



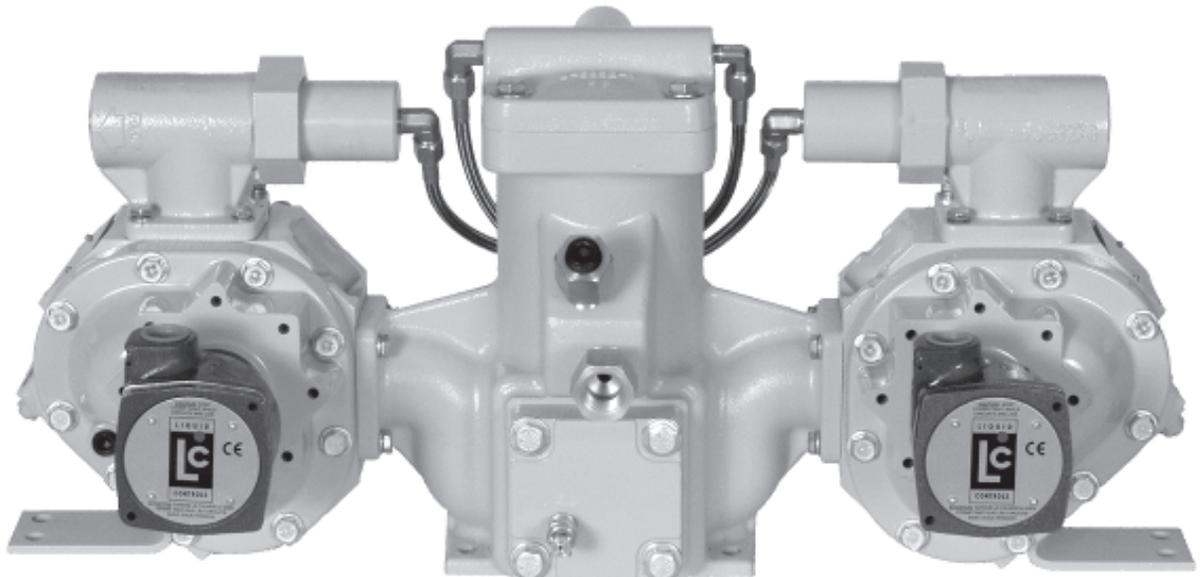
# Installation & Parts Manual

## MA-4 Positive Displacement Meter for LPG Motor Fuel Dispensers

(Single & Dual Meter Versions)

**LIQUID  
CONTROLS**  
A Unit of IDEX Corporation

**IDEX**  
IDEX CORPORATION



Installation: M100-11

[www.lcmeter.com](http://www.lcmeter.com)

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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 meter in question (See Page 4).

Meter Serial Number \_\_\_\_\_

Full Service Distributor \_\_\_\_\_

Full Service Distributor Phone Number \_\_\_\_\_

## Publication Updates & Translations

The most current English versions of all Liquid Controls publications are available on our website, [www.lcmeter.com](http://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**

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 10).

### Be Prepared

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

Provide easy access to the appropriate fire extinguishers for your product. Consult with your local fire department

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

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

### In the Event of a Gas Leak

**In the event of a large gas leak:** Evacuate the area and notify the fire department.

**In the event of a small, contained gas leak:**

1. Stop the leak and prevent accidental ignition.
2. Prevent the entrance of gas into other portions of the buildings. Some gases, such as LPG, seek lower levels, while other gases seek higher levels.
3. Evacuate all people from the danger zone.

# How LC Meters Work

- 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.

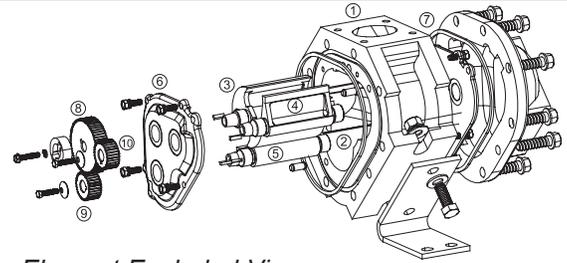
Liquid Controls meters are positive displacement meters. They are designed for liquid measurement in both custody transfer and process control applications. They can be installed in pump or gravity flow systems. Because of their simple design, they are easy to maintain, and easy to adapt to a variety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



*Meter Element Exploded View*

upstream product and the metered downstream product.

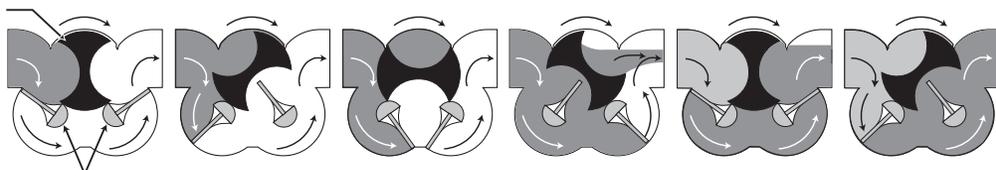
Capillary seals mean no metal-to-metal contact within the metering element. This means no wear. No wear means no increase in slippage, and no increase in slippage means no deterioration in accuracy.

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.

Blocking rotor



Displacement rotors

# Owner's Information Packet

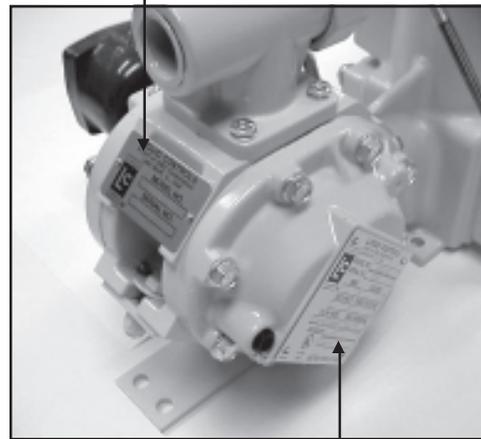
Is all your documentation included with your meter? LC meters come in many variations. The information sent to you depends on the accessories you have ordered with your meter. Make an inventory of your Owner's Information Packet. First, find your LC packing slip with the computer printout. Locate the serial number and the meter model number on this printout. Cross-reference the packing slip with the actual meter serial numbers.

Included in your Owner's Information Packet are the following:

- Installation and Parts Manual
- Bill of Materials
- SCAMP™ Installation and Operation Manual

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, if applicable. 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" on Page 27 in this manual.

*Serial Number Plate (Side)*



*Serial Number Plate (Rear)*

## Installation Requirements

### **⚠ 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 10).

- 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 the literature provided in your Owner's Information Packet. 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 all applicable federal, state, local, construction, electrical, and safety codes.
- Class 10 meters for LPG must be installed in accordance with the requirements of ANSI-NFPA 58 in addition to all other state and local codes.
- Under normal operation, do not expose any portion of the LP-Gas system to pressures in excess of rated working pressures without an automatic safety valve to vent the over pressure discharge to a place of safety away from the operator and other people. Failure to provide such a safety relief may result in leakage or rupture of one or more of the components in the system. This can result in injury or death from the gas, a fire, or pieces of flying debris from the rupture.
- Before shipment, protective thread caps were placed in all meter and accessory openings. They should remain in place until you are ready to attach piping.
- Prior to meter installation, the entire piping system should be thoroughly flushed of all debris, with a liquid that is compatible with the construction of the meter.
- Keep all external surfaces of the meter clean.
- Apply pipe compound to male threads only.

# Installation & Operation Requirements

## **⚠ WARNING**

When a Back Check Valve is used, an automatic safety valve must be installed to prevent pressure build-up in excess of rated working pressure in the meter housing. One automatic safety valve should be installed in each meter. Remove the pipe plug from the front cover or rear cover and insert the appropriate automatic safety valve.

- 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 pipe.

- 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 Liquid Controls Sales or Engineering.

## **Operation Requirements**

The meter must remain full of product at all times. An easy way to accomplish this is to put the meter assembly in the line below the piping center-line (a 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. A word of 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 the upstream or inlet lines are constructed in a manner which allows reverse flow, foot valves or back checks must be installed.

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

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 supersede 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 meter assembly. Systems should be made free of conditions that cause or introduce entrained air or vapor.

Follow the manufacturer's recommendations 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.

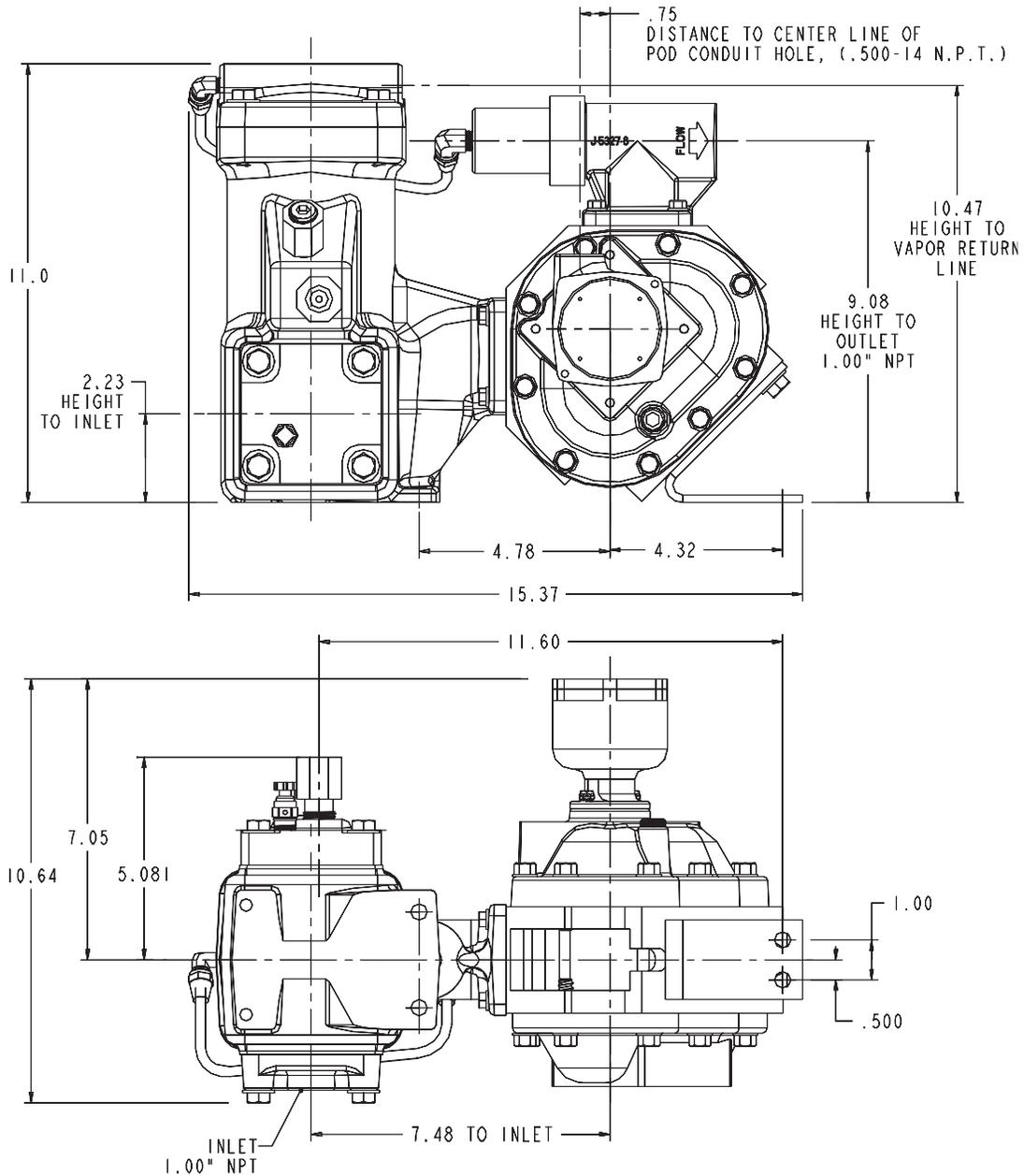
For liquids such as light hydrocarbons that tend to flash or vaporize easily at higher ambient temperatures, it is desirable to use flooded suctions and piping sized larger than the normal pump size.

Hydraulic shock is harmful to all components of an operating system including valves, the 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.

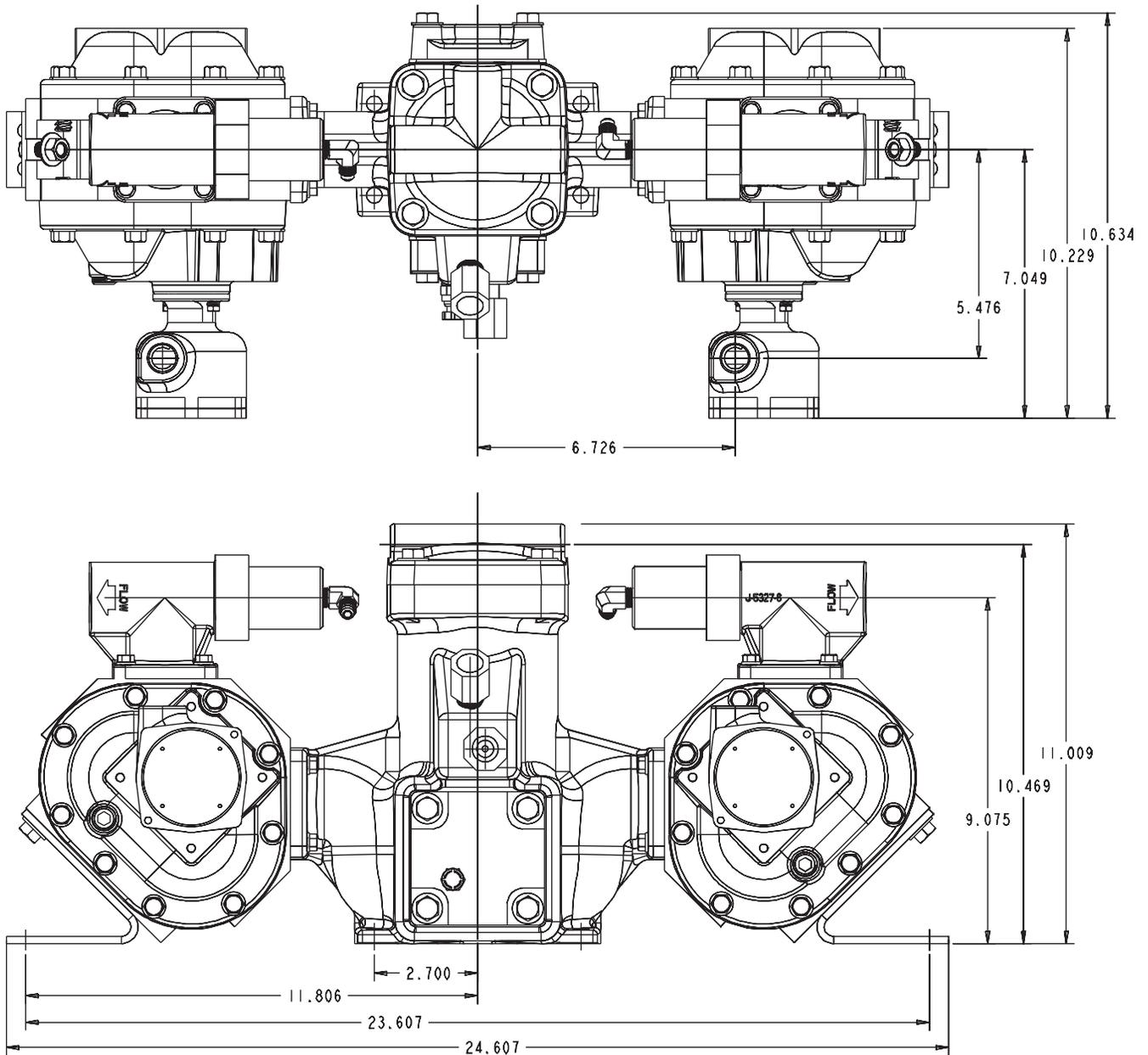
# Installation

## Mounting Dimensions - Single Meter



**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 the prints, check to see that all equipment ordered is shown and that any extra pressure taps, plugs, etc. are noted and their size specified.

## Mounting Dimensions - Dual Meter



**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 the prints, check to see that all equipment ordered is shown and that any extra pressure taps, plugs, etc. are noted and their size specified.

# Installation

## Theory of Operation

The Liquid Controls MA-4 LPG Meter combines a positive displacement meter, differential valve, strainer, and vapor eliminator in one assembly.

The Liquid Controls vapor eliminator employs a sleeve-type valve that permits a “leak” flow of approximately 0.2 GPM from the vapor vent back to the supply tank. A 200-mesh strainer is incorporated in the vapor eliminator casting and is easily accessible by removing the strainer cover.

The Liquid Controls differential valve incorporates a piston-diaphragm type construction, with the piston moving away from its seat when at least 15 psi pressure (above product vapor pressure) is maintained at the meter outlet. The soft seat valve assures measurement accuracy by requiring 1) pump operation for delivery, 2) adequate back pressure to prevent product vaporization during measurement, and 3) blockage of flow when the vapor eliminator release valve opens.

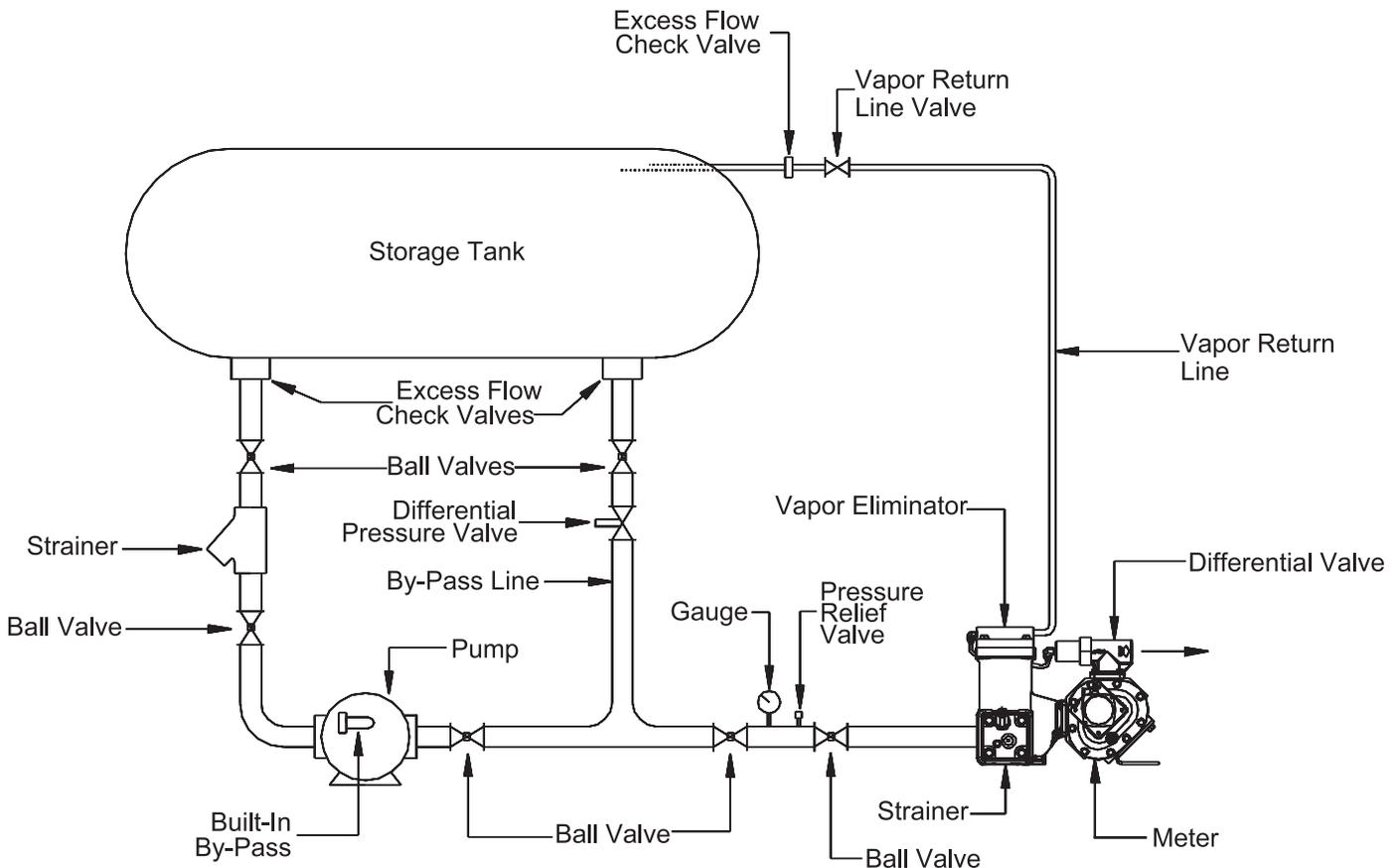
## Meter Installation

### Meter:

Install the meter assembly in dispenser cabinet to a secure base, using the supplied bracket on the meter housing and the “feet” located on the strainer assembly base. Make inlet and outlet connections at the flanged surfaces on the strainer and differential valve, respectively.

### Vent Line:

The vent line from the meter’s vapor vent to the vapor space on the supply tank should be 1/4 inch minimum inside diameter tube or pipe. A shut off valve must be installed in the vapor vent line to allow removal of the strainer or to service the meter. The vapor release vent line must be returned to the vapor space of the supply tank and normally should not be made common with the other vapor return lines or pump bypass lines. When properly installed, this line must permit free flow in either direction. **If the valve in the vent line is closed the meter will not function.** These instructions must be followed to maintain proper function of the differential valve.



## Meter Start-up and Operation

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

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

Placing your meter in operation:

Check to determine that all fittings and flanges are tight and liquid lines are closed.

Open the vapor line to the meter. Using vapor pressure only, check each joint with a liquid soap solution to see that no leaks go undetected. When all joints have been checked, admit liquid SLOWLY to avoid operation on vapor at speeds greater than the minimum indicated on the serial number plate and to insure that cover cavities do not contain vapor which can be compressed. Proper slow filling can be done by throttling the system with a valve at the meter OUTLET or by allowing the system to fill by gravity.

With the valve(s) open between the tank and the meter, 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 maximum 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.

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.

### CAUTION!

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

# Meter Maintenance

## ⚠ 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.

Prevent pipe strain or stress from occurring when making meter or accessory repairs. Pipe strain and stress occur 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 easily be 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 to 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 specifications. All fasteners such as screws and bolts should be torqued to proper specification. See the "Torque Chart" on Page 25 of this manual.

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

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

Coating threads. When removing and replacing bolts and castings in a meter, always coat the threads with anti-seize.

Removing flange seals. When removing the flange assembly, always carefully remove the O-ring seal. Make sure that the flange surface is clean. Discard and replace the old O-Ring seal if it is nicked or scratched in any way. If it is undamaged, it can be reused.

Examine all fasteners. Make sure fasteners 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 or the Service Department at Liquid Controls for assistance if this occurs.

Check the O-Rings. O-Rings should be smooth. Cracked or worn O-Rings should be replaced. However, a more serious problem of shock may have occurred if the O-Rings look nibbled. Shock problems must be verified and resolved. Contact your full-service distributor or the Service Department at Liquid Controls for assistance if this occurs.

Check the bearing plates. Check the bearing plates for flatness. Use a straight edge. Warped bearing plates can be caused by shock problems that must be resolved. Contact your full-service distributor or the Service Department at Liquid Controls for assistance if this occurs.

Weights & Measures. Check with the regulatory agency that governs Weights & Measures in your area. Removing a seal wire may require Weights & Measures recalibration.

# Pulse Output Device (POD5)

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The Liquid Controls Pulse Output Device (POD) converts the rotary motion of the Positive Displacement Meter into electronic pulses making it possible to interface the meter to electronic monitoring and control equipment. The POD5 was specifically designed to interface with the MA-4 meter and the SCAMP A™ electronics.

The POD5 mounts directly to the front cover of the MA-4 meter. The motion of the meter's blocking rotor is magnetically coupled through a stainless steel wall into the electronics compartment of the POD5. This eliminates any dynamic seal and isolates the electronics from the process fluid in the meter.

Inside the POD5 electronics compartment an optical shaft encoder converts the rotary motion into a high resolution, two-channel quadrature square wave. Both outputs switch from 5 volts in the "ON" state to zero volts in the "OFF" state.

The POD5 electronics compartment also serves as a conduit junction box. The POD5 has an O-Ring sealed, threaded cover. The standard wire entrance is a 1/2-14 NPT female hub, which accepts threaded conduit or a cable gland. A plug-in connector on the encoder facilitates wiring of the unit. With the wiring entrance sealed and the cover in place, the housing is ENCLOSURE TYPE NEMA 4X weatherproof rated. In addition, the housing is CENELEC rated flameproof, and UL and Canadian-UL explosion-proof rated when properly installed with approved conduit.

## **⚠ 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 10).

## **INSTALLATION:**

The POD5 comes factory installed on the meter ready for wiring with the conduit orientation in the up position. The hub can be oriented in one of four possible directions; facing up, down, left, or right. If a different orientation is required remove the two mounting screws and pull the POD5 from the front cover. Remove the POD5 O-ring from the cover.

- After determining the orientation of the conduit hub, determine which two of the four mounting screw holes will be used to fasten the POD5 to the front of the meter cover. It is suggested that the mounting screws be driven into these holes first to "pre-tap" the threads in the meter cover. This will make it easier to thread the screws when the POD5 is in place.
- Position the O-ring on the bottom of the POD5.
- Align the fork driver to the drive mechanism inside the meter and guide the POD5 into the opening in the meter cover. When the driver is properly aligned the POD5 will go in until its mounting flange abuts the meter cover.
- Rotate the POD5 to the desired orientation and thread in the mounting screws finger tight. Using a 5/16" box end wrench, tighten the screws to the appropriate torque as specified in the "Torque Chart" in this manual.

## **WIRING:**

Wiring into the POD5 must enter through its conduit hub. For explosion-proof rated installations (Class I, Div. 1) the wiring must be enclosed in rigid conduit that is rated for explosion-proof installation. The conduit must be engaged five (5) full threads into the female hub on the POD5 to meet explosion-proof standards. When a Division 2 installation is called for, either rigid conduit, flexible conduit such as LiquidTight, or no conduit can be used. When no conduit is used, the instrument cable must be brought into the conduit hub using a cable gland to seal the wiring entrance to maintain the ENCLOSURE TYPE 4X rating. Regardless of the type of conduit/cable gland used, thread sealant should be applied to prevent moisture from getting into the POD5 electrical housing.

Removing the cover of the POD5 will expose the plug-in connector and ground screw.

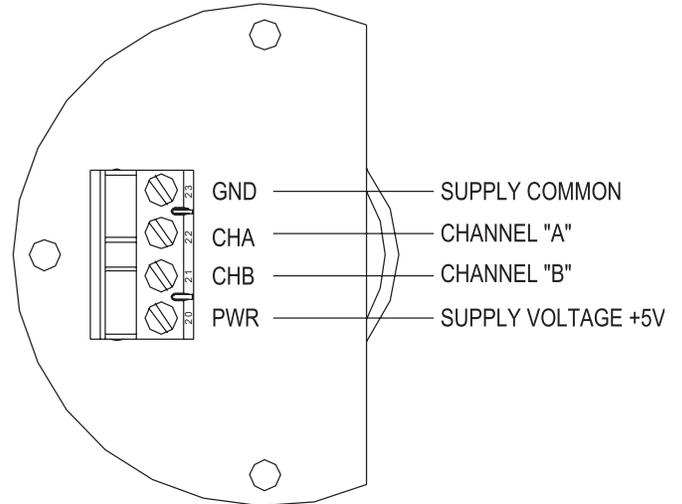
## Service Information

Due to the simplicity of the POD5, there are few things that can go wrong with the device. However, as with all electronic devices, failures can occur making it necessary to replace failed part(s). There are only three functional spare parts for the POD5; the hub/magnet assembly-North Poles, hub/magnet assembly-South Poles, and the encoder assembly. The South Pole hub/magnet assembly operates inside the flowmeter and, therefore, is exposed to and is wetted by the process fluid. Due to its materials of construction, this assembly is unlikely to fail. In the event that it does fail, the POD5 has to be removed from the meter front cover to access the driver/lower magnet assembly.

Remove the POD5 from the meter by removing the two hex head mounting screws and pulling out the POD5. Remove the two allen head set screws using a 1/16 hex driver and pull on the driver tang to extract the driver/lower magnet assembly. Disassemble the hub/magnet assembly from the drive shaft and attach the new hub/magnet assembly in its place. Reassemble the unit.

It is more likely that if a failure of the POD5 occurs, it can be repaired by replacing the encoder assembly. Simply turn off the power to the unit, open the cover, disconnect the electrical connector, loosen the mounting screws and pull the encoder assembly out. Remove the hub/magnet assembly from the old encoder shaft. Reassemble the new encoder assembly.

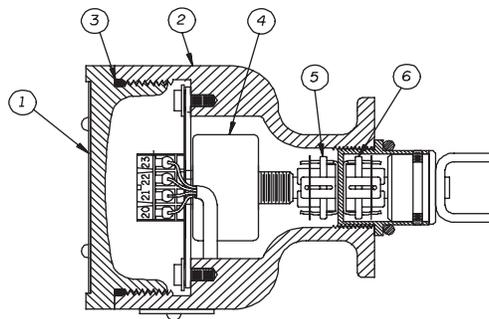
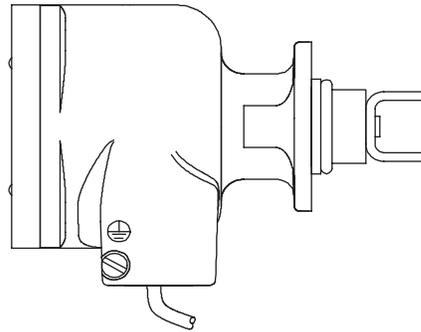
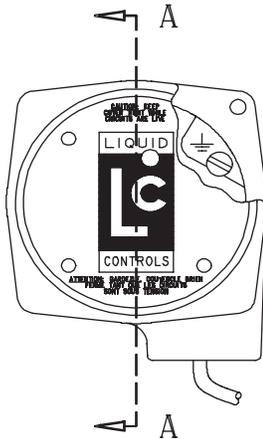
**Caution:** It is important to use the correct hub/magnet assemblies to maintain the magnetic couple. Use of two North Pole or two South Pole assemblies will not allow the driver to function properly.



*Encoder Schematic*

# Pulse Output Device (POD5)

## Specifications



SECTION A-A

PART NUMBER	ITEM NUMBER	DESCRIPTION
81164	1	Cover Assembly
81657	2	Housing Assembly
09212	3	Cover O-Ring
81653	4	Pulser & Bracket Assembly
501240	5	Hub & Magnet Assembly (North Poles)
501241	6	Hub & Magnet Assembly (South Poles)

### SPECIFICATIONS:

Voltage Supply: ..... (V+): 5VDC  
 Current Supply: ..... 26 mA Typical  
 Output Signal Resolution: ..... 100 pulses per encoder revolution per channel, upscaled.  
 Square Wave: ..... Dual quadrature channel output.  
 Pulse Timing: ..... Nominal 50% on, 50% off.  
 Rise/Fall Time of Pulse: ..... 5 microseconds maximum.  
 Output: ..... Capable of driving one TTL input (0 to 5 volts)  
 Operating Temperature: ..... -40°F to +185°F (-40°C to +85°C)  
 Humidity Range: ..... 0-100% non-condensing  
 Shock: ..... 50 G's for 10 milliseconds  
 Vibration: ..... 1 G at 10-150Hz  
 Electromagnetic Compatibility: ..... (EMI, RFI, etc.) to CE standards  
 Pulse Transmission Distance: ..... Up to 100 feet

# Vapor Eliminator & Strainer Maintenance

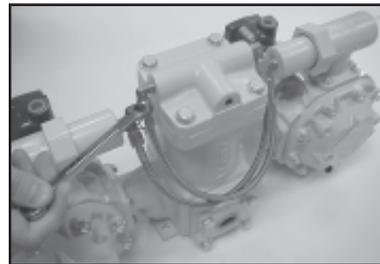
Servicing of the vapor eliminator and strainer involves occasional cleaning of the strainer, or, when required, replacing a float or sticking valve.

## ⚠ 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 10).

## Disassembling and Assembling

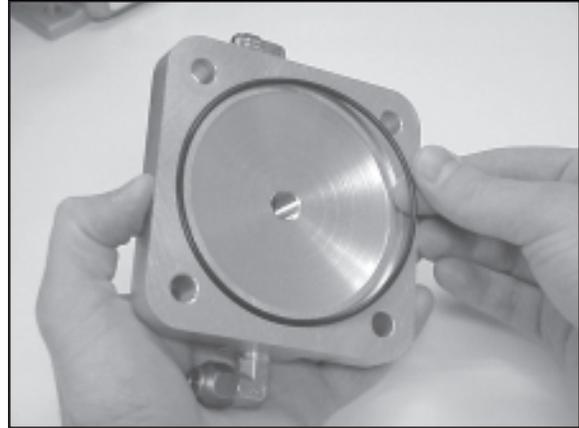
1. Disconnect the tubing between the differential valve and vapor eliminator cover. For the dual meter system, this may require removal of two segments of tubing.
2. Remove the four screws on the Vapor Eliminator cover. Lift the cover to inspect the internal float assembly. Be careful not to damage the O-Ring seal.
3. If the float is crushed or damaged, remove cotter pin and replace float.
4. Carefully inspect the sleeve valve for any resistance to smooth movement of the sleeve on the stem. Inspect all holes in the sleeve and the stem for foreign material, which could cause sticking of the valve and obstruct the flow through the valve. With the float removed, the sleeve must move on the stem by its own weight. If defective, replace sleeve and stem assembly. **Note:** The vent hole is larger than the cotter pin hole used to attach the sleeve to the float. If replacing the sleeve, ensure that the sleeve is in the correct orientation with the larger hole on top.



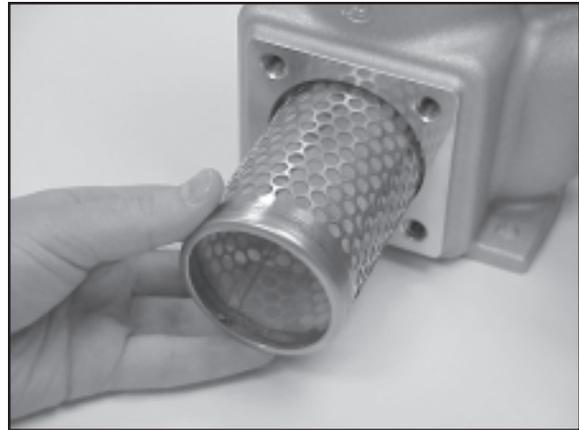
# Vapor Eliminator & Strainer Maintenance

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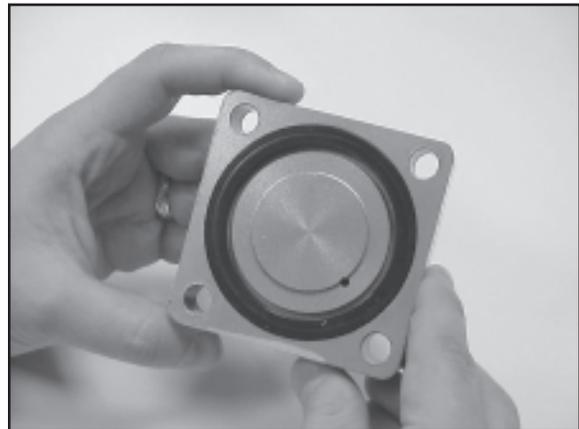
5. Inspect the vapor eliminator cover O-Ring and O-Ring groove. The groove in which the O-Ring is located must be free of dirt. The flat face against which the O-Ring seats must be clean and free of nicks and dents that may allow product to leak past the O-Ring seal. Replace the O-Ring seal, if necessary.



6. Remove the four screws on the strainer cover. Remove the cover and pull the strainer out straight and level being careful not to drop trapped debris into the strainer housing.
7. Clean out strainer with compressed air, inspect for any breaks or other defects, and replace if necessary.
8. Reinstall strainer.



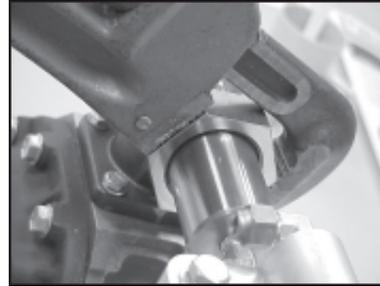
9. Inspect the strainer cover rubber seal and seal groove. The groove in which the rubber seal seats must be clean and free of dirt. The flat face against which the seal seats must be clean and free of nicks and dents that may allow the product to leak past the seal.



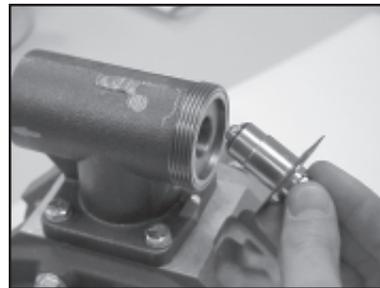
Faulty operation of the differential valve may be caused by defective valve seals, the spring, or the diaphragm. The diaphragm and the O-Ring valve seat are the only parts that should require replacement in normal service. It is not necessary to remove the valve from the line for disassembly.

## Disassembling the Valve

1. Remove connecting tube between differential valve and vapor eliminator cover. See illustration on Page 15.
2. Unscrew the union nut and remove the spring case, limit stop, and spring from the body.



3. Remove the diaphragm and piston assembly.



4. The diaphragm can be inspected by unscrewing the nut and removing the diaphragm head.



5. Inspect the diaphragm for cuts, tears, or pinhole leaks. Replace if defective. **Caution: Do not over tighten diaphragm retaining nut.** Torque diaphragm retaining nut to 18-20 inch-lbs.

6. Check the O-Ring and replace if necessary.



7. Reinstall piston assembly into body, insert spring, limit stop, spring case and union nut.

8. Reassemble connecting tube.

# Disassembling the Meter

## Tools:

Rotor Gear Wrench or Socket  
Bearing Plate Wrench or Socket  
Counter Bracket Wrench or Socket  
Drain Plug Allen Wrench  
Cover Socket or Open End/Box End

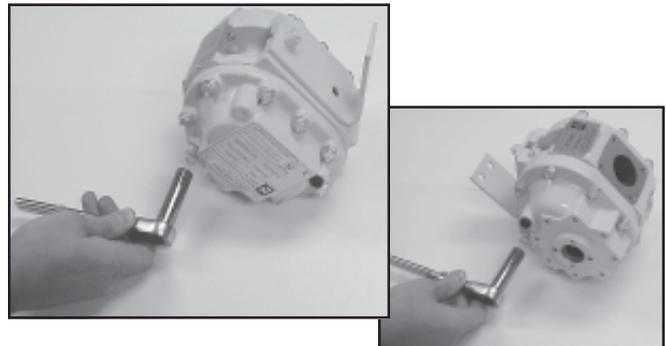
Spare Displacement Rotor Gear *(if unavailable, use a shop rag between gear teeth)*  
Plastic or Rubber Mallet  
2 Standard Screwdrivers  
Emery Cloth, Wire Brush

**NOTE:** See Page 25 for the Torque Chart and the Wrench and Socket Size Chart.

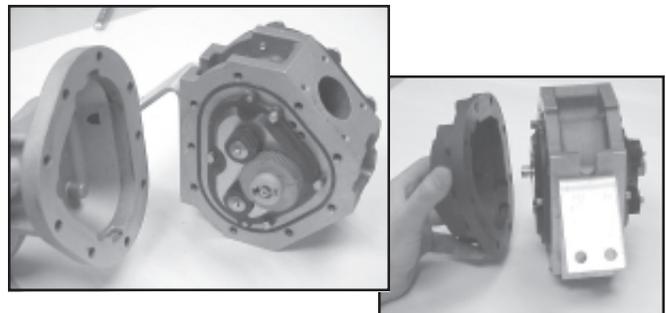
### ⚠ WARNING

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 10).

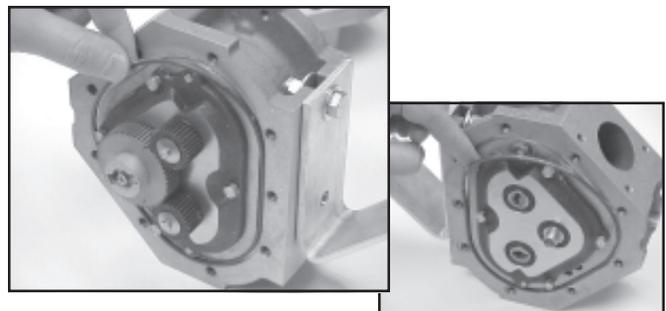
1. Use the cover socket or open end/box end wrench to remove the bolts holding the front cover to the outer body. Remove the bolts holding the rear cover.



2. Remove the front and rear covers.

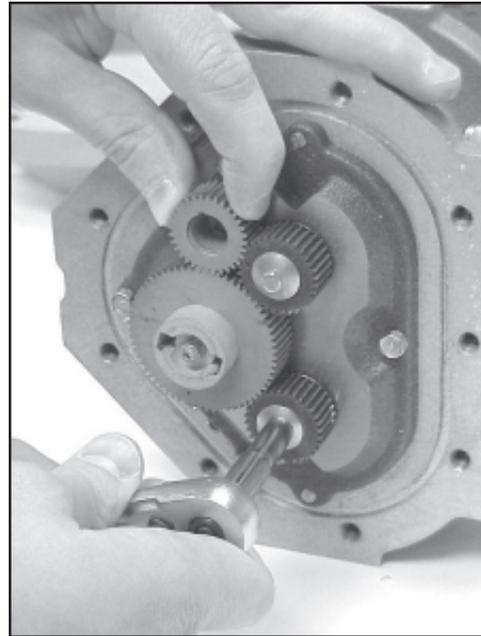


3. Remove the O-Rings from the front and rear of the housing. Undamaged Buna O-Rings may be reused.

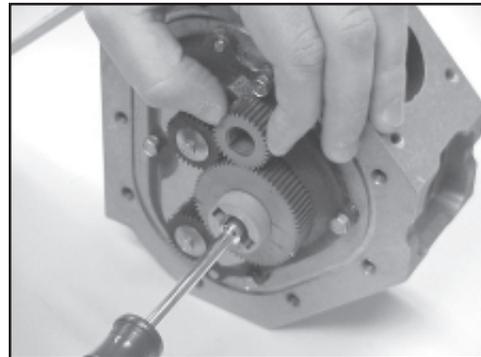


## Disassembling the Meter

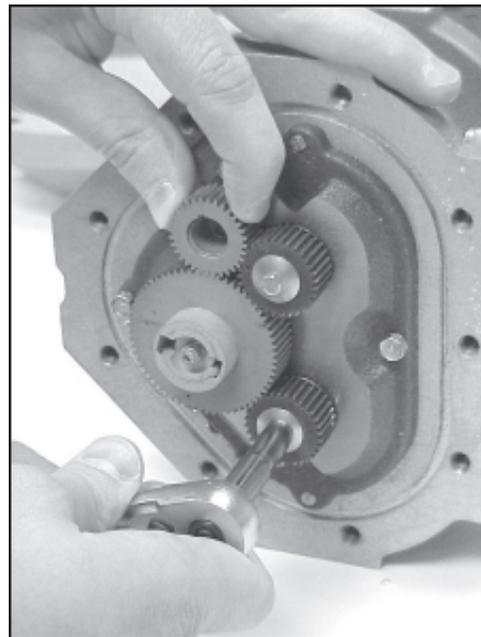
4. Hold a spare displacement rotor gear between the right displacement rotor gear and the blocking rotor gear to keep them from turning (if unavailable, use a shop rag between gear teeth). Use the rotor gear wrench or socket to remove the right displacement rotor screw and washer.



5. 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.



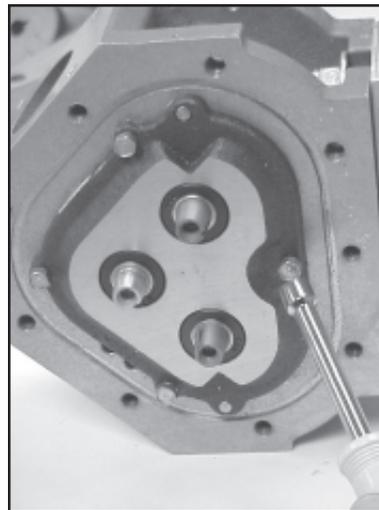
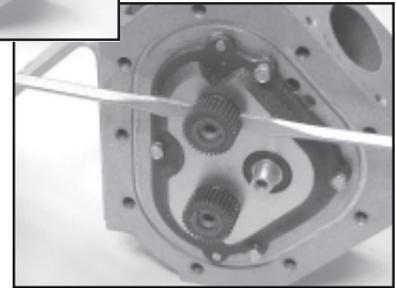
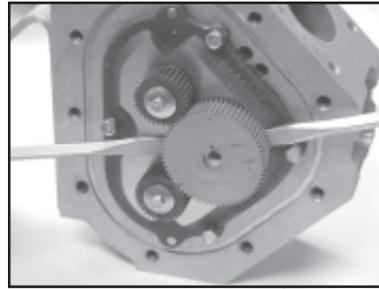
6. Hold the spare gear between the right displacement rotor gear and the blocking rotor gear. Use the rotor gear wrench or socket to remove the left displacement rotor gear screw and washer.



## Removing the Non-Corroded Rotor Gears

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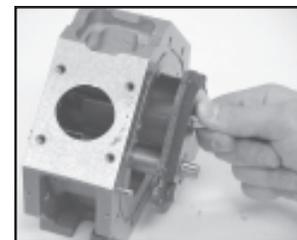
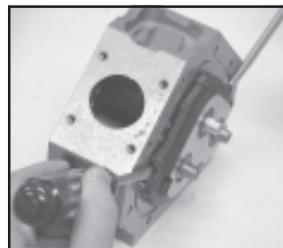
7. If the Gears show signs of corrosion, use the alternative method describe on Page 21, "Removing Corroded Rotor Gears". Insert two standard screwdrivers behind the blocking rotor gear. Gently pry the gear off its rotor tapered end. If the gear does not pry off easily, or feels stuck, use the alternative method described on Page 21, "Removing Corroded Rotor Gears".
8. Use the same method to remove the left and the right rotor gears. Remember, if the gear does not pry off easily or feels stuck, use the alternative method described on Page 21, "Removing Corroded Rotor Gears".
9. 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.
10. Use the bearing plate wrench to remove the bolts that hold the front bearing plate to the meter housing. On the back of the meter housing, remove the bolts that hold the rear bearing plate to the housing. Go to Step 1, "Removing the Bearing Plates and Rotors".



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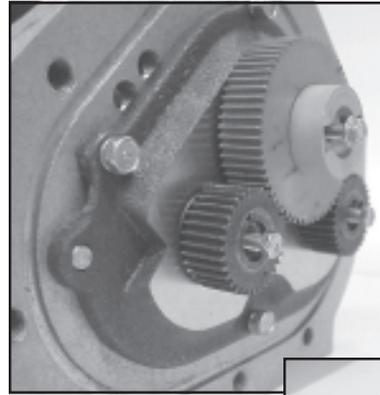
## Removing the Bearing Plates and Rotors

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.
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 rear bearing plate off the dowel pins.

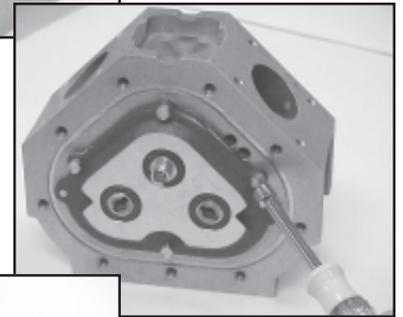


## Removing Corroded Rotor Gears

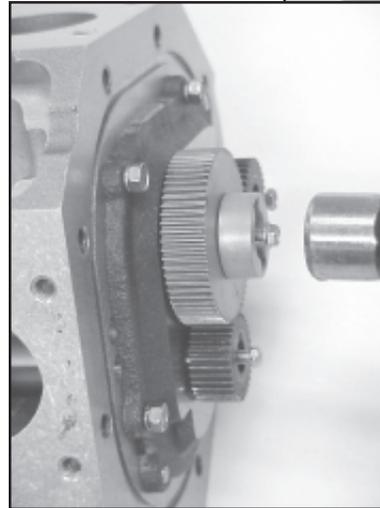
1. Replace all three rotor gear screws, without washers, halfway onto each of the rotor ends.



2. 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.

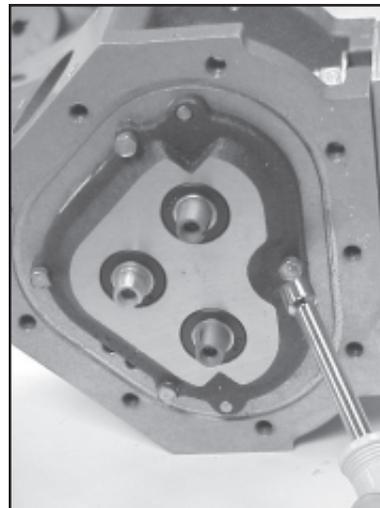


3. With a plastic or rubber mallet, tap on the heads of the screws lightly and equally. As you tap on the screw heads, the gears are driven off the rotors. As the rotors are driven in, the rear bearing plate and the rotor assembly are pushed away from the housing.



4. Use the bearing plate wrench or socket to remove the screws that hold the front bearing plate to the meter housing.

5. Inspect and clean all critical surfaces like gear teeth, rotors and internal housing faces. Remove any crystalline formations using a 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 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.



# Reassembling the Meter

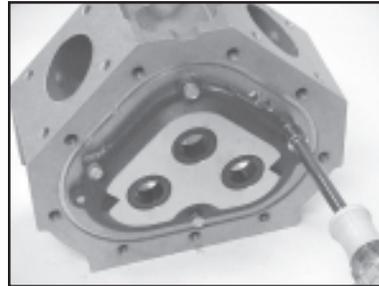
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Tools: Cover socket or open end/box end wrench  
Spare displacement rotor gear  
Rotor gear wrench or socket  
Bearing Plate wrench or socket

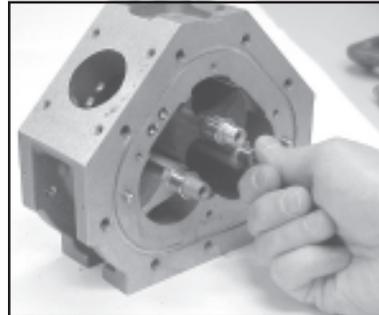
**NOTE:** See Page 25 for Torque Chart and Wrench and Socket Size Chart.

**NOTE:** The principles of meter disassembly and reassembly are the same for all the Liquid Controls Positive Displacement meters. Although your meter may look slightly different than those pictured, the steps are the same except as noted.

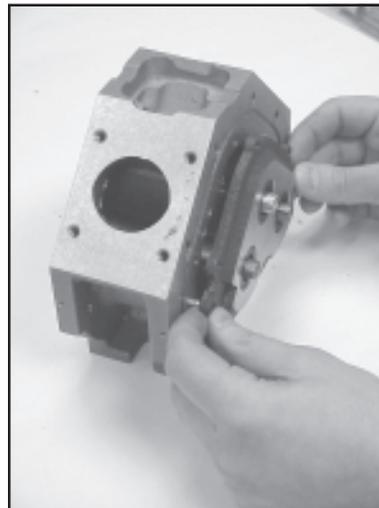
1. Rotor gears are on the front bearing plate. Install the non-rotor gear bearing plate using the bearing plate screws and wrench.



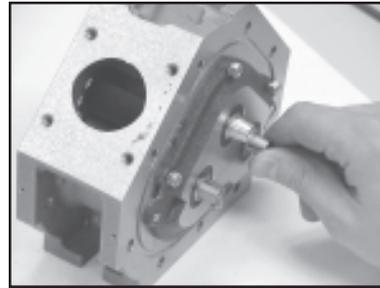
2. Insert the non-tapered ends of the three rotors into the housing from the opposite side. Place each rotor into its respective bore in the installed bearing plate.



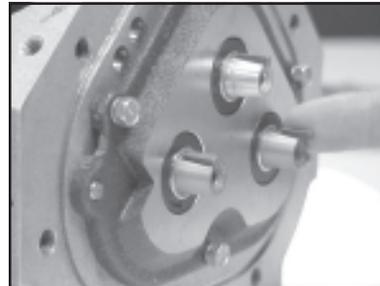
3. Place the remaining bearing plate over the three tapered rotor ends and fasten it with the bearing plate screws. Use the bearing plate wrench.



- The 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, & 4.

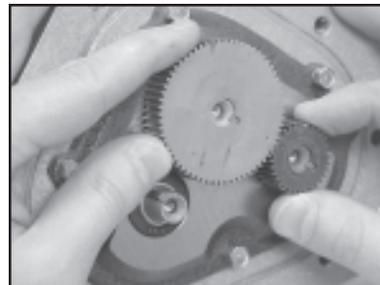


- The rotor key is a small wedge of metal. Each rotor has a notch, or "keyway", to hold a key. Position a key into each one of the three rotors. Press the keys into the rotor keyways with your thumb and forefinger.



- 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 Page 24.

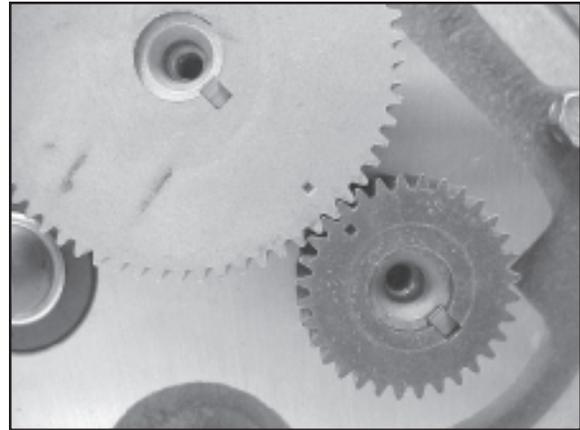
Hint: Before you place the right displacement rotor gear on its tapered end, hold the right rotor gear in position. Turn the blocking rotor gear. Try to line up the timing marks before you place the right displacement rotor gear on its tapered rotor end.



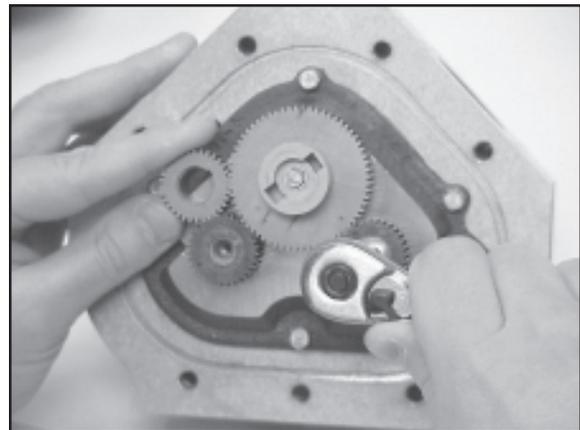
- Position the left displacement rotor gear on its tapered rotor end so that its timing mark lines up with the blocking rotor gear. See "Timing the Rotor Gears" on Page 24.

# Timing the Rotor Gears

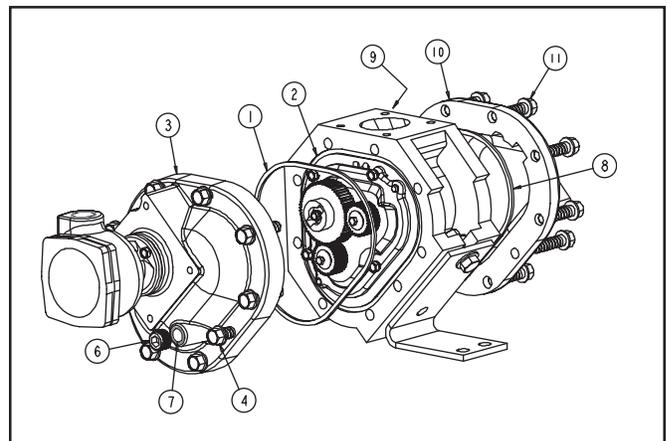
Rotor gears are timed by lining up the timing marks (circled in illustration). The blocking rotor gear has a tooth **directly in front** of its timing mark. On the displacement rotor gears, the timing mark falls **in the space between** two gear teeth. Make sure that the tooth in front of the timing 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” on Page 26.



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.
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.
6. Fasten the front cover (3) with the cover screws (4) using the cover socket or open end/box end wrench.
7. Install an O-Ring (8) into the groove (9) on the rear of the meter housing. Not shown; similar to (2).
8. Fasten the rear cover (10) with the cover screws (11) using the cover socket or open end/box end wrench.
9. Install POD5 Pulse Output Device.



# Torque Chart

Bolt Size	Grade 5 Fasteners	
	Inch-Pounds	Newton-Meter
	NOMINAL*	NOMINAL*
#8 (.164) - 32 UNC-2A	3.5	4.8
#10 (.190) - 24 UNC-2A	5.2	7.1
1/4" (.250) - 20 UNC-2A	7.3	9.9
5/16" (.3125) - 18 UNC-2A	15.3	20.7
3/8" (.375) - 16 UNC-2A	27	37
7/16" (.4375) - 14 UNC-2A	43	58
1/2" (.500) - 13 UNC-2A	66	90
5/8" (.625) - 11 UNC-2A	132	179
3/4" (.750) - 10 UNC-2A	233	316

NOTE: Torque tolerance is  $\pm 10\%$ .

## Wrench and Socket Size Chart

<i>Meter Element</i>	<i>Dust Cover Screws</i>	<i>Drain Plug</i>	<i>Meter Cover Screws</i>	<i>Counter Bracket Screws</i>	<i>Bearing Plate Screws</i>	<i>Rotor Gear Screws</i>
<b>Wrench Size</b>	5/16 hex wrench	1/4" Allen wrench	1/2" hex wrench/socket	3/8" hex wrench/socket	5/16" hex wrench/socket	5/16" hex wrench/socket

NOTE: Prior to installation, apply a small amount of Locquic Primer N764 to each screw. 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 connections in the rotor. Please apply these techniques when repairing meters in the field.

# Troubleshooting

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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 10).

**PROBLEM:** Leakage from the cover seal.

**PROBABLE CAUSE AND SOLUTION:**

Seal has been damaged due to shock pressure or cover bolts have not been tightened sufficiently. Replace seal and/or re-torque cover bolts.

**PROBLEM:** Product flows through meter but the register does not operate.

**PROBABLE CAUSE AND SOLUTION:**

- A Check the pulse output device, and gear train. Replace components if required.
- B If all meter parts are moving, the problem is in the encoder. The faulty encoder should be checked and repaired by trained technician.

**PROBLEM:** Breaking teeth on timing gears.

**PROBABLE CAUSE AND SOLUTION:**

- A Starting or stopping flow in meter too rapidly. Replace the damaged components. Correct the system operational practices.
- B Pump bypass not adjusted properly. Readjust as necessary.

**PROBLEM:** Product flows through meter but register does not record properly.

**PROBABLE CAUSE AND SOLUTION:**

- A SCAMP™ is not properly calibrated. Refer to SCAMP™ manual (Bulletin #500184) supplied with meter.
- B The vapor release valve is sticking, allowing vapor to pass through meter. Inspect and repair as required.
- C The differential valve diaphragm is leaking. Replace the diaphragm.

**PROBLEM:** No flow through meter.

**PROBABLE CAUSE AND SOLUTION:**

- A Faulty or non-functioning pump.
- B The valve is not open or not functioning.
- C The meter is “frozen” due to build up of chemical “salts” or foreign material inside metering chamber. To correct, clean the meter and inspect for damage.
- D The vapor vent line valve is shut or there may be an obstruction in vapor vent line between differential valve and vapor space in tank.
- E Blocked strainer.

**PROBLEM:** Meter runs too slowly.

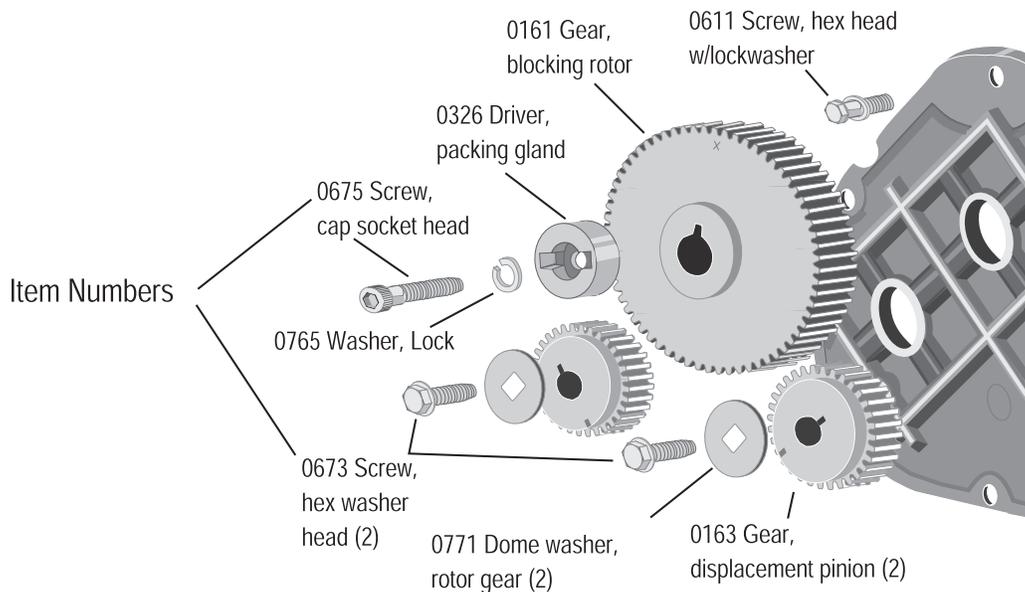
**PROBABLE CAUSE AND SOLUTION:**

- A The valve’s internal mechanism is faulty. The valve does not open fully.
- B The meter gears or rotors are “salted” enough to slow up rotation parts. To correct, clean the meter.

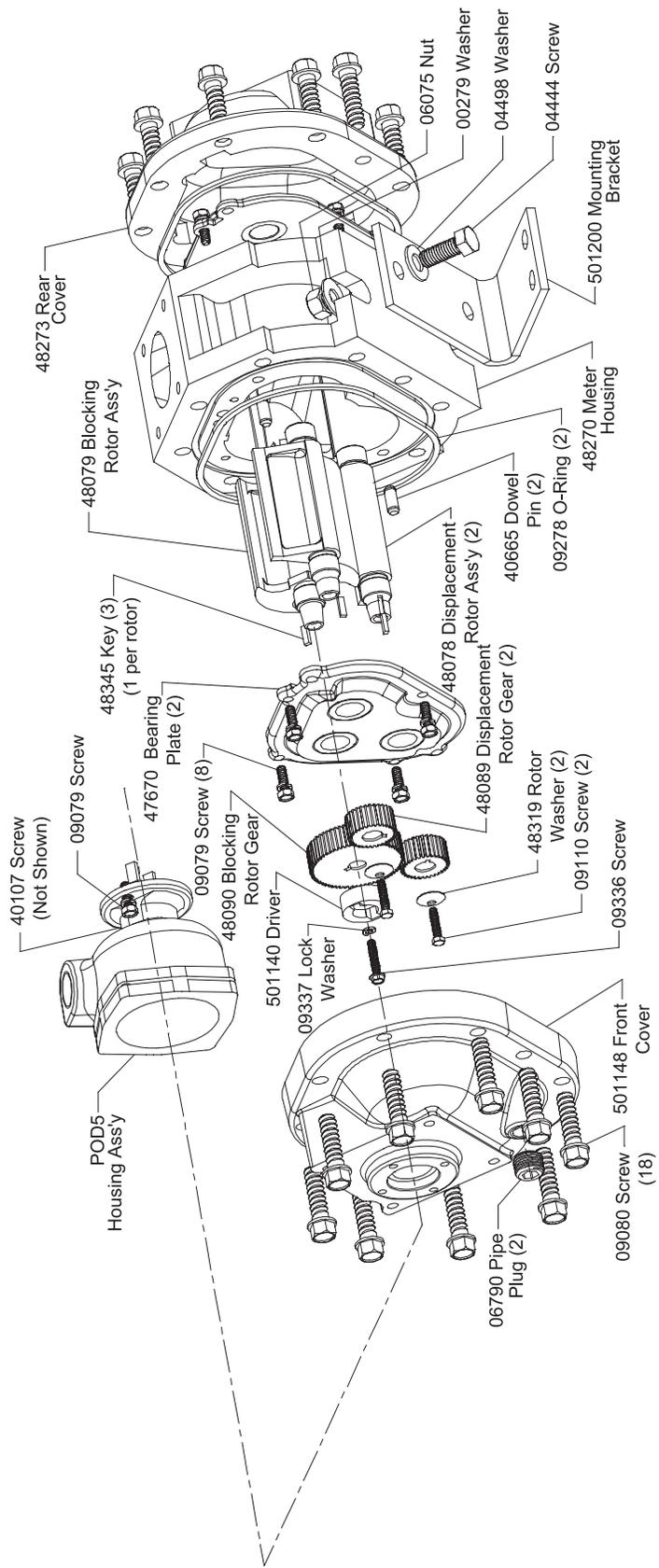
# How to Order Replacement Parts

1. Refer to the exploded view drawings on Pages 28-31. 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.

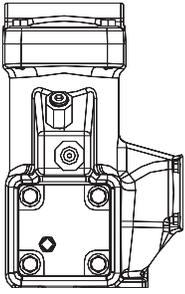
**The Bills of Material are on the LC public website. Always check the website for the most current BOM.**



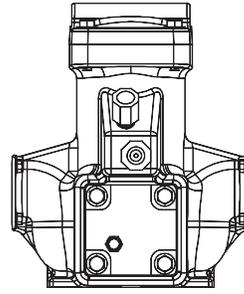
# Meter Assembly Exploded View



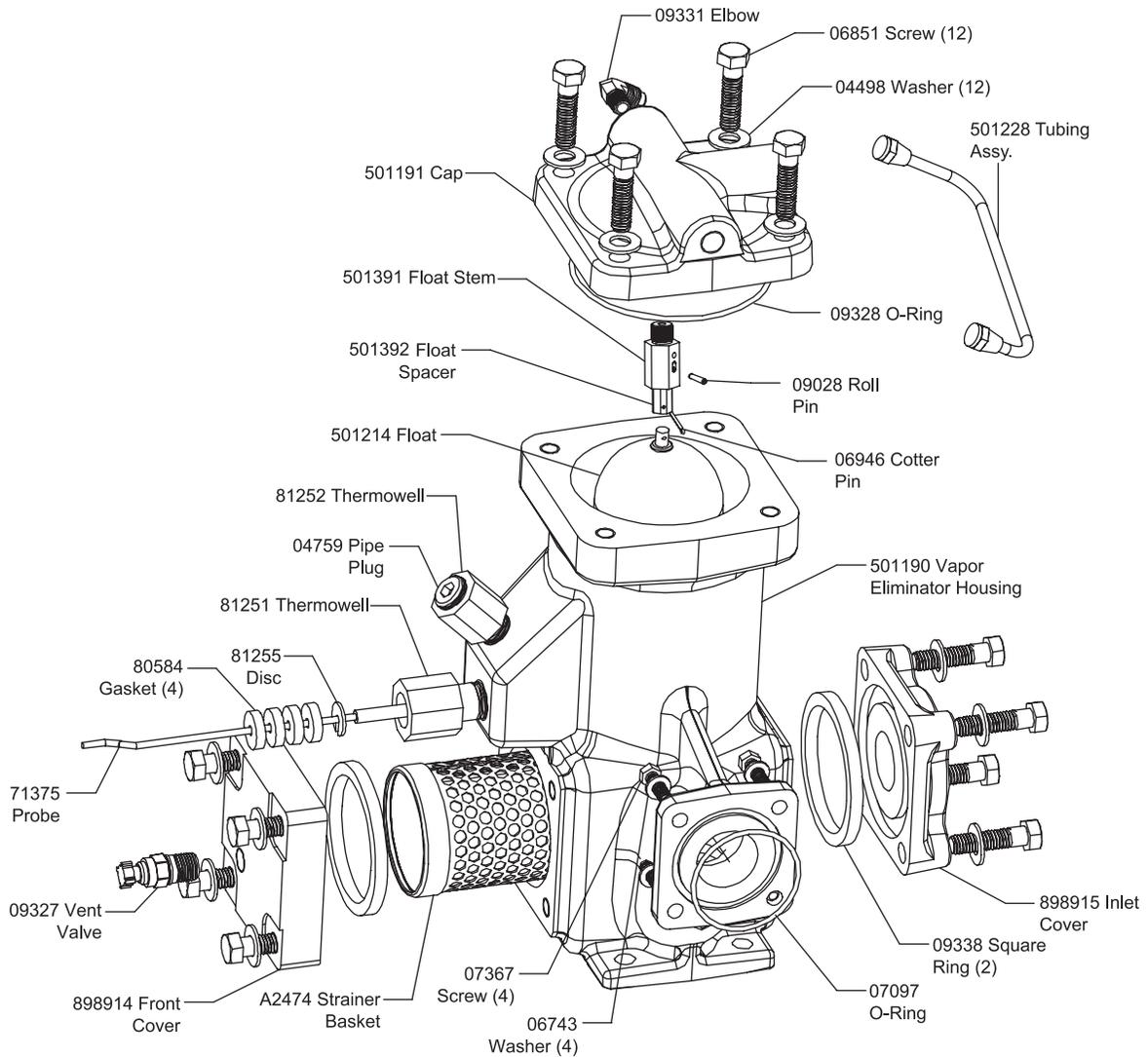
# Strainer Assembly Exploded View



Single Meter Strainer Assembly  
**A2694** - Temperature Compensated  
**A2696** - Non-Compensated



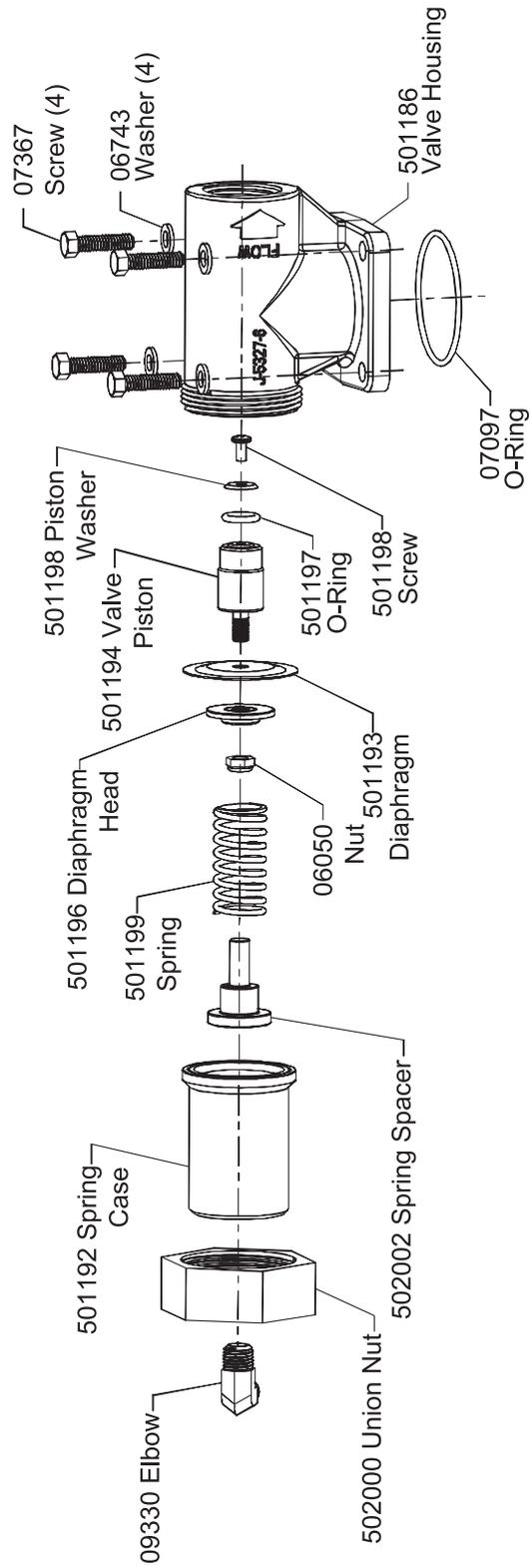
Dual Meter Strainer Assembly  
**A2697** - Temperature Compensated



**NOTE:**

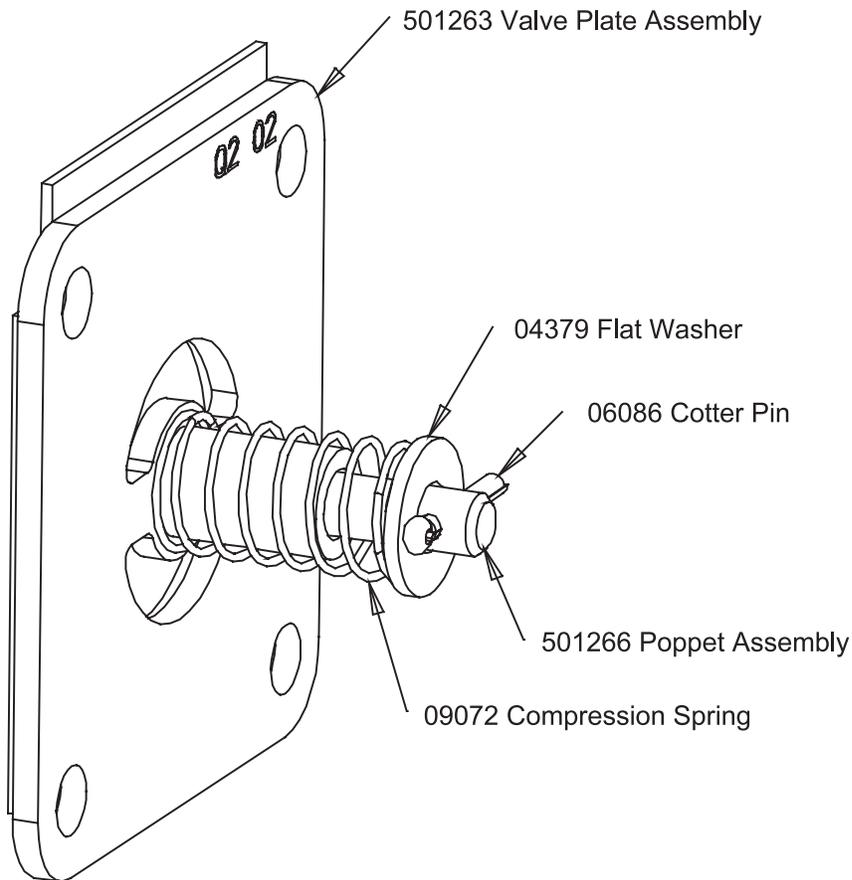
- Assembly shown is for systems that use Electronic Temperature Volume Compensation (ETVC). Systems without ETVC use a 1/2" pipe plug (07223) in place of part numbers 81251, 81255, 80584 and 71375.
- Probe (71375): Class I Division 1 may require installation with conduit per local codes.

# Differential Valve Exploded View



## Optional Back Check Valve Assembly (PN. 501267)

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**WARNING:**

When a Back Check Valve is used, an automatic safety valve must be installed to prevent pressure build-up in excess of rated working pressure in the meter housing. One automatic safety valve should be installed in each meter. Remove the pipe plug from the front cover or rear cover and insert the appropriate automatic safety valve.



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



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