

LPM-102

LP-Gas Flowmeter

Operation & Maintenance

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INTRODUCTION

The Model LPM-102 LP-gas flowmeter is a compact meter consisting of all necessary components required for accurate measurement of liquid propane.

Product entering the flowmeter passes through a strainer assembly, provided to trap particles that could cause premature inaccuracies in registration.

The LPM102 incorporates a sleeve-type vapor elimination valve that permits a leak flow of approximately .02 gpm (75.7 cc) back to the supply tank. This valve operates in conjunction with Liqua-Tech's innovative soft seat pressure differential valve. The valve's piston moves away from its seat when at least 15 psi (1.034 bar) above product vapor pressure is maintained at the measuring chamber outlet. This ensures that only liquid is measured by the meter.

LPM-102 utilizes the proven oscillating piston design. This precise method of metering has been proven to be both accurate and dependable in thousands of installations. The rotational movement of the oscillating piston chamber is transferred through a gear train assembly, which in turn can operate various types of registration devices.

INSTALLATION

1. Plan the installation for maximum rate of delivery, sizing the supply tank outlet, piping and valve for free gravity flow to the

pump suction. To accomplish this, locate the pump as close as possible to the supply tank and use short inlet connections with few restrictions. Keep the number of elbows to a minimum, and use large radius elbows, wherever possible. To further reduce the likelihood of causing vapor in the pump suction line, a pump bypass valve should be installed in a return line to the supply tank.

2. Locate the flowmeter at any convenient place in the pump discharge line. If the flowmeter is to be operated under extremes of environment (dirt, water, physical damage, etc.), an enclosure or other protection should be provided. Allow 6" (15.24 cm) vertical clearance for removal of the register and vapor release mechanism. The clearance for removing the differential valve (front on right-hand assembly) is 3½" (8.89 cm). Do not install any bypass around the flowmeter; the valve in such a line might eventually leak, work open, or be left open causing improper measurement.

When Installing

Secure the connecting piping to prevent strain on the flowmeter casing. Use pipe compound sparingly or suitable pipe tapes on male threads only. Provide the installation with means for pressure relief as outlined in the National Fire Protection Association Pamphlet 58 or local codes and practices.

NOTE: All isolated sections of the system MUST be equipped with a hydrostatic relief device to prevent damage. Failure perform this precaution could result in serious injury or death from explosion/fire.

Vent Line

The vent line from the flowmeter's vapor vent to the vapor space of the supply tank should be 3/8" (10 mm) minimum inside diameter tube or pipe. A shut-off valve must be installed in the vapor vent line to permit emptying of the meter for cleaning or when service is performed on the flowmeter. The vapor release vent line must be returned to the supply tank and should not be made a common connection with other vapor return lines or pump bypass lines. When properly installed, this line must permit free flow in either direction. If valve in vent line is closed, flowmeter will not function. These instructions must be followed in order to maintain proper function of the differential valve.

NOTE: A vapor return line should not be used from supply tank to tank being filled, inasmuch as such connection would cause confusion as to the amount delivered as a result of possible passage of vapor in either direction.

OPERATION

Pressurize the system slowly by allowing vapor to flow through the vent line. Then pass sufficient liquid through the system to clear the lines of air and vapor.

After starting the pump, slowly open outlet valve downstream of the flowmeter. Check the rate of flow after the system is filled; it should not exceed maximum indicated rate of flow 18 gpm (68 lpm).

Adjust the external pump bypass to deliver the maximum practical rate of flow for the least amount of pump pressure (see pump manufacturer's instructions).

Maximum working pressure on the system must not exceed 350 psi (24.13 bar). Avoid the use of small diameter hose and exces-

sive pressures to achieve the desired flow rates; these may result in leakage and undue wear on the pump.

Although all flowmeters are carefully calibrated and tested after assembly and no changes should be necessary; field calibration is recommended after installation is complete.

While the installation is still new, clean the strainer frequently. After the system has been in service, only periodic cleaning is necessary.

MAINTENANCE

General Maintenance

For sustained accuracy of flowmeters, little maintenance is required other than to see that the proper conditions of operation are preserved. Once the flowmeter has been installed correctly, these conditions consist merely in guarding against foreign matter, such as vapor, sediment or water entering the measuring chamber. However, should any malfunction develop, do not dismantle the flowmeter until the cause of the trouble has first been determined. (Refer to *TROUBLESHOOTING*.)

Sediment - The liquid passing through the measuring chamber must be free of grit and other forms of sediment to prevent unnecessary friction and to eliminate scoring of the piston and chamber walls. Evidence of trouble from this source will be found in under-registration of the flowmeter. Periodic cleaning and inspection of the flowmeter strainer will help to insure against this form of trouble.

Vapor - Being an instrument that measures by volume, a flowmeter will record the passage of vapor as well as the liquid being measured. Over-registration will result. Where this condition exists, check for adequacy of the vapor elimination system.

Water - Incidental water will cause no damage to the flowmeter. Trouble from this source may be expected when water is allowed to remain in the flowmeter.

Erratic Registration

Erratic registration is usually caused by vaporization of the product, faulty differential valve or vapor release valve (over-registration), or by dirt or pipe scale in the measuring chamber (under-registration). Clean the flowmeter if necessary, as directed in *MAINTENANCE*. If flowmeter continues to creep when outlet valve is closed, check differential valve seals. (Refer to *TROUBLESHOOTING*.)

Consistent Over- or Under- Registration

When the flowmeter consistently registers either more or less than is delivered and no other cause in system function can be determined, calibration of the metering system is recommended.

CALIBRATION ON UNCOMPENSATED FLOWMETERS

Test the flowmeter using a volumetric prover large enough to permit the flowmeter to operate for at least one minute at normal flow rate. Slip tube and rotary gauge reading are not sufficiently accurate for proving flowmeters. A detailed description of an LP-Gas test procedure may be found in the National Bureau of Standards Handbook 99, *Testing Liquefied Petroleum Gas Liquid-Measuring Devices*.

A thermometer well is provided for taking temperature readings while calibrating. It is covered by a snap plug to keep dirt from entering the well.

When temperature readings are to be obtained, the well must be filled with permanent type antifreeze, or with a light oil.

If a gravimetric test method is used, the conversion to gallons must be on the basis of: (1) specific gravity determined at the time of the test (not an assumed value), and (2) the temperature of the product as it is passed through the flowmeter. The volumetric test method, however, is considered to yield more accurate results and is preferred. After performing the test procedure:

1. Determine the percentage of over- or under-delivery for each test conducted.
2. Remove the register screws and take off the register.

3. Note the numbers stamped on the register change gear (on register spindle marked *R* on the adapter plate) and on the stuffing box change gear (or flowmeter spindle marked *S* on the adapter plate). Locate the gear tooth combination on the *Change Gear Chart*.

4. Add the step-wise increments of change in registration until the desired amount is reached. If the flowmeter is under-registering (delivering too much), select a new pair of gears farther down the chart. If the flowmeter is over-registering (delivering too little), select a new pair of gears farther up the chart.

5. Remove the old change gears and replace them with the new pair. Always place the change gear with the smaller number of teeth on the *R* shaft and the gear with the greater number of teeth on the *S* shaft as indicated on the adapter plate. To remove change gears, close the split end of the spindle slightly with a pair of pliers to permit removal of the change gear. After slipping on the new gear, spread the ends of the spindle slightly.

6. Reinstall the register, run several gallons (liters) through the flowmeter, and retest.

CALIBRATION ON COMPENSATED FLOWMETERS

1. Remove the two seal screws and cover from the temperature compensator.

2. Move the anchor pin from *Compensated Anchor* to *Uncompensated Anchor*. (Flowmeter reading will now be uncompensated.)

3. Perform the same LP-Gas flowmeter test procedure as outlined for uncompensated flowmeters.

4. If necessary to change flowmeter calibration, refer to *CALIBRATION ON UNCOMPENSATED FLOWMETERS*, steps 1 to 6.

5. Move anchor pin to *Compensated Anchor*, and operate flowmeter for at least 50 gallons (189 liters) before proceeding with calibration tests. (Flowmeter readings will now be temperature compensated.)

6. Perform same flowmeter test procedure used for uncompensated flowmeter. Temperature reading must be taken at the prover only. (Temperature at flowmeter is assumed to be 60°F.)

7. If necessary to adjust compensated registration, turn calibration dial located on the right side of the Lever Arm (to turn adjustment, use wrench on hex hub of dial). Turn clockwise *To Give More* or counterclockwise *To Give Less*. Each dial graduation will change compensated delivery approximately 0.15%.

MEASURING CHAMBER MAINTENANCE

CAUTION: Be sure meter is completely relieved of pressure before performing any internal maintenance. Pressure must be 0 psig. Failure to properly depressurize and evacuate the system could result in serious injury or death from explosion/fire.

Perform the following outdoors, away from buildings and sources of ignition. Before opening any part of the flowmeter, close all valves between supply tank and flowmeter. Replacement gaskets should be on hand.

To Remove and Disassemble

This operation is not difficult and may be performed by any competent mechanic. No special tools are required. No trouble need be expected, if these few simple but important directions are followed. Do not open the flowmeter until you have checked over all other possible causes of erratic registration. (Refer to *TROUBLE SHOOTING*.)

1. Prepare a clean surface on which to place the parts as they are removed. (The parts are machined to close tolerances and should be handled with care.) Also check that a replacement gasket is on hand before opening the flowmeter, it may need to be replaced.
2. Remove the flowmeter top taking care not to damage the gasket, it is to be reused.
3. Lift the measuring chamber from the flowmeter casing.
4. Remove the top plate by inserting a screwdriver in one of the

slots provided, and prying it off. Be careful not to scratch or nick any part of the chamber.

5. Lift out the piston by its spindle. If care is taken to draw it straight, it should come out easily. Do not force it.

6. Remove the control roller from the lower cylinder head. If the diaphragm or seal pin requires replacement, they may be removed by pulling upward, using pliers if necessary.

To Clean the Measuring Chamber

The parts may be most easily cleaned of scale, embedded chips, heavy corrosion and other foreign matter, using gasoline and a stiff-bristle (not wire) brush. Do not use abrasives, such as emery cloth or sandpaper. When the piston is badly corroded, replace the whole chamber.

The sliding surfaces between the chamber and piston take on a burnished finish and wear little if any. The parts of the measuring chamber which may show wear after long periods of service are the diaphragm and the control roller. These parts will not require replacement until the accuracy of the flowmeter begins to fall at low rates of flow. To change these parts, merely substitute new parts for the old, when the flowmeter is disassembled for cleaning.

To Reassemble the Chamber in the Flowmeter

Before assembling the flowmeter, make sure all parts are clean. If possible, flush out the flowmeter body. Assemble the parts carefully; they should slide together easily without hammering or forcing. It is essential that all contact surfaces between the upper and lower cylinder heads and the cylinder, or between the measuring chamber and its seat in the casing, be free from nicks.

1. Assemble the diaphragm and seal pin in the chamber, if replacement of these parts was necessary.

2. Place the control roller on its pin, and see that it will rotate freely.

3. Reinstall the piston, and oscillate it carefully by hand; it should move easily without binding. If it sticks, do not force it, but remove it and locate the cause. Do not file down the roller as this will destroy the accuracy of the flowmeter.

4. Reinstall the top plate, and again oscillate the piston to make sure that it is free.

5. Before installing the measuring chamber in the casing, make sure that the seat is clean and free of nicks. Install the chamber, making sure that the dowel pin in the main casing enters the slot in the bottom housing properly and allows the chamber to rest squarely on the seat. The top of the chamber should be flush with the gasket seal.

GEAR TRAIN MAINTENANCE

CAUTION: Be sure meter is completely relieved of pressure before performing any internal maintenance. Pressure must be 0 psig. Failure to properly depressureize and evacuate the system could result in serious injury or death from explosion/fire.

Perform the following outdoors, away from buildings and sources of ignition. Before opening any part of the flowmeter, close all valves between supply tank and flowmeter. Replacement gaskets and seals should be on hand.

To Replace Gear Train Shaft Seal

1. Remove the register, gear plate and adapter tower.

2. Remove the star driver.

3. Remove the stuffing box nut.

4. Remove shaft seal. Inspect top of spindle to be sure it is free of nicks or burrs which might damage the new shaft seal when it is placed on spindle.

5. Replace shaft seal with new part. Be sure expander and spring are in position before inserting new seal.

6. Assemble nut and tighten down all the way.

To Replace Gear Train

1. Remove the register, gear plate and adapter tower.

2. Remove the star driver.

3. Remove the flowmeter main case cover, with gear train assembly attached. Be careful to keep dirt out of flowmeter, and avoid damage to the cover gasket (a replacement gasket may be necessary).

4. Remove the stuffing box nut.

5. Take off the clamp nut and remove the gear train assembly from the underside of the flowmeter top casing.

6. Install replacement gear train, making sure that the replacement has the same gear reduction, and new gear train is orientated with anti-rotation pin. Both clamp nut and stuffing box nut should be torqued to 200 inch lbs.

7. Before installing the top casing, inspect the gasket and replace it, if necessary. Next, position the driving arm of the gear train so that it will not rest in the piston spindle. Then reassemble the main case cover on the main casing and secure it with the four cap screws.

VAPOR RELEASE MAINTENANCE

CAUTION: Be sure meter is completely relieved of pressure before performing any internal maintenance. Pressure must be 0 psig. Failure to properly depressureize and evacuate the system could result in serious injury or death from explosion/fire.

Perform the following outdoors, away from buildings and sources of ignition. Before opening any part of the flowmeter, close all valves between supply tank and flowmeter. Replacement gasket should be on hand.

Servicing of the vapor release and strainer portion of the assembly consists only of occasional cleaning of the strainer, and when required, replacement of a collapsed float or servicing a sticking valve.

To Disassemble the Vapor Release

1. Disconnect the tubing between the differential valve and the vapor release cover.

2. Remove the cap screws on the vapor release cover, and lift off cover and float assembly.

3. If 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.

5. Inspect the vapor release cover O-ring and O-ring groove before replacing the O-ring.

CAUTION: The grooves in which the O-ring gaskets are located must be free of dirt. The flat face against which the O-ring seals must be clean and free of nicks or dents which may allow product to leak past the gasket.

6. Install the float and cover assembly and tighten cover bolts.

7. Replace tubing between differential valve and vapor eliminator cover.

STRAINER MAINTENANCE

Occasional inspection of the strainer is vital to the flowmeters sustained accuracy.

CAUTION: Be sure meter is completely relieved of pressure before performing any internal maintenance. Pressure must be 0 psig. Failure to properly depressureize and evacuate the system could result in serious injury or death from explosion/fire.

Perform the following outdoors, away from buildings and sources of ignition. Before opening any part of the flowmeter, close all valves between supply tank and flowmeter. Replacement gaskets should be on hand.

To Inspect the Strainer:

1. Remove the four strainer cover bolts located on the lower left hand side of the meter.
2. Pull strainer out.
3. Inspect and clean if necessary with compressed air and/or light brush. Check for any breaks, worn O-rings, or any other defects and replace if necessary.
4. Reinstall strainer, cover and tighten cover bolts.

DIFFERENTIAL VALVE MAINTENANCE

CAUTION: Be sure meter is completely relieved of pressure before performing any internal maintenance. Perform the following outdoors, away from buildings and sources of ignition. Before opening any part of the flowmeter, close all valves between supply tank and flowmeter and loosen coupling at vapor release cover to relieve pressure on the flowmeter. Replacement gaskets should be on hand.

Faulty operation of this valve may be caused by defective valve seats, spring or seals.

To Disassemble Differential Valve

1. Remove connecting tube.
2. Remove four screws, cover and spring.
3. Insert a 1/4-20x4-inch bolt valve plug and pull from housing using pliers.
4. Inspect O-rings, U-cups and seats of valve plug and housing. Replace defective parts. Inspect I.D. of sleeve for roughness and smooth with fine emery cloth if necessary.
5. Replace U-cups on valve plug and insert into sleeve. Assemble spring. Push valve and sleeve into casing and press against spring. Valve plug should move to its closed position by spring force only. If valve remains partly open, locate cause and correct.
6. Replace cover and tubing and reconnect vapor vent line.

TROUBLESHOOTING

Complaint	Possible Cause
Register not working when liquid is flowing	Bypass around flowmeter not shut off
	Ice inside register
	Loose register or worn gear train
	Register in need of repair
	Sheared key on change gear caused by ice in register or mechanically tight mechanism
Change gear has ridden up its shaft and not engaging the other change gear	
Leakage at the stuffing box	Worn shaft seal or spindle
Chronic leakage at the main case gaskets	Excessive line or shock pressure
	Defective gasket or loose bolts
Unsatisfactory flow rate or complete stoppage of flow	Obstruction in vapor vent line between differential pressure valve and vapor space in tank
	Pump too small or inefficient. (The pump must have sufficient capacity and pressure to pump against higher heads than are normally found in gasoline or fuel oil installations. This is especially true when the delivery nears completion.)
	Pump vapor bound due to improper installation by bypass relief valve or a restriction in suction line. (Refer to INSTALLATION)
	Pump bypass stuck open or spring weak
	High loss of head. (This is caused by too many valves and elbows and the length, diameter and condition of the delivery hose.)
	Pressure buildup in tank being filled. Condition becomes worse as delivery nears completion unless vapor return line (not recommended) is used or vapor space type filling is used.
	Blocked strainer, or piston in flowmeter stuck. Clean strainer and/or measuring chamber.
	Open valve in piping allowing liquid to circulate around pump
	Worn pump
	Vapor release valve fails to close, causing differential to remain closed or open slightly
	Vent line connection to supply tank must be minimum 3/8" inside diameter. Any orifice or partially closed valve will result in malfunction of differential valve
	Excessive leakage through vapor release valve (replace)
Pump/motor not rotating in proper direction	
Under-registration - erratic	Dirt in the measuring chamber
	Badly worn control roller or diaphragm
	Main casing distorted or damaged
Over-registration - erratic	Leaking O-ring on differential valve
	Vapor release valve jamming, allowing vapor to pass through flowmeter
	Vent line from the vapor release valve plugged causing vapor to pass through the flowmeter
Consistent over- or under-registration	Flowmeter in need of calibration

