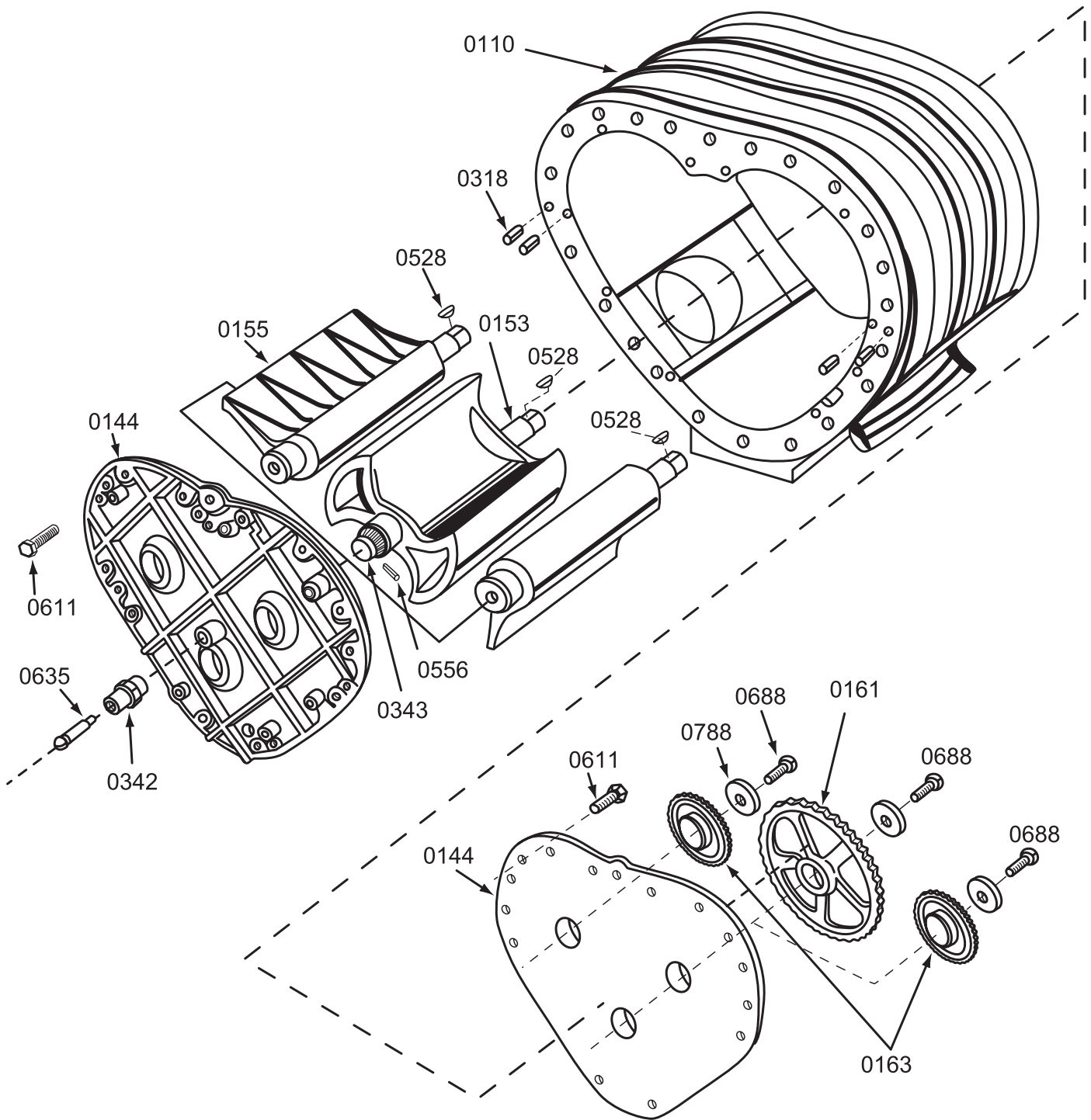
M60, M80 Meter Cover



NOTE: Numbers shown are **ITEM** numbers, not Part Numbers. Refer to the Bill of Materials supplied in the red Owner's Information Packet to locate the **PART NUMBER** associated with these **ITEM NUMBERS**.

NOTE: Meter components may appear different between models.

M60, M80 Meter Element



NOTE: Numbers shown are **ITEM** numbers, not Part Numbers. Refer to the Bill of Materials supplied in the red Owner's Information Packet to locate the **PART NUMBER** associated with these **ITEM NUMBERS**.

NOTE: Meter components may appear different between models.



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