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Section 5 - Liquid Controls’ M5—Operation and Maintenance Manual
IMPORTANT

Examine the shipment immediately on arrival to ensure there has been no damage or loss in transit. Pump Measure Control, Inc. (PMC), as shipper, is not liable for the hazards of transportation.

Read all instructions and tags concerning the dispenser carefully and entirely before starting the installation. An improperly installed dispenser is dangerous and is likely to be a source of ongoing problems.

This manual covers the MSH Series dispensers. Portions of this manual that refer exclusively to one version or the other are indicated.

Installation

All PMC dispensers must be installed according to all applicable NEC, NFPA and local codes. The installation portion of this manual is intended to provide some points to watch for when designing and installing the system the dispenser is to operate with. It is the responsibility of the installer and end customer to ensure that the entire system (tanks, pumps, dispensers, etc.) is designed and installed correctly.

A. Piping

1. The remote dispensers equipped with a hose reel should have a check valve installed between the dispenser’s outlet and the reel. The check valve prevents fuel from being displaced back through the dispenser when the pump is turned off. This can cause count run-up on the dispenser at the start of a transaction when the hose is re-pressurized. The check valve should be spring loaded and have pressure relief to prevent over pressurization of the hose due to thermal expansion of the fuel.

2. Each dispenser should be installed with a sump equipped with provision to mount a LISTED emergency shut off valve. The shuts-off valve is installed to stop the flow of fuel to the dispenser in the event of fire or if the dispenser is knocked off the island.

3. Dispensers should be located as close to the supply tank as possible. Supply lines should be sized to allow simultaneous maximum flow desired for all dispensers fed from it.

4. The vertical supply riser must be cut to the proper height in order to avoid undue stress on the dispenser when installing the ground joint union.

5. When the dispenser has been connected to the piping, the lines should be tested for leaks. Remember to allow any fresh pipe compound used in threaded joints to cure or set before performing the leak tests.

6. All hoses used with the dispensers shall be sufficiently reinforced as to not affect the operation or accuracy of the units through its expansion and contraction from pressure.

B. Electrical Wiring

1. All electrical wiring should be done by a qualified licensed electrician. All wiring must follow National Electrical Code and satisfy all local rules and regulations.

2. All field wiring is to be connected to the dispenser in the unit’s junction box.

3. Refer to electrical wiring diagrams in the rear of the manual details on wiring.
C. Start-Up

1. Make sure all filtration and/or strainers are in place prior to filling the piping system with product. Any loose debris in the piping must be prevented from passing through the meter where it can cause damage.

2. **IT IS IMPORTANT TO BLEED THE AIR FROM THE LINES VERY SLOWLY.** Running the meter RPM up on air pushed through the supply line ahead of the product can cause severe, and often total, damage to the meter.

3. After all air has been removed from the supply piping, run 15 to 20 gallons of product through the dispenser to completely fill the system and discharge all air from the unit.

4. Although the dispensers are shipped from the factory properly adjusted, rough handling in transit or special installation conditions can alter this. Before the dispensers are placed into service, their calibration should be verified and any necessary changes made. Refer to the section detailing dispenser calibration.

5. Before placing unit in service, verify that the register/pulser are functioning properly.

---

**Operation**

1. To start the dispenser, reset the register mounted to the meter. Remove the nozzle from its boot and lift the ON/OFF lever that it rests on. If the dispenser is stand alone or is authorized to dispense by a control system, the dispenser will be ready to dispense.

2. After delivery is complete, the ON/OFF lever is pushed down and the nozzle returned to its boot. This will end the transaction.

3. During delivery, VOLUME delivered will be displayed on the face of the register. At the completion of a transaction, this information will remain on the display until the register is manually reset.

4. If equipped with an optional pulser, the register will supply a real time output pulse stream for use by remote devices. The pulse stream represents volume dispensed and its resolution is determined by the pulser installed (1/10th gallon or 1/100th gallon available).
<table>
<thead>
<tr>
<th>NO</th>
<th>PART NO</th>
<th>DESCRIPTION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONTACT PMC</td>
<td>MSH-30 STAND ASSEMBLY</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>NB-1B</td>
<td>ON / OFF LEVER ASSEMBLY</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>75-MS1</td>
<td>HOSE HANGER</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>M5A1</td>
<td>LC METER / COUNTER ASSEMBLY</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0789030-002</td>
<td>ZERO START TICKET PRINTER</td>
<td>OPTIONAL EQUIPMENT</td>
</tr>
<tr>
<td>6</td>
<td>CONTACT PMC</td>
<td>10:1 OR 100:1 PULSER</td>
<td>OPTIONAL EQUIPMENT</td>
</tr>
<tr>
<td>7</td>
<td>85-SF17A</td>
<td>SATELLITE FUEL BLOCK</td>
<td>MSH-34BA Only</td>
</tr>
<tr>
<td>8</td>
<td>FL1-90</td>
<td>1&quot; FNPT FLANGED ELBOW</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>EF8210G004</td>
<td>NORMALLY CLOSED SOLENOID</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>SW1-2</td>
<td>SWITCH ASSEMBLY</td>
<td>SEE PMC DRAWING NO 91-98A29</td>
</tr>
</tbody>
</table>

**Diagram**

1. CONTACT PMC
2. NB-1B
3. 75-MS1
4. M5A1
5. 0789030-002
6. CONTACT PMC
7. 85-SF17A
8. FL1-90
9. EF8210G004
10. SW1-2

---

**Drawing Information**

DRAWING NUMBER: 91-08G123

DATE: 3/18/05

DRAWN BY: CAT

"THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND IS SUBJECT TO COPYRIGHT OWNERSHIP BY PMC, INC."
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<td>MSH-60 STAND ASSEMBLY</td>
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</tr>
<tr>
<td>2</td>
<td>NB-1A</td>
<td>ON / OFF LEVER ASSEMBLY</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>75-MS1</td>
<td>HOSE HANGER</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>M5A1</td>
<td>LC METER / COUNTER ASSEMBLY</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0789030-002</td>
<td>ZERO START TICKET PRINTER</td>
<td>OPTIONAL EQUIPMENT</td>
</tr>
<tr>
<td>6</td>
<td>CONTACT PMC</td>
<td>10:1 OR 100:1 PULSER</td>
<td>OPTIONAL EQUIPMENT</td>
</tr>
<tr>
<td>7</td>
<td>85-SF17A</td>
<td>SATELLITE FUEL BLOCK (MSH-64BA Only)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>FL1.5-90</td>
<td>1-1/2&quot; FNPT ELBOW</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>EF8210G022</td>
<td>NORMALLY CLOSED SOLENOID</td>
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<td>10</td>
<td>SW1-2</td>
<td>SWITCH ASSEMBLY</td>
<td>SEE PMC DRAWING NO 91-98A29</td>
</tr>
<tr>
<td>PART #</td>
<td>PART DESCRIPTION</td>
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<td></td>
</tr>
<tr>
<td>---------</td>
<td>------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>75-NB-2A NOZZLE BOOT HOUSING (incl LEVER)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>75-NB-2B LEVER (Not sold separately)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>20-10006-SS SENSOR MOUNTING PLATE (FH Only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>65-PRX-1 SENSOR (FH Only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>85-NB-7 LEVER SHAFT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>NB-5 SPRING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>35-62035 5/16 X 3/8&quot; SS SHOULDER SCREW</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
WEIGHT OF DRY BREAK AND ADAPTER PULLS SWITCH OFF

OFF POSITION

ON POSITION

REMOVE DRY BREAK & PUSH SWITCH LEVER TO ON POSITION
<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>QTY</th>
<th>PART NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SWITCH BOX HOUSING</td>
<td>1</td>
<td>75-SW1</td>
</tr>
<tr>
<td>2</td>
<td>SWITCH BOX LID</td>
<td>1</td>
<td>75-SW2</td>
</tr>
<tr>
<td>3</td>
<td>SWITCH LEVER</td>
<td>1</td>
<td>75-SW4</td>
</tr>
<tr>
<td>4</td>
<td>SW-5 SPRING</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>SWITCH SHAFT</td>
<td>1</td>
<td>75-SW3</td>
</tr>
<tr>
<td>6</td>
<td>#10-32 x 1&quot; PHILLIPS PAN HD MACH SCREW</td>
<td>4</td>
<td>35-41105</td>
</tr>
<tr>
<td>7</td>
<td>1923-1-E2 DPDT SWITCH (20A @ 125VAC)</td>
<td>1</td>
<td>1923-1-E2</td>
</tr>
<tr>
<td>8</td>
<td>#6-32 x 1 PHILLIPS PAN HD MACH SCREW</td>
<td>2</td>
<td>35-22102</td>
</tr>
<tr>
<td>9</td>
<td>LINKAGE ROD AND TWO BALL JOINTS</td>
<td>1</td>
<td>LRBJ</td>
</tr>
<tr>
<td>10</td>
<td>ON / OFF LEVER ASSEMBLY</td>
<td>1</td>
<td>75-CD27/28</td>
</tr>
</tbody>
</table>

**Ball Joint**

**Ball Joint**
Installation & Maintenance Instructions

2—WAY INTERNAL PILOT—OPERATED SOLENOID VALVES
NORMALLY CLOSED OPERATION — GENERAL SERVICE
1”, 1¼” OR 1½” NPT

NOTICE: See separate solenoid installation and maintenance instructions for information on: Wiring, Solenoid Temperature, Cause of Improper Operation, Coil or Solenoid Replacement.

DESCRIPTION
Series 8210 valves are 2—way normally closed internal pilot—operated solenoid valves designed for general service. Valves are made of rugged forged brass. Series 8210 valves are provided with a general purpose solenoid enclosure.
Series EF8210 and 8211 are the same as Series 8210 except they are provided with an explosionproof or explosionproof/watertight solenoid enclosure.

OPERATION
Normally Closed: Valve is closed when solenoid is de—energized; open when energized.

IMPORTANT: Minimum operating pressure differential is 5 psi.

Manual Operator (optional feature)
Manual operator allows manual operation when desired or during an electrical power outage. To engage manual operator (open the valve), turn lever clockwise until it hits a stop. Valve will now be in the same position as when the solenoid is energized. To disengage manual operator (close the valve), turn lever counterclockwise until it hits a stop.

To engage, turn lever clockwise until it hits a stop.

Partial view of Manual Operator

⚠️ CAUTION: For valve to operate electrically, manual operator lever must be fully rotated counterclockwise.

INSTALLATION
Check nameplate for correct catalog number, pressure, voltage, frequency, and service. Never apply incompatible fluids or exceed pressure rating of the valve. Installation and valve maintenance to be performed by qualified personnel.

Future Service Considerations
Provision should be made for performing seat leakage, external leakage, and operational tests on the valve with a nonhazardous, noncombustible fluid after disassembly and reassembly.

Temperature Limitations
For maximum valve ambient and fluid temperatures, refer to chart below. Check catalog number prefix and watt rating on nameplate.

<table>
<thead>
<tr>
<th>Watt Rating</th>
<th>Catalog Number Prefix</th>
<th>Solenoid Class</th>
<th>Maximum Ambient Temp.</th>
<th>Maximum Fluid Temp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>None or DF</td>
<td>F</td>
<td>122°F (50°C)</td>
<td>180°F (82°C)</td>
</tr>
<tr>
<td>AC</td>
<td>HT</td>
<td>H</td>
<td>140°F (60°C)</td>
<td>180°F (82°C)</td>
</tr>
<tr>
<td>6.1 AC</td>
<td>None, KF, SF or SC</td>
<td>F</td>
<td>125°F (54°C)</td>
<td>180°F (82°C)</td>
</tr>
<tr>
<td>11.2 DC</td>
<td>None or HT</td>
<td>F or H</td>
<td>77°F (25°C)</td>
<td>150°F (65°C)</td>
</tr>
<tr>
<td>11.6 DC</td>
<td>None, HT, KF, SC, SF</td>
<td>F or H</td>
<td>104°F (40°C)</td>
<td>150°F (65°C)</td>
</tr>
</tbody>
</table>

Positioning
This valve is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertically and upright to reduce the possibility of foreign matter accumulating in the solenoid base assembly area.

Piping
Connect piping to valve according to markings on valve body. Apply pipe compound sparingly to male pipe threads only. If applied to valve threads, the compound may enter the valve and cause operational difficulty. Avoid pipe strain by properly supporting and aligning piping. When tightening the pipe, do not use valve or solenoid as a lever. Locate wrenches applied to valve body or piping as close as possible to connection point.

⚠️ CAUTION: To protect the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601 and 8602 for strainers.

MAINTENANCE

⚠️ WARNING: To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize valve, and vent fluid to a safe area before servicing the valve.

NOTE: It is not necessary to remove the valve from the pipeline for repairs.
Cleaning
All solenoid valves should be cleaned periodically. The time between cleanings will vary depending on the medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. In the extreme case, faulty valve operation will occur and the valve may fail to open or close. Clean strainer or filter when cleaning the valve.

Preventive Maintenance
- Keep medium flowing through the valve as free from dirt and foreign material as possible.
- Periodic exercise of the valve should be considered if ambient or fluid conditions are such that corrosion, elastomer degradation, fluid contamination build up, or other conditions that could impede solenoid valve shifting are possible. The actual frequency of exercise necessary will depend on specific operating conditions. A successful operating history is the best indication of a proper interval between exercise cycles.
- Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. If parts are worn or damaged, install a complete rebuild kit.

Causes of Improper Operation
- Incorrect Pressure: Check valve pressure. Pressure to valve must be within range specified on nameplate.
- Excessive Leakage: Disassemble valve and clean all parts. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

Valve Disassembly
1. Disassemble valve in an orderly fashion using exploded views for identification and placement of parts. Refer to Figure 1 for AC construction; Figure 2 for DC construction. For 1” or 1 1/4” NPT valve construction, see Figure 1; for 1 ½” NPT valve construction, see Figure 2.
2. Remove solenoid enclosure. See separate instructions.
3. For valves supplied with optional manual operators, see section on Disassembly of Manual Operator.
4. Unscrew solenoid base sub—assembly from valve body. Then remove core assembly with core spring and solenoid base gasket. For AC construction (Figure 1) core spring is a loose piece.
5. For normal maintenance (cleaning) it is not necessary to remove the valve seat. However, for valve seat removal use a 7/16” thin wall socket wrench
6. Remove bonnet screws, valve bonnet, diaphragm spring, diaphragm assembly, body gasket, body passage eyelet (present on current valve constructions only) and body passage gasket.
7. All parts are now accessible for cleaning or replacement. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

Service Notice
When installing a new ASCO Rebuild Kit, please be aware that the diaphragm assembly may not be identical to the diaphragm assembly in the valve. See Figure 1 for alternate diaphragm constructions. The two diaphragm constructions are interchangeable and will perform equally well.

CAUTION: To ensure proper valve operation, install all parts supplied in ASCO Rebuild Kit. Do not mix old and new parts.

Valve Reassembly
1. Lubricate body gasket, body passage gasket, bonnet gasket and solenoid base gasket with DOW CORNING® 200 Fluid lubricant or an equivalent high—grade silicone fluid.
2. Install body passage gasket, body passage eyelet, diaphragm assembly, diaphragm spring, valve bonnet and bonnet screws. Hand thread screws as far as possible. Then torque bonnet screws in a crisscross manner to 144 ± 15 in—lbs [16,3 ± 1,7 Nm].
3. If removed, install valve seat in valve body. Apply a small amount of thread compound compatible with valve media to valve seat threads. Torque valve seat to 75 ± 10 in—lbs [8,5 ± 1,1 Nm].
4. For valves supplied with optional manual operator, see section on Reassembly of Manual Operator.
5. For AC construction (Figure 1), install core spring in core assembly. Wide end of core spring in core first, closed end protrudes from top of core.
6. Install solenoid base gasket, core assembly with core spring and solenoid base sub—assembly in valve body. Torque solenoid base sub—assembly to 175 ± 25 in—lbs [19,8 ± 2,8 Nm].
7. Install solenoid. See separate instructions.

WARNING: To prevent the possibility of death, serious injury or property damage, check valve for proper operation before returning to service. Also perform internal seat and external leakage tests with a nonhazardous, noncombustible fluid.
8. Restore line pressure and electrical power supply to valve.
9. After maintenance is completed, operate the valve a few times to be sure of proper operation. A metallic click indicates the solenoid is operating.

Disassembly of Manual Operator
1. Unscrew solenoid base sub—assembly from manual operator body.
2. Unscrew manual operator body from valve body. Then remove stem retainer from base of manual operator body and stem/spacer sub—assembly.
3. Pull stem/spacer sub—assembly with stem gasket from side of manual operator body. Then remove core assembly with core spring, solenoid base gasket and manual operator bonnet gasket.
4. For further disassembly refer to section on Valve Disassembly step 4.

Reassembly of Manual Operator
1. Lubricate stem gasket with DOW CORNING® 111 Compound lubricant or an equivalent high—grade silicone grease.
2. For AC construction (Figure 1), install core spring in core assembly. Wide end of core spring in core first, closed end protrudes from top of core.
3. Holding the manual operator body in a horizontal position, install core assembly with core spring from the bottom end.
4. Insert the stem/spacer sub—assembly with the stem gasket into the side hole of the manual operator body. Rotate the lever of the stem/spacer sub—assembly to the 12 o'clock position.
5. Install stem retainer on base of manual operator body and simultaneously engage it into the slot provided on the stem/spacer sub—assembly.

IMPORTANT: The spacer on the stem/spacer sub—assembly must be inside of the stem retainer for AC construction (Figure 1) and outside of the stem retainer for DC construction (Figure 2).
6. Install manual operator bonnet gasket and body with preassembled parts into valve body. Torque manual operator body to 175 ± 25 in—lbs [19,8 ± 2,8 Nm].
7. Replace solenoid base gasket and solenoid base sub—assembly. Torque solenoid base sub—assembly to 175 ± 25 in—lbs [19,8 ± 2,8 Nm].
8. For further reassembly, refer to Valve Reassembly step 6.
## Torque Chart

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Torque Value Inch-Pounds</th>
<th>Torque Value Newton-Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid base sub-assembly</td>
<td>175 ± 25</td>
<td>19.8 ± 2.8</td>
</tr>
<tr>
<td>Manual operator body</td>
<td>144 ± 15</td>
<td>16.3 ± 1.7</td>
</tr>
<tr>
<td>Bonnet screw</td>
<td>75 ± 10</td>
<td>8.5 ± 1.1</td>
</tr>
<tr>
<td>Valve seat</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### IMPORTANT
Captive spacer on stem/spacer sub-assembly must be located on the inside of stem retainer when reassembled.

### MANUAL OPERATOR (OPTIONAL)

- Solenoid base sub-assembly
- Stem gasket
- Stem/spacer sub-assembly
- Core spring (see note)
- Core assembly
- Manual operator body
- Stem retainer
- Body passage gasket
- Body passage eyelet
- Body gasket
- Diaphragm assembly
- Diaphragm spring
- Valve bonnet
- Bonnet screw (4)

### PARTIAL VIEW

- * Indicates Parts Supplied In ASCO Rebuild Kits
- **1** This part is NOT supplied in all kits

### IMPORTANT
See torque chart

---

Figure 1. Series 8210 valve without solenoid, AC construction with 1” or 1 ¼” NPT valve body shown.

Parts marked with an asterisk (*) in the exploded view are supplied in Rebuild Kits. When Ordering Rebuild Kits for ASCO valves, order the Rebuild Kit number stamped on the valve nameplate. If the number of the kit is not visible, order by indicating the number of kits required, and the Catalog Number and Serial Number of the valve(s) for which they are intended.
Figure 2. Series 8210 valve without solenoid, DC construction with 1 ½” NPT valve body shown.
**SERVICE NOTICE—**

ASCO® solenoid valves with design change letter “G” in the catalog number (example: 8210G-1) have an epoxy encapsulated ASCO® Red Hat II® solenoid. This solenoid replaces some of the solenoids with metal enclosures and open-frame constructions. Follow these installation and maintenance instructions if your valve or operator uses this solenoid.

---

**DESCRIPTION**

Catalog numbers 8016G1 and 8016G2 are epoxy encapsulated pull-type solenoids. The green solenoid with lead wires and 1/2” conduit connection is designed to meet Enclosure Type 1—General Purpose, Type 2—Dripproof, Types 3 and 3S—Raintight, and Types 4 and 4X—Watertight. The black solenoid on catalog numbers prefixed “EF” is designed to meet Enclosure Types 3 and 3S—Raintight, Types 4 and 4X—Watertight, Types 6 and 6P—Submersible, Type 7 (A, B, C, & D) Explosionproof Class I, Division I, Groups A, B, C, & D and Type 9 (E, F, G)—Dust—Ignitionproof Class II, Division I, Groups E, F, & G. The Class II, Groups F & G Dust Locations designation is not applicable for solenoids or solenoid valves used for steam service or when a class “H” solenoid is used. See Temperature Limitations section for solenoid identification and nameplate/retainer for service. When installed just as a solenoid and not attached to an ASCO valve, the core has a 0.250—28 UNF—2B tapped hole, 0.38 minimum full thread.

**Series 8016G solenoids are available in:**

- **Open—Frame Construction**
  The green solenoid may be supplied with 1/4” spade, screw, or DIN terminals (Refer to Figure 4).

- **Panel Mounted Construction**
  These solenoids are specifically designed to be panel mounted by the customer through a panel having a .062 to .093 maximum wall thickness. (Refer to Figure 3 and section on Installation of Panel Mounted Solenoid).

**Optional Features For Type 1 — General Purpose Construction Only**

- **Junction Box**
  This junction box construction meets Enclosure Types 2, 3, 3S, 4, and 4X. Only solenoids with 1/4” spade or screw terminals may have a junction box. The junction box provides a 1/2” conduit connection, grounding and spade or screw terminal connections within the junction box (See Figure 5).

- **DIN Plug Connector Kit No. K236034**
  Use this kit only for solenoids with DIN terminals. The DIN plug connector kit provides a two pole with grounding contact DIN Type 43650 construction (See Figure 6).

**OPERATION**

When the solenoid is energized, the core is drawn into the solenoid base sub—assembly. IMPORTANT: When the solenoid is de—energized, the initial return force for the core, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force for AC construction is 11 ounces, and 4 ounces for DC construction.

**INSTALLATION**

Check nameplate for correct catalog number, service, and wattage. Check front of solenoid for voltage and frequency.

**WARNING:** Electrical hazard from the accessibility of live parts. To prevent the possibility of death, serious injury or property damage, install the open—frame solenoid in an enclosure.

---

**FOR BLACK ENCLOSURE TYPES 7 AND 9 ONLY**

⚠️ **CAUTION:** To prevent fire or explosion, do not install solenoid and/or valve where ignition temperature of hazardous atmosphere is less than 165°F. On valves used for steam service or when a class “H” solenoid is used, do not install in hazardous atmosphere where ignition temperature is less than 180°F. See nameplate/retainer for service.

**NOTE:** These solenoids have an internal non—resetable thermal fuse to limit solenoid temperature in the event that extraordinary conditions occur which could cause excessive temperatures. These conditions include high input voltage, a jammed core, excessive ambient temperature or a shorted solenoid, etc. This unique feature is a standard feature only in solenoids with black explosionproof/dust—ignitionproof enclosures (Types 7 & 9).

⚠️ **CAUTION:** To protect the solenoid valve or operator, install a strainer or filter, suitable for the service involved in the inlet side as close to the valve or operator as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601, and 8602 for strainers.

**Temperature Limitations**

For maximum valve ambient temperatures, refer to chart. The temperature limitations listed, only indicate maximum application temperatures for field wiring rated at 90°C. Check catalog number prefix and watt rating on nameplate to determine maximum ambient temperature. See valve installation and maintenance instructions for maximum fluid temperature.

**NOTE:** For steam service, refer to Wiring section, Junction Box for temperature rating of supply wires.

<table>
<thead>
<tr>
<th>Watt Rating</th>
<th>Catalog Number Coil Prefix</th>
<th>Class of Insulation</th>
<th>Maximum Ambient Temp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1, 8.1, 9.1, &amp; 11.1</td>
<td>None, FB, KF, KP, SF, SP, SC, &amp; SD</td>
<td>F</td>
<td>125°F (51.7°C)</td>
</tr>
<tr>
<td>6.1, 8.1, 9.1, &amp; 11.1</td>
<td>HB, HT, KB, KH, SS, ST, SU, &amp; ST</td>
<td>H</td>
<td>140°F (60°C)</td>
</tr>
<tr>
<td>10.6</td>
<td>None, KF, SF, &amp; SC</td>
<td>F</td>
<td>104°F (40°C)</td>
</tr>
<tr>
<td>10.6</td>
<td>HT, KH, SU, &amp; ST</td>
<td>H</td>
<td>104°F (40°C)</td>
</tr>
</tbody>
</table>

*Minimum ambient temperature −40°F (−40°C).*

**Positioning**

This solenoid is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertically and upright to reduce the possibility of foreign matter accumulating in the solenoid base sub—assembly area.

**Wiring**

Wiring must comply with local codes and the National Electrical Code. All solenoids supplied with lead wires are provided with a grounding wire which is green or green with yellow stripes and a 1/2” conduit connection. To facilitate wiring, the solenoid may be rotated 360°. For the watertight and explosionproof solenoid, electrical fittings must be approved for use in the approved hazardous locations.

**Additional Wiring Instructions For Optional Features:**

- **Open—Frame solenoid with 1/4” spade terminals**
  For solenoids supplied with screw terminal connections use #12—18 AWG stranded copper wire rated at 90°C or greater. Torque terminal block screws to...
10 ± 2 in–lbs [1.0 ± 1.2 Nm]. A tapped hole is provided in the solenoid for grounding, use a #10–32 machine screw. Torque grounding screw to 15 – 20 in–lbs [1.7 – 2.3 Nm]. On solenoids with screw terminals, the socket head screw holding the terminal block to the solenoid is the grounding screw. Torque the screw to 15 – 20 in–lbs [1.7 – 2.3 Nm], with a 5/32” hex key wrench.

**Junction Box**

The junction box is used with spade or screw terminal solenoids only and is provided with a grounding screw and a 1/2” conduit connection. Connect #12 –18 AWG standard copper wire only to the screw terminals. Within the junction box use field wire that is rated 90°C or greater for connections. For steam service use 105°C rated wire up to 50 psi or use 125°C rated wire above 50 psi. After electrical hookup, replace cover gasket, cover, and screws. Tighten screws evenly in a crisscross manner.

**DIN Plug Connector Kit No.K236–034**

1. The open–frame solenoid is provided with DIN terminals to accommodate the DIN plug connector kit.
2. Remove center screw from plug connector. Using a small screwdriver, pry terminal block from connector cover.
3. Use #12–18 AWG stranded copper wire rated at 90°C or greater for connections. Strip wire leads back approximately 1/4” for installation in socket terminals. The use of wire—end sleeves is also recommended for these socket terminals. Maximum length of wire—end sleeves to be approximately 1/4”.
4. Timing of the ends of the lead wires is not recommended.
5. Thread wire through gland nut, gland gasket, washer, and connector cover.

NOTE: Connector cover may be rotated in 90° increments from position shown for alternate positioning of cable entry.

6. Check DIN connector terminal block for electrical markings. Then make electrical hookup to terminal block according to markings on it. Snap terminal block into connector cover and install center screw.
7. Position connector gasket on solenoid and install plug connector. Torque center screw to 5 ± 1 in–lbs [0.6 ± 1.1 Nm].

NOTE: Alternating current (AC) and direct current (DC) solenoids are built different. To convert from one to the other, it may be necessary to change the complete solenoid including the core and solenoid base sub—assembly, not just the solenoid. Consult ASCO.

**Installation of Solenoid**

Solenoids may be assembled as a complete unit. Tightening is accomplished by means of a hex flange at the base of the solenoid. The 3/4” bonnet construction (Figure 1) must be disassembled for installation and installed with a special wrench adapter.

**Installation of Panel Mounted Solenoid** (See Figure 3)

Disassemble solenoid following instruction under Solenoid Replacement then proceed

3/4” Valve Bonnet Construction

1. Install retainer (convex side to solenoid) in 1.312 diameter mounting hole in customer panel.
2. Then position spring washer over plugnut/core tube sub—assembly.
3. Install plugnut/core tube sub—assembly through retainer in customer panel. Then replace solenoid, nameplate/retainer and red cap.

15/16” Valve Bonnet Construction

1. Install solenoid base sub—assembly through 0.69 diameter mounting hole in customer panel.
2. Position spring washer on opposite side of panel over solenoid base sub—assembly then replace.

**Solenoid Temperature**

Standard solenoids are designed for continuous duty service. When the solenoid is energized for a long period, the solenoid becomes hot and can be touched by hand only for an instant. This is a safe operating temperature.

**MAINTENANCE**

⚠️ WARNING: To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize solenoid operator and/or valve, and vent fluid to a safe area before servicing.

**Cleaning**

All solenoid operators and valves should be cleaned periodically. The time between cleaning will vary depending on medium and service conditions. In general, if the voltage to the solenoid is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. Clean strainer or filter when cleaning the valve.

**Preventive Maintenance**

- Keep the medium flowing through the solenoid operator or valve as free from dirt and foreign material as possible.
- While in service, the solenoid operator or valve should be operated at least once a month to insure proper opening and closing.
- Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any worn or damaged parts.

**Causes of Improper Operation**

- **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic click signifies that the solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or blown fuses, open—circuited or grounded solenoid, broken lead wires or splice connections.
- **Burned–Out Solenoid:** Check for open—circuited solenoid. Replace if necessary. Check supply voltage; it must be the same as specified on nameplate/retainer and marked on the solenoid. Check ambient temperature and check that the core is not jammed.
- **Low Voltage:** Check voltage across the solenoid leads. Voltage must be at least 85% of rated voltage.

**Solenoid Replacement**

1. On solenoids with lead wires disconnect conduit, coil leads, and grounding wire.
2. Disassemble solenoids with optional features as follows:
   - **Spade or Screw Terminals**
     Remove terminal connections, grounding screw, grounding wire, and terminal block (screw terminal type only).
   - **DIN Plug Connector**
     Remove center screw from DIN plug connector. Disconnect DIN plug connector from adapter. Remove socket head screw (use 5/32” hex key wrench), DIN terminal adapter, and gasket from solenoid.
3. Snap off red cap from top of solenoid base sub—assembly.
4. Push down on solenoid. Then use a suitable screwdriver, insert blade in slot provided between solenoid and nameplate/retainer. Pry up slightly and push to remove. Then remove solenoid from solenoid base sub—assembly.
5. Reassemble using exploded views for parts identification and placement.

**Disassembly and Reassembly of Solenoids**

1. Remove solenoid, see Solenoid Replacement.
2. Remove finger washer or spring washer from solenoid base sub—assembly.
3. Unscrew solenoid base sub—assembly.
   - **NOTE:** Some solenoid constructions have a plugnut/core tube sub—assambly, bonnet gasket and bonnet in place of the solenoid base sub—assembly. To remove bonnet use special wrench adapter supplied in ASCO Rebuild Kit. For wrench adapter only, order ASCO Wrench Kit No.K218948.
4. The core is now accessible for cleaning or replacement.
5. If the solenoid is part of a valve, refer to basic valve installation and maintenance instructions for further disassembly.
6. Reassemble using exploded views for identification and placement of parts.

**ORDERING INFORMATION FOR ASCO SOLENOIDS**

When Ordering Solenoids for ASCO Solenoid Operators or Valves, order the number stamped on the solenoid. Also specify voltage and frequency.
**Torque Chart**

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Torque Value in Inch—Pounds</th>
<th>Torque Value in Newton—Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>solenoid base sub—assembly</td>
<td>175 ± 25</td>
<td>19,8 ± 2,8</td>
</tr>
<tr>
<td>valve bonnet (3/4” bonnet construction)</td>
<td>90 ± 10</td>
<td>10,2 ± 1,1</td>
</tr>
<tr>
<td>bonnet screw (3/8” or 1/2” NPT pipe size)</td>
<td>25</td>
<td>2,8</td>
</tr>
<tr>
<td>bonnet screw (3/4” NPT pipe size)</td>
<td>40</td>
<td>4,5</td>
</tr>
</tbody>
</table>

---

**Figure 1. Series 8016G solenoids**

- **3/4” Bonnet Construction**
  - **15/16” Bonnet Construction**
  - **Alternate Construction**

- See torque chart for bonnet screws
- Remove red cap and push solenoid down. Then pry here to lift nameplate/retainer and push to remove.
- Tapped hole in core
  - 0.250—28 UNF—2B
  - 0.38 minimum full thread.

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**Figure 2. Series 8016G solenoid**

**Bolted Bonnet Construction**

**Figure 3. Series 8016G panel mounted solenoids**

See torque chart for bonnet screws

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Form No.V6583R7

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## Torque Chart

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Torque Value in Inch–Pounds</th>
<th>Torque Value in Newton–Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>terminal block screws</td>
<td>10 ± 2</td>
<td>1,1 ± 0,2</td>
</tr>
<tr>
<td>socket head screw</td>
<td>15 – 20</td>
<td>1,7 – 2,3</td>
</tr>
<tr>
<td>center screw</td>
<td>5 ± 1</td>
<td>0,6 ± 0,1</td>
</tr>
</tbody>
</table>

---

### Figure 4. Open—frame solenoids

- **Junction Box Solenoid with 1/4" Spade Terminals or Screw Terminals**
  - screw terminal block (see note)
  - junction box gasket
  - junction box with 1/2" conduit connection and grounding terminal
  - cover screw
c
- **Open—Frame Solenoid with Screw Terminals. Socket head screw is used for grounding.**
  - socket head screw (5/32" hex key wrench)
  - terminal block screw

---

### Figure 5. Junction box (optional feature)

- **Open—Frame Solenoid with DIN Terminal Plug Connector**
  - gasket
  - DIN terminal adapter
  - socket head screw (5/32" hex key wrench)

**Notes:**

1. Connector cover may be rotated in 90° increments from position shown for alternate position of cable entry.
2. Refer to markings on DIN connector for proper electrical connections.

---

### Figure 6. DIN plug connector kit No. K236034 (optional feature)

- **Indicates that these parts are included in DIN plug connector Kit No. K236034**
  - connector
  - DIN connector terminal block (see note 2)
  - connector cover (see note 1)
  - center screw
  - gland nut
  - gland gasket
  - washer

---

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Exploded View: M-5/MA-5/MA-4 Meter Covers

The 0250 Packing Gland is field servicable. See “Servicing the Drive Components” in the M/MA Meter Manual.

How to Order Replacement Parts

1. Find the item number listed on the exploded drawing. The 4 digit item numbers are listed with a word description.
2. Find the computer printout titled Parts List that has been provided with your meter. Look up the item number on the Parts List. The Parts List shows each item number with a corresponding part number. Find the corresponding 5 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.
When placing order for replacement parts please reference the meter's serial number.
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<tr>
<th>ITEM</th>
<th>PART#</th>
<th>DESCRIPTION</th>
<th>QTY</th>
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<td>EEC APPROVED</td>
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<td>00306</td>
<td>SCREW, DRV #2 x 0.19</td>
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<td>49368</td>
<td>NAMEPLATE, METERS</td>
<td>WITH EEC APPROVAL</td>
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<td>L1102</td>
<td>METER ELEMENT</td>
<td>M-5-1 FOR FORK DRIVE</td>
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<td>SCREW, DRV #2 x 0.19</td>
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<td>0611</td>
<td>09079</td>
<td>SCREW, #10-24 X 0.625</td>
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<td>09079</td>
<td>SCREW, #8-32 X 0.750 LG</td>
<td>HEX HD 18-8 STAINLESS STL</td>
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<td>0318</td>
<td>40665</td>
<td>PIN, DOWEL</td>
<td>0.250 DIA X 0.625 LOND</td>
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<td>ALUM / SS HC</td>
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<td>48079</td>
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<td>SINTERED IRON, TAPER</td>
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<td>48090</td>
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<td>HEX SCKT HD, 302 SS</td>
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<td>HEX WSHR HD, THD FRMG</td>
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<td>ALUM, NEW STYLE</td>
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EMERGENCY POWER DISCONNECT

NOTES:
1. REFER TO MANUFACTURERS' INSTALLATION MANUALS FOR GROUNDING REQUIREMENTS FOR ALL EQUIPMENT INSTALLED.
SLAVE ONLY OPERATES IF MASTER'S HANDLE IS UP

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SLAVE CAN OPERATE WHETHER OR NOT MASTER'S HANDLE IS UP

NOTES:
1. REFER TO MANUFACTURERS' INSTALLATION MANUALS FOR GROUNDING REQUIREMENTS FOR ALL EQUIPMENT INSTALLED.
L1
L2
N
EGND

DISPENSER BREAKER
MSH-SERIES
MASTER DISPENSER

EMERGENCY POWER DISCONNECT

PEDISTAL TERMINATION BOARD

FUEL MASTER MU2500
w/o 2-STAGE VALVE CTRL

MAIN POWER CONNECTION
H N G

TO OTHER DISPENSERS

CARD SYSTEM BREAKER

DISPENSER BREAKER

PUMP BREAKER

PUMP PROD. #1

MOTOR CONTROL WITH SIGNAL ISOLATION

FROM OTHER DISPENSERS

EARTH GROUND
120VAC
120VAC

FUELMASTER FMU2500 TO MSH SERIES MASTER (WIRING)

NOTES:
1. REFER TO MANUFACTURERS’ INSTALLATION MANUALS FOR GROUNDING REQUIREMENTS FOR ALL EQUIPMENT INSTALLED.
Installation & Parts Manual
M/MA Meters

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 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.
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.
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.

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**OTHER ACCESSORIES**

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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.

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.
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.

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**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 of 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.
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.

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.
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:

   \[
   \text{Volume in prover} - \text{volume on meter counter} \times 100 \\
   \text{volume in prover}
   \]

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.
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.

⚠️ 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.
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.

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**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).

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**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

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.
Disassembling the Meter

**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.

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**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.
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.
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.
<table>
<thead>
<tr>
<th>Bolt Size</th>
<th>Foot-Pounds</th>
<th>Newton-Meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>#8 (.164) - 32 UNC-2A</td>
<td>42</td>
<td>4.8</td>
</tr>
<tr>
<td>#10 (.190) - 24 UNC-2A</td>
<td>63</td>
<td>7.1</td>
</tr>
<tr>
<td>1/4&quot; (.250) - 20 UNC-2A</td>
<td>7.3</td>
<td>9.9</td>
</tr>
<tr>
<td>5/16&quot; (.3125) - 18 UNC-2A</td>
<td>15.3</td>
<td>20.7</td>
</tr>
<tr>
<td>3/8&quot; (.375) - 16 UNC-2A</td>
<td>27</td>
<td>37</td>
</tr>
<tr>
<td>7/16&quot; (.4375) - 14 UNC-2A</td>
<td>43</td>
<td>58</td>
</tr>
<tr>
<td>1/2&quot; (.500) - 13 UNC-2A</td>
<td>66</td>
<td>90</td>
</tr>
<tr>
<td>5/8&quot; (.625) - 11 UNC-2A</td>
<td>132</td>
<td>179</td>
</tr>
<tr>
<td>3/4&quot; (.750) - 10 UNC-2A</td>
<td>233</td>
<td>316</td>
</tr>
</tbody>
</table>

*Torque Tolerance is ± 10%
## Wrench and Socket Size Chart

<table>
<thead>
<tr>
<th>Meter Element</th>
<th>MA-4 M-5 MA-5</th>
<th>M-7 MA-7 M-10</th>
<th>M-15 M-25</th>
<th>MA-15</th>
<th>M-30 M-40</th>
<th>M-60 M-80</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dust Cover Screws</strong></td>
<td>5/16 hex wrench</td>
<td>5/16 hex wrench</td>
<td>slotted screwdriver</td>
<td>slotted screwdriver</td>
<td>slotted screwdriver</td>
<td>slotted screwdriver</td>
</tr>
<tr>
<td><strong>Meter Cover Screws</strong></td>
<td>1/2&quot; hex wrench/socket</td>
<td>1/2&quot; hex wrench/socket</td>
<td>1/4&quot; Allen or 1/2&quot; hex wrench/socket</td>
<td>1/4&quot; Allen or 1/2&quot; hex wrench/socket</td>
<td>9/16&quot; hex wrench/socket</td>
<td>3/4&quot; hex wrench/socket</td>
</tr>
<tr>
<td><strong>Counter Bracket Screws</strong></td>
<td>3/8&quot; hex wrench/socket</td>
<td>3/8&quot; hex wrench/socket</td>
<td>N/A</td>
<td>3/8&quot; hex wrench/socket</td>
<td>N/A</td>
<td>3/8&quot; hex wrench/socket</td>
</tr>
<tr>
<td><strong>Bearing Plate Screws</strong></td>
<td>5/16&quot; hex wrench/socket</td>
<td>5/16&quot; hex wrench/socket</td>
<td>5/16&quot; hex wrench/socket</td>
<td>5/16&quot; hex wrench/socket</td>
<td>7/16&quot; hex wrench/socket</td>
<td>1/2&quot; hex wrench/socket</td>
</tr>
</tbody>
</table>

### 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.
### 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.

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⚠️ **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.
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.
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.
Illustrated Parts Breakdown

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.
Illustrated Parts Breakdown

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.
Backed by our Worldwide reputation for Quality, Accuracy and Advanced Design.