



**RED SEAL
MEASUREMENT**

Accu-Flo
Meter Service Ltd.

www.accuflo.com
1-800-921-ACCU

**Operating and Maintenance Manual
Petroleum and LPG Truck Meters**

M250
Rev. B
P.D. Oscillating Piston Flowmeters:
2" Type 4-MT and MTSC Petroleum
2" Type 4D-MT LP Gas

2" Type 4D-MT for LP-Gas

2" Type 4-MT and MTSC for Refined Fuels



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2" LP-GAS (TYPE 4D-MT) AND PETROLEUM (TYPE 4-MT, MTSC) TRUCK FLOWMETERS

SECTION I — GENERAL INFORMATION

NOTE: This manual covers the installation, calibration and maintenance procedures for the 2" 4D-MT LPG Flowmeter and the 2" Type 4-MT and MTSC Petroleum Flowmeter (See cover photograph of both meters).

The instructions are, for the most part, applicable to both the 2" Type 4-MT and MTSC Petroleum and the 2" Type 4D-MT LP-Gas meters. However there are some procedures and routines specific to each meter; in these cases, individual sections will be devoted to each meter.

The 2" Type 4D-MT and Type 4-MT, MTSC meters are very similar in construction and share many of the same parts. Common to both meters are the main case and measuring chamber, the body of the air/vapor release, and the register/gear train and optional temperature compensation assembly. The LPG version uses a differential control valve at the outlet to maintain backpressure on the meter, which ensures that vapor is not measured. The Petroleum version uses a shutoff or optional preset valve (connected to the register) and incorporates an extension on the top of the air release for better elimination of entrained air and measurement of heavy oils.

Both units include a stainless steel strainer, housed in the air/vapor release, which is a fine mesh filter in a double sleeve.

A Temperature Compensator is used in most LPG meters and some petroleum meters. The way in which it operates is the same for both units. By sensing product temperature, the Temperature Compensator controls the readout drive ratio to provide a registration compensated to 60°F. The Temperature Compensator is located in a housing between the top of the meter maincase and the bottom of the register and adds approximately seven (7) inches to the overall meter height.

The following components are unique to the 2" Type 4D-MT LPG Meter:

— The Vapor Release Assembly, which prevents entrapped vapor from passing through the flowmeter, has a hydraulic-assisted main valve with a float-operated pilot valve. When vapor collects in the Vapor Release, the vent valve opens venting vapor to the supply tank establishing pump pressure to close the Differential Valve. A hydrostatic pressure relief valve is incorporated into the cover to protect the meter from excessive pressure and possible rupture. This valve provides controlled venting of product vapor through the vapor return line back to the storage tank to relieve pressure inside the meter.

— The Differential Valve is diaphragm-actuated and opens when at least 15-psi pump pressure is established at the inlet of the flowmeter. This valve serves three functions to assure system measurement accuracy by requiring: (1) pump operation for delivery, (2) adequate back pressure to prevent product vaporation during measurement, and (3) blockage of flow when the Vapor Release valve opens.

GENERAL INFORMATION

LP-GAS METER

SECTION II — INSTALLATION

A. LP-GAS INSTALLATION — TYPE 4D-MT

CAUTION

Always install the flowmeter according to local Safety Codes for LPGas equipment. The flowmeter shall be installed outdoors, away from buildings and sources of ignition. External examination is recommended every 2 years and a pressure test at the maximum working pressure (24 bar) every 10 years. LPGas meters should be adequately grounded to eliminate hazard due to static electrical discharge. Flowmeter castings may be impregnated according to MIL-STD-276 and MIL-STD-I17563B.

1. Installation Planning. 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 reduce the likelihood of causing vapor in the pump suction line, install a pump bypass valve in a return line to the supply tank as shown in the installation drawing. (See Figure 2).

2. Flowmeter Location. 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 sufficient clearances for removal of the register, strainer and vapor release. 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.

3. Configuration. The meter and vapor release assembly may be rotated 90 degrees for better fit on board the truck. To conform with Weights and Measures requirements, install flowmeter (right- or left-hand assembly) so that flowmeter nameplate is visible.

4. Cleaning. All piping on the inlet side of the flowmeter should be very thoroughly cleaned out. Flush out all lines thoroughly before installing the flowmeter. While the installation is still new, the strainer should be cleaned very frequently. After the system has been thoroughly flushed of foreign material, only periodic cleaning is required. **IMPORTANT: Refer to Page 17 for maintenance interval requirements.**

5. Piping and Bolting Considerations. The meter is supplied with a ductile iron inlet check valve tapped for 2" NPT and a ductile iron companion flange tapped for 2" NPT on the outlet. Secure the connecting piping to prevent strain on the flowmeter. Use pipe compound sparingly or suitable pipe tapes on male threads only. **IMPORTANT: Refer to the chart on page 28 for bolt torques and anti-seize compound information.**



FIGURE 1 — 2" Type 4D-MT (Cutaway View)
with Automatic Temperature Compensator

LP-GAS METER INSTALLATION

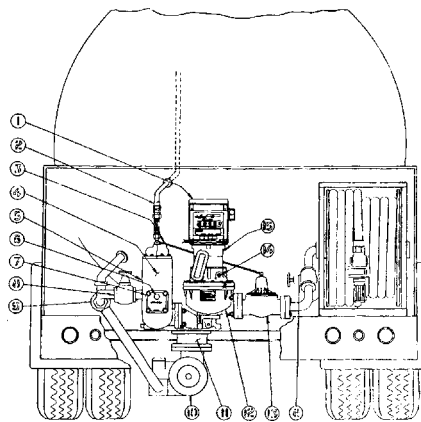
BOLT TORQUES AND ANTI-SEIZE COMPOUNDS

COMPANION FLANGES

6. Vapor Release. Provide the installation with means for pressure relief as outlined the National Fire Protection Association Pamphlet 58. **The vent line from the flowmeter's vapor vent to the vapor space of the supply tank should be 3/8-inch OD tubing or equivalent pipe size.** The vent line check valve functions as a shut-off valve when disconnected and permits removal of the strainer for cleaning or when other service is performed on the flowmeter. The Vapor Release vent line must be returned to the vapor space of the supply tank and normally should not be made a common connection with other vapor 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 flowmeter will not function. Also, if the valve in the vent line is closed, the hydrostatic relief valve in vapor release cannot relieve pressure inside meter. Therefore, an additional hydrostatic relief valve must be installed in the vent line between the meter and the valve. These instructions must be followed in order to maintain proper function of the differential valve.

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

1. Register
2. Check Valve
3. Pressure Bypass and Vent Valve
4. Vapor Release and Strainer
5. Inlet Check Valve (at rear)
6. Thermometer Well (uncompensated flowmeter)
7. Strainer Cover
8. Manual Valve
9. External Pump Bypass Valve
10. Pump
11. Internal Control Valve
12. Flowmeter
13. Differential Valve
14. Thermometer Well
15. Temperature Compensator



**FIGURE 2
INSTALLATION ARRANGEMENT**

7. Startup Procedures

- **Pressurize the system slowly** by allowing vapor flow through the vent line. Check for system leaks. Then pass sufficient liquid through the system to clear the lines of air and vapor.
- After starting pump, **slowly open outlet valve** downstream of the flowmeter. Check the rate of flow after the system is filled; it should not exceed rated maximum flow of flowmeter.
- **Adjust the external pump bypass** to deliver the maximum practical rate of flow for the least amount of pump pressure.
- NOTE: The pump relief valve (normally built into the pump assembly) should relieve at a pressure above which the external bypass has been set.
- **Maximum working pressure on the system must not exceed 350 psi.** Avoid the use of a small diameter hose or pipe and resultant need for excessive pressures to achieve the desired flow rates; these may result in leakage, undue wear on pump and unsafe operation.
- All flowmeters are carefully calibrated and tested at the factory and no changes should be necessary.
- **While the installation is still new, clean the strainer frequently.** After the system has been in service, only periodic cleaning is necessary. **DO NOT OPERATE THE METER WITHOUT THE STRAINER!**

VENT LINE LP-GAS

**LP-GAS
STARTUP PROCEDURE**

B. PETROLEUM INSTALLATION — TYPE 4-MT And TYPE 4-MTSC

CAUTION

Containers employed to collect vapor or liquid discharged from the meter vapor release should be of sufficient size to prevent any liquid escape during normal operation, and should have a suitable flame arrestor vent. All vent lines and fittings should be of metal construction, and all valves should be designed so that normal vibration does not cause accidental opening.

1. Installation Planning. For Pumped Systems, 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 or sweep elbows wherever possible.

On **Gravity Systems**, piping should be pitched uniformly down from the compartment to the flowmeter to prevent the accumulation of air at high points. The point to which the discharge line from the flowmeter will drain should be at least 6" above the center of the flowmeter spuds but below the bottom of the compartments.

2. Flowmeter Location. The flowmeter may be located at any convenient point on the discharge line from the pump. The piping on the outlet side of the flowmeter should be so arranged as to eliminate the possibility of draining the measuring chamber. All piping connected to the flowmeter must be firmly secured to prevent strain on the flowmeter casing. The use of flexible connections to the pump or tank is recommended. Mount the unit securely to the chassis of the truck to prevent strains due to vibration. It is also advisable to enclose the flowmeter if possible to protect it from damage.

Be sure to allow headroom for the removal of the strainer basket, register, and air release mechanism. There must be no by-pass connection around the flowmeter. Experience has shown that the valve in this line will eventually leak, work open or be accidentally left open.

The meter and air release assembly may be rotated 90 degrees for better fit on board the truck. To conform with Weights and Measures requirements, install flowmeter (right- or left-hand assembly) so that flowmeter nameplate is visible. Instructions on changing the assembly from right hand to left hand and left hand to right hand are covered on Page 12 of this manual.

3. Piping Considerations. The meter is supplied with a 2" NPT threaded ductile iron companion flange on the inlet and a 2" 150 lb. flat face ANSI Type flange on the outlet. Use pipe thread cement on the male threads only. **IMPORTANT:** Refer to the information on Page 28 for bolt torques and anti-seize compound recommendations.

4. Blowing the Hose. As it is impossible to blow all the liquid from the hose, the amount of liquid left in the lines on the discharge side of the flowmeter will not be the same before and after every delivery. It is therefore recommended that provision be made to keep the hose and outlet piping full of liquid at all times. For this purpose a hose nozzle with a check valve should be used.

PETROLEUM METER INSTALLATION

BOLT TORQUES AND COMPANION FLANGES

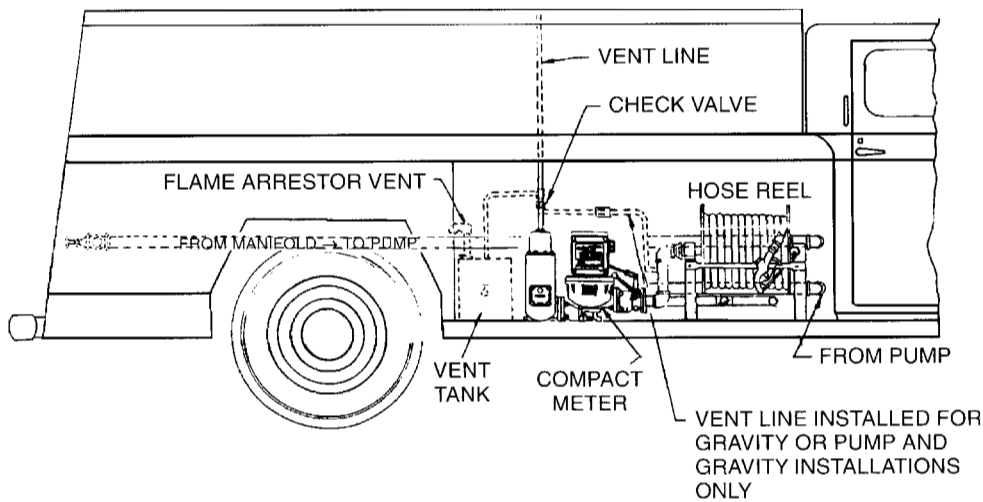


FIGURE 3
TRUCK INSTALLATION —PETROLEUM

5. Pumping Out Underground Tanks. In making provisions for pumping out underground tanks, DO NOT provide any connection between the outlet of the flowmeter and the compartments or manifold. A valve in this line which is leaky or carelessly left open will allow part of the metered liquid to be diverted.

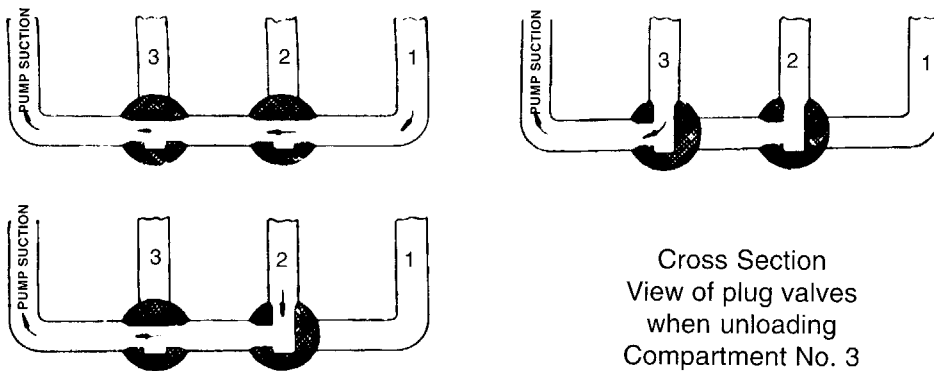
6. Vent Pipe. The vent pipe from the air release should be 1" pipe or equivalent. Care should be taken to prevent any possible obstruction to the free flow of air through this line. Do not exceed torque recommendation for vent pipe or vapor release cover may be damaged.

— **On Pump Systems** it should either be connected to the top of one of the compartments or run into a container of about 5 gallons capacity to collect any liquid discharged with the air.

— **On Gravity Systems** it should be connected to the outlet side of the flowmeter, running the line as high as possible to prevent any slight leakage of the valve from bypassing the flowmeter.

— **On Combination Pump and Gravity Systems,** run the vent lines as for pump operation and install a check valve as close as possible to the air vent connection to prevent the possibility of drawing in air at this point. In addition a second line should be connected from the air release to the discharge side of the flowmeter with a check valve installed to prevent flow of liquid back through vent line during pump operation.

If the valve of an empty compartment or auxiliary suction connection is open even slightly, while another compartment is being emptied, air drawn in through, this valve will be churned up with the liquid to such an extent by the pump that it may be carried through the air release and cause over-registration. The volume of the air release of the Type 4-MT AND MTSC has been greatly increased so that this is less of a problem than with earlier designs; however careful planning of the installation combined with this new feature will eliminate this over-registration situation.



Cross Section
View of plug valves
when unloading
Compartment No. 3

FIGURE 4
MANIFOLD VALVE INTERLOCKING

7. Valves and Interlocks. Either the compartment or the manifold valves should be interlocked so that delivery can be made from only one compartment at a time. Compartment valves are ordinarily interlocked by means of a selector lever in the can box.

Manifold valves may be of the 2 way-3 port lubricated pug type so arranged as to achieve the same purpose. (See illustration).

On Gravity or Pump and Gravity Systems, the back pressure valve in the bottom of the air release unit must be removed (see Page 24).

8. Installation and Startup Procedures

- Inlets and outlets are clearly marked; do not install backwards.
- All piping on the inlet side of the flowmeter should be very thoroughly cleaned out. Flush out all lines thoroughly before installing the flowmeter.
- Pass sufficient liquid through to clear the line of air.
- Check the rate of flow. It should not exceed the maximum rate of flow for the meter.
- The by-pass on the pump should be so regulated as to deliver the maximum practical rate of flow for the least amount of static pressure. Pressure on the flowmeter should not exceed 150 psi. Do not try to increase the rate of flow through undersized pipes and fittings by means of excessive pressures which will cause leaking gaskets and collapsed air release floats.
- Temperature of the liquid should not exceed 140°F.
- Test the flowmeter in a prover of not less than 100 gallons. All flowmeters are carefully calibrated and tested at the factory and no changes should be necessary.
- If the registration is inaccurate, refer to section on calibration.

**INTERLOCKING OF
COMPARTMENT
OR MANIFOLD VALVES**

**INSTALLATION AND
STARTUP PROCEDURES
PETROLEUM**

SECTION III — OPERATION

A. LP-GAS OPERATION

1. If it has not been done so already, pressurize the system slowly by allowing vapor flow through the vent line. Then pass sufficient liquid through the system to clear the lines of air and vapor.
2. Reset the 800 series register to zero by turning operating knob to the rear stop. On Printer models, first insert ticket. To insert a ticket, be sure that the reset knob is turned forward to a stop. Then depress the dust bar above the ticket and insert ticket either “face down, bottom end first” or “face up, top end first” as noted on the instruction plate. Turn reset knob backward to stop. This resets the visible wheels to zero, locks ticket in place, and prints the initial reading on the ticket. The ticket now cannot be removed without tearing it.
3. Start the Pump. Slowly open the outlet valve downstream of the flowmeter.
4. Open hose valve and make delivery.
5. After completion of delivery on Printer models, stamp final reading on ticket by turning reset knob forward to the front stop. This prints the final reading and releases the ticket. The cumulative totalizer is visible through the mask at the upper right-hand corner of register; this total may be manually written on the ticket or in a log if desired.

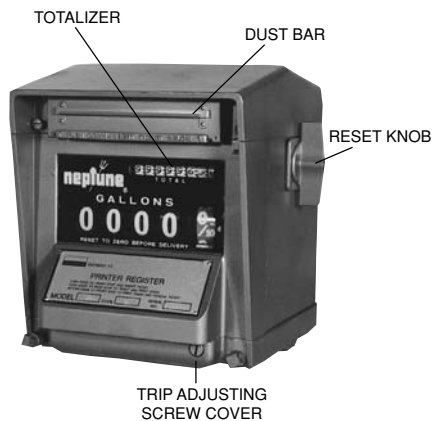


FIGURE 5
STANDARD 800 SERIES
PRINTER REGISTER



FIGURE 6
PRESET 800 SERIES
PRINTER REGISTER
(PETROLEUM ONLY)

B. PETROLEUM OPERATION

1. Reset the 800 series register to zero by turning operating knob to the rear stop. On Printer models, first insert ticket. To insert a ticket be sure that the operating knob is turned forward to a stop. Then depress the dust bar above the ticket slot and insert the ticket either “face down bottom end first” for “face up top end first” as noted on the instruction plate. Turn the operating knob backward to the stop. This resets the visible wheels to zero, locks the ticket in place and prints the initial reading on the ticket. It is now impossible to remove the ticket without tearing it.

LP-GAS FLOWMETER OPERATION

800 SERIES REGISTER DIAGRAMS

2. On Preset models, set the Preset wheels to the desired quantity using the push buttons on the lower face of the register. Pushing the red emergency stop button will trip the valve. After it has been used the mechanism may be set for a new Figure or the delivery may be completed automatically as originally set by re-opening the valve except if the flow has been stopped with 8 gallons or less remaining. In this case the delivery can be completed by manually holding the valve partially open.

3. Start pump and open the valve (manual or preset).

4. Open hose nozzle and make delivery. When the preset volume is reached, the valve will close on Preset models.

5. After completion of delivery on Printer models, stamp final reading on ticket by turning operating knob forward to the front stop. This operation prints the final reading and releases the ticket.

SECTION IV — CALIBRATION AND ADJUSTMENT

A. 800 SERIES REGISTER ADJUSTMENT

800 Series printer registers are shipped from factory with the ticket guides properly adjusted. If it is necessary to reposition ticket, proceed as follows:

1. Remove register top cover.
2. Insert a ticket into the printer. Loosen the clamp screws on the rear of the ticket guides. Move the guides to the right or left as required. Tighten clamp screw. The ticket must slide freely between the guides. If the ticket binds at the forward end of the guide, remove the guide, and rebend the tail of the guide.
3. To raise or lower printing, push the two stop pins to the front or rear with end of a screwdriver.
4. Replace the top cover and reseal.

To change the letters that are printed on the ticket, follow this procedure to change the position of the letter wheels.

1. With top cover removed, the "letter" wheels are visible.
2. Using a screwdriver or similar tool, turn wheels until desired letters are in position to print. The letters appearing at top are in position to print.

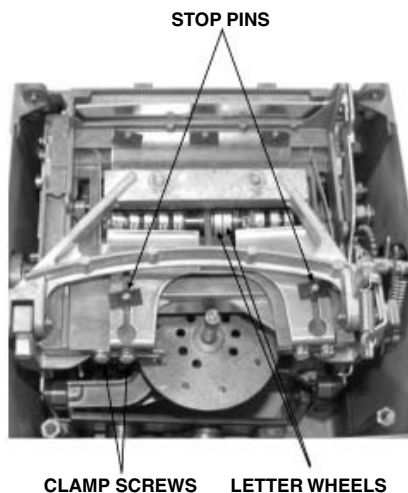


FIGURE 7
PRINT UNIT ADJUSTMENTS

ADJUSTING TICKET POSITION

ADJUSTING PRINT LETTERS

B. CALIBRATION (LP-GAS)

Test the flowmeter using a volumetric prover large enough to permit the flowmeter to operate for at least one minute at maximum flow rate. Slip tube and rotary gauge readings are not sufficiently accurate for proving flowmeters. A detailed description of LP-Gas test procedure may be found in the NCWM Course 305, "Liquefied Petroleum Gas Liquid Measuring Devices." Specifications and tolerances are contained in NIST Handbook H-44.

A thermometer well is provided for taking temperature readings while calibrating. It is located in the compensator on compensated flowmeters. On uncompensated flowmeters, it will be found in the strainer cover. It is covered by a snap plug to keep dirt from entering the well. The well should be filled with permanent type anti-freeze, if available, or with a light oil when temperature readings are to be obtained.

If a gravimetric test is used, the conversion to gallons must be on the basis of: (1) specific gravity determined at the time of test (not an assumed value), at (2) the temperature of the product as it passed through the flowmeter.

Slip tube and rotary gauge readings are not sufficiently accurate for use as flowmeter checks and will produce erratic results.

Erratic Registration

Erratic registration may be an indication of vapor or dirt in the measuring chamber. It cannot be corrected by recalibration. Clean the strainer and if necessary the flowmeter as directed under MAINTENANCE. For proper operation the installation must be in accordance with the descriptions in Section II of this manual.

Consistent Over or Under Registration

When the flowmeter registers consistently either more or less than is delivered, the calibration may be corrected in the following manner:

Procedure for Uncompensated Flowmeters

Test the flowmeter to determine any error in registration. If there is an error less than 0.309%, proceed as follows:

1. Remove the register top cover.
2. Lift and turn change gear shifter (see Figure 8) in the direction indicated on the top of the shifter.
3. There is a series of holes in the plate into which the guide pin enters at different settings. Altering the setting by one hole changes the calibration approximately 34 cubic inches in 100 gallons, or .15%.

Example: Suppose that the flowmeter consistently gives 68 cubic inches too much when it registers 100 gallons. After removing the cover plate move the gear shifter 2 spaces to the right (from position E to position C) to decrease the delivery about 68 cubic inches in 100 gallons.

Erratic Registration

Consistent Over or Under Registration

**Uncompensated Flowmeters
Error <0.309%**

After changing the calibration always replace the top cover, making sure that the sheet steel housing on the sides and back fits into the groove in the bottom edge of cover. Run a small amount of liquid through the flowmeter before testing. In order to prevent tampering, always reseal after calibration is completed. If there is an error greater than 0.309% (approx. 68 cu. in. in 100 gals.), proceed as follows:

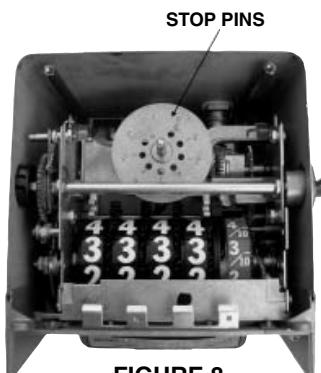
1. Remove the register. (Refer to REGISTER MAINTENANCE.)
2. Looking into the bottom of the register determine the number of teeth on the "R" and "S" change gears. (See Figure 9).
3. Refer to CHANGE GEAR CHART (Figure 10) and select the proper gears.
4. Install new gears being sure to put change gear "R" on the "R" spindle and change gear "S" on the proper spindle.
5. Replace register and tighten two screws.

Procedure for Compensated Flowmeters

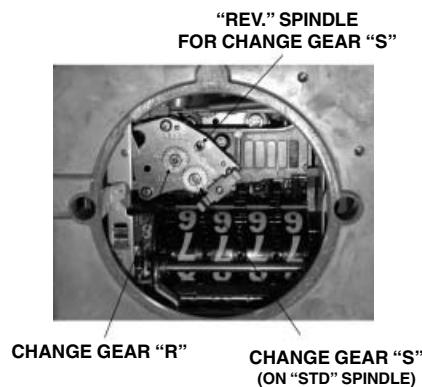
1. Remove the two seal screws and cover from the temperature compensator. (See Figure 11). Do not remove sealing wax at top of lever arm.
2. Move anchor pin from "Compensated Anchor" to "Uncompensated Anchor." (Flowmeter readings will now be uncompensated.) (See Figure 11).
3. Perform same LP-Gas flowmeter test procedure as outlined for uncompensated flowmeters.
4. If necessary to change flowmeter calibration, refer to PROCEDURE FOR UNCOMPENSATED FLOWMETERS, steps 1 to 5.
5. Move anchor pin to "compensated Anchor" and operate flowmeter for at least 50 gallons before proceeding with calibration tests. (Flowmeter readings will now be temperature compensated.)
6. Perform same flowmeter test procedure used for uncompensated flowmeter. Temperature readings 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 at the lower end 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%; that is, 34 cubic inches per 100 gallons.

**Uncompensated Flowmeter
Error >0.309%**

Compensated Flowmeters



**FIGURE 8
GEAR SHIFTER
ADJUSTMENTS**



**FIGURE 9
CHANGE GEAR
ARRANGEMENT**

	GEAR TEETH		CHANGE	
	REG.	S.B.	%	Cu. In. per 100 US gal.
↑ To Deliver Less Increase Registration ↓ To Deliver More Decrease Registration	25	27	.29	68
	26	28	.27	62
	27	29	.24	56
	28	30	.23	54
	29	31	.21	48
	30	32	.20	46
	31	33	.18	42
	32	34	.18	42
	33	35	.17	40
	34	36	.32	74
	18	19	.27	62
	19	20	.24	56
	20	21	.23	54
	21	22		

FIGURE 10
REGISTER "CHANGE GEARS" FOR
2" FLOWMETERS (US GALLONS)

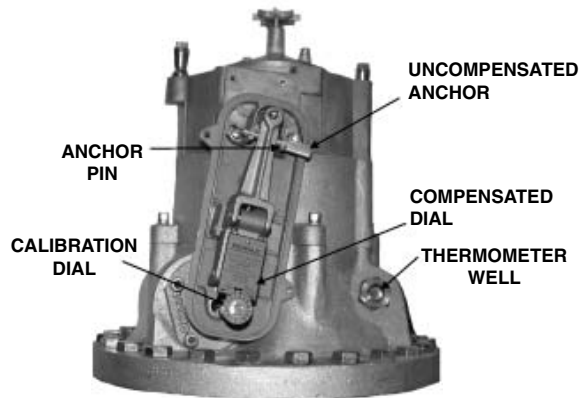


FIGURE 11
REMOVING ANCHOR PIN
FOR CALIBRATION

C. CALIBRATION (PETROLEUM)

NOTE: For temperature corrected petroleum meters you may follow procedure for calibrating LP-Gas meters (see Page 10).

1. Test all flowmeters with 100-gallon or larger test measures. Do not base calibration upon truck compartments.
2. Preset flowmeters should first be tested and adjusted without the Preset (set the register for more than the test quantity), then tested with the Preset.
3. If the Preset mechanism does not trip correctly, see instructions on Page 14 "To Adjust the Tripping Point." Rerun the test, and then if the delivery is not correct, a service man should be called.

Erratic Registration

Erratic registration is an indication of trouble in the system, commonly caused by air or dirt in the measuring chamber. Do not try to correct this by recalibration of the flowmeter immediately; first check over the piping for air leaks, clean the strainer and then, if the trouble has not been found, clean the flowmeter as directed on pages 16, 17, 18 and 19. If this does not correct the trouble, check for faulty installation.

Over-registration is an indication of air; under-registration is generally caused by dirt or pipe scale in the measuring chamber or the liquid by-passing the flowmeter in some manner.

PETROLEUM CALIBRATION

Erratic Registration

When the flowmeter registers consistently either more or less than is delivered, the calibration may be corrected in the following manner:

1. Remove four screws holding top cover and remove cover.
2. Lift and turn the gear shifter (see Figure 8 on Page 10) in the direction indicated on the top of the shifter.
3. There is a series of holes in the plate into which the guide pin enters at different settings. Altering the setting by one hole changes the calibration approximately 34 cubic inches in 100 gallons.

After changing the calibration always replace top cover, making sure that the sheet steel housing on the sides and back fits into the groove in the bottom edge of cover. Run a small amount of liquid through the flowmeter before testing. To prevent tampering, always reseal after calibration is completed.

Changing Meter from Left Hand to Right Hand Assembly

When the flowmeter is assembled as a Left Hand assembly and it is desired to change it to a Right Hand assembly, or vice versa, proceed as follows:

1. Remove clevis pin (E) from valve linkage.
2. Unscrew the outside register link lock nut (P) and remove connecting rod (G) and clevis (F) as a unit.
3. Remove register link (N), rotate 1/2 turn and reassemble onto register as described in appropriate valve adjustment instructions.
4. Loosen two clamp screws on lower front of register, lift register up and turn register 180 degrees.
5. Remove operating shaft cap screw (C) on both sides.
6. Interchange connecting rod arm (H) and valve operating handle (A). The connecting rod arm must be assembled with notches (J and K) in specific relationship. (See item 3 of valve linkage adjustment instructions for details regarding position of notches).
7. Reassemble operating shaft cap screws (C).
8. Remove valve handle stop set screws (B) and screw into hold on opposite side of valve.
9. If the inlet is moved to opposite side, be sure to rotate the air release cover assembly 180°.

CHANGING CONFIGURATION OF THE METER (Right hand to left hand and vice versa)

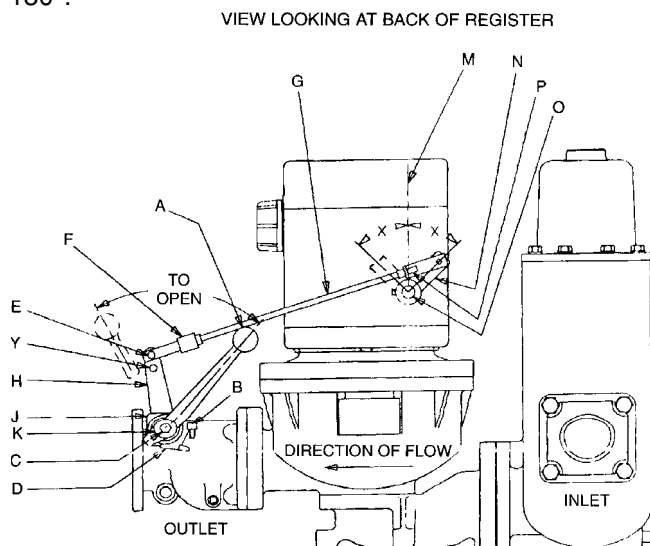


FIGURE 12
RIGHT HAND PRESET VALVE ASSEMBLY

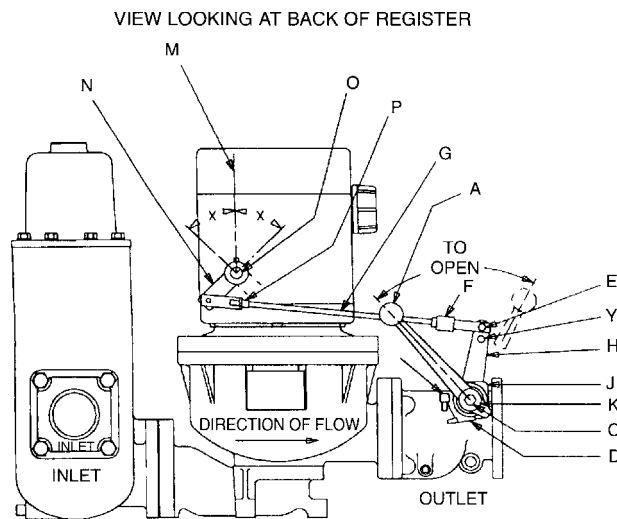


FIGURE 13
LEFT-HAND ASSEMBLY

After completing the above instructions, the valve linkage must be adjusted in accordance with the following procedure **ADJUSTMENT OF PRESET VALVE**.

ADJUSTMENT OF PRESET VALVE (PETROLEUM ONLY)

Note: Before any adjustment of the Preset Valve is made, be sure that the Preset setting wheels indicate a quantity, other than zero, to insure that the trip mechanism of the register is in proper position.

1. Depress the emergency stop button on the register and turn the shaft (O) clockwise.
2. Assemble register arm (N) on knurled knot in position as shown for specific assembly. (See illustration). Arm should move an equal distance each side of vertical center line (M) (Angle $x=x$).
3. Assemble valve arm (H) as shown for specific assembly. On the right hand assembly there must be one notch between the cast mark (K) on the valve arm and the cast mark (J) on the stop plate (J above K). On the left hand assembly these cast marks must be in line.
4. Assemble one nut (P) on connecting rod (G) and assemble clevis to the other end of the connecting rod a distance of 1".
5. Insert end of connecting rod through the register arm link and assemble clevis (F) to valve arm (H) using upper hold (Figure 13). Insert clevis pin (E).
6. Open valve all the way. The opening of the valve is stopped by the set screw (B) which should project approximately 1/8" below the lug holding it. Turn shaft (O) counterclockwise to latch mechanism. With valve held open, tighten nut (P) against register arm link. The assemble and tighten second nut at (P).
7. Depress the emergency stop button and allow the valve to close. At this point the linkage between the valve and the register must be free. If it is not, the above adjustments must be rechecked.
8. Set the register to deliver the minimum quantity and open valve to run product through the flowmeter.
9. After the initial trip occurs the valve should close to the intermediate flow position. This rate should be approximately 20 to 25 gpm. If the valve closes too far, or all the way, unscrew clevis (F) on rod (G) to hold valve open further. If the rate of flow is too fast during the intermediate position, turn the clevis onto the rod to allow the valve to close further. It should not be necessary to turn more than one

PRESET VALVE ADJUSTMENT
To adjust valve linkage

turn in either direction.

10. It is sometimes necessary to change the position of set screw (B) if the clevis has been readjusted. If the register mechanism will not latch up, unscrew the set screw to allow the valve to open further. If the connecting rod (G) is under compression, when the valve is held all the way open, turn the set screw down to relieve the pressure on the register.

11. The preset trip adjusting screw should be near its mid-position. If a small adjustment of this screw will not permit the register to shut off "on the mark" it is usually possible to correct this by a slight adjustment of the clevis (F). This will move the main valve nearer to or further away from its seat during the intermediate flow and thereby change the amount of time needed for the valve to fully close at the last trip. (Also see "To Adjust the Tripping Point")

Note: If it is difficult to obtain proper rate of flow during intermediate trip position and still have register latch up fully, check Preset valve to insure that it is opening all the way. Check valve by removing set screw (B) and clevis (F) from valve arm; open valve as far as possible. The distance between lug on arm and on stop plate must not be more than $\frac{1}{4}$ ".

Registers are shipped from the factory with the Preset mechanism adjusted to trip correctly at the normal rate of flow.

If a change in the valve closing speed of closing or some other reason causes the Preset not to trip at the correct point, the trip point may be adjusted as follows:

If the valve is closing "off the mark," either late (over delivery) or early (under delivery), adjust the clevis (see illustrations, "E" on Pages 12 and 13) in half-turn increments to bring the trip point to the zero mark. Turn the clevis to lengthen the connecting rod when the trip point is early, or turn to shorten the rod when the trip point is late. Continue this procedure until the final trip is on or close to the zero mark. The set screw (B) must also be readjusted as described in "To Adjust Valve Linkage." The intermediate flow rate will be satisfactory when the final trip is adjusted as described.

Further adjustment of the trip point is possible, but is not recommended for normal applications. The following procedure should be used only when very exact setting of the final trip is necessary.

Adjust the clevis, as described above, and proceed as follows:

Remove the trip adjusting screw cover located in the lower right corner of the register front housing (see illustration). Insert a narrow blade ($\frac{3}{16}$ " screwdriver) until it engages the slotted head of the adjusting screw. One turn of this screw will change the tripping point

To Adjust the Tripping Point

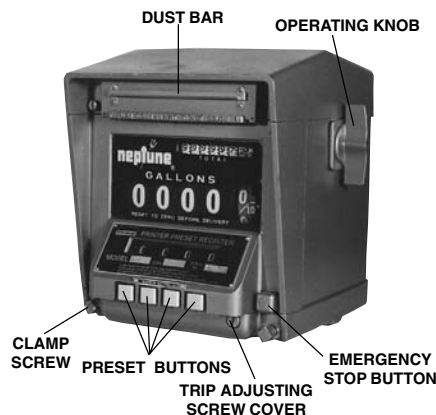


FIGURE 14
800 SERIES REGISTER
DIAGRAM

about one-quarter of one-tenth gallon.

If the Preset trips before reaching the zero mark (early), turn the adjusting screw clockwise.

If the Preset trips after reaching the zero mark (late), turn counterclockwise.

Do not turn the adjusting screw more than $1\frac{1}{2}$ turns. If the trip point is not on zero after $1\frac{1}{2}$ turns, return the adjusting screw to its original position and turn the clevis a half turn in the appropriate direction. Then repeat the trip screw adjustment procedure.

SECTION V — MAINTENANCE

A. METER MAINTENANCE (General)

For sustained accuracy of Actaris LP-Gas and Petroleum 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, air, 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 suggestions in "TROUBLESHOOTING."

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 maximum flow rate and to prevent possible damage of the flowmeter if clogged strainer ruptures.

Being an instrument that measures by volume, a flowmeter will record the passage of vapor or air as well as the liquid being measured, resulting in over-registration. In LP-Gas, this will not occur with proper Vapor Release and Differential Valve function and installation. For petroleum products, over-registration will be prevented through the proper use of the air release valve, which vents air before it passes through the measuring chamber.

Incidental water will cause no damage to the flowmeter. Trouble from this source may be expected only when water is allowed to stand in and around the flowmeter for a considerable period of time.

When washing trucks, care should be taken to cover the register. Water in the register will cause trouble particularly in cold weather when ice may form and cause sticking.

While the installation is still new, the strainer should be cleaned very frequently. After the system has been thoroughly flushed of foreign material, only periodic cleaning is recommended.

Before a flowmeter is put in storage, the measuring chamber must be flushed with a light lubricating oil of the best quality to prevent injury from condensation.

CAUTION

Before opening any part of the flowmeter, close valve between supply tank and flowmeter. Disconnect coupling vent line at vapor release cover. Perform the following outdoors, away from building or sources of ignition:

Open valve slowly at end of delivery hose or other outlet piping. After pressure is dissipated unscrew Vent Valve (hex. nut) slowly (maximum 3 turns) on top of Vapor Release to depressurize product in flowmeter.

NOTE: The main components of the 2" Type 4-MT and 4D-MT meters are made of cast aluminum. The bolts themselves are plated steel, and may damage the aluminum meter components if overtorqued. To avoid problems associated with overtorquing of the bolts, refer to Page 28 of this manual for exact torque requirements and recommended anti-seize compounds.

GENERAL MAINTENANCE

SEDIMENT

VAPOR/AIR

WATER

CLEANING

STORAGE

To Clean the Strainer

Remove the strainer cover and strainer. Clean strainer with compressed air. Inspect strainer for any breaks or other defects and replace if necessary. Reinstall strainer and strainer cover.

To Inspect Air/Vapor Release Unit.

Trouble with this unit may arise from: (1) Collapsed ball float allowing vent to remain open; (2) dirty or worn valve disk; or (3) binds in float linkage.

1. Uncouple the vent connection (See Caution).
2. Remove the cap screws on the air/vapor release cover and lift out the mechanism.
3. If the float is damaged, remove by taking out the hinge pins and replace with a new one.



FIGURE 15
VAPOR/AIR RELEASE COMPONENTS

4. If the valve is leaky.
 - a. Remove the air/vapor release unit from the underside of the cover (by unscrewing three small screws).
 - b. Take off the sleeve (for petroleum, the sleeve with piston seal).
 - c. Move the ball in the direction of the valve housing as far as possible and remove valve disc assembly.
 - d. The valve disc assembly should be taken apart to inspect for dirt or defective pilot valve seat. Replace valve if seats are defective.
 - e. For Petroleum, replace piston seal, if defective.
 - f. When reassembling, make sure that the valve disc assembly moves freely in sleeve and for petroleum meters that piston seal is properly positioned.

Faulty operation of this unit may be caused by defective valve seat or torn diaphragm.

For more information on parts and components see form P250.

Adjustable Air Release

The current Type 4-MT and MTSC air release cover assembly includes a fully adjustable float linkage for fine tuning the air release for various conditions. The float can be raised or lowered to increase the sensitivity of the unit.

For those conditions where spitting is not an issue, but improved air elimination is required, the linkage can be shortened by removing the cotter pin and adjusting the linkage in. Using gentle hand pressure to lift the float to the top position, there should be a minimum of $\frac{5}{16}$ " between the arms and the float after adjustment.

To reduce spitting, but also slightly reduce air elimination, the linkage can be lengthened in a like manner. Remove the cotter pin and adjust the linkage out to lower the float. With the float in the down position, the float should clear the inner wall of the air release body by a minimum of $\frac{1}{16}$ ". When reinstalling the cover assembly, be sure the float is oriented so the incoming flow assists in raising the float.

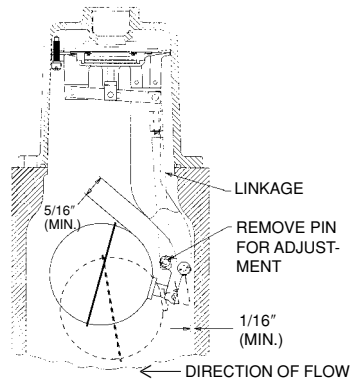


FIGURE 16.
2" ADJUSTABLE
AIR RELEASE

B. REGISTER MAINTENANCE (GENERAL)

Register parts are such that only minor field repairs are advisable. When a register is in need of repair or service other than that for which instruction is given here, it should be returned to the nearest Schlumberger distributor.



FIGURE 17.
800 SERIES REGISTER — LOWER VIEW

Register Removal

Disconnect valve linkage at valve end (petroleum only — cotter pin, washer, and clevis pin must be removed before hand). Loosen the two clamp screws on lower front of register. Lift register off flowmeter.

When one register is removed and another substituted, (1) Check the number of teeth on the change gears (see illustration). They must be the same as the gears on the old register and on the same respective spindles. The number of teeth is stamped on each gear. To remove these gears, close the split end of the spindle slightly. (2) Make sure that the position of the change gear shifter is the same on the new register as the old one. Each hole is lettered for convenience.

Cleaning Register Masks

Register masks are made of plastic and require special treatment instructions for cleaning. If the mask becomes soiled with grease and oil, solvents for these substances, such as kerosene or naphtha, may be used to remove dirt. However, sprays that are commonly employed in cleaning glass windshields must not be used as cleaners, since they may contain solvents.

A water solution of non-abrasive soap is recommended for washing grease, oil, or dirt from the mask. It is then cleaned by rubbing gently with a soft cloth, in a manner similar to cleaning window glass, rinsing the plastic in clean water, and finally drying.

REGISTER MAINTENANCE

Cleaning Register Masks

Scouring cleanser and similar material must not be used in cleaning the mask, since they contain abrasives that scratch the surface.

The use of solvents, such as acetone, ethyl acetate, benzene, and ethylene dichloride, to brighten the surface is never recommended since these substances soften the surface of the plastic.

C. MEASURING CHAMBER MAINTENANCE (General)

CAUTION

Before opening any part of the flowmeter, close valve between supply tank and flowmeter. Disconnect coupling in vent line at vapor release cover. Disconnect coupling in vent line at vapor release cover. Perform the following outdoors, away from buildings or source of ignition:

Open valve slowly at end of delivery hose or other outlet piping. After pressure is dissipated, unscrew Vent Valve (hex. nut) slowly (maximum 3 turns) on top of Vapor release to depressurize product in flowmeter.

The Actaris 2" Type 4-MT, MTSC and Type 4D-MT use the same measuring chamber. In both new meters and replacement parts, each chamber contains a matched piston and housing that have been calibrated together to achieve the accuracy necessary for custody transfer. Pistons from one chamber may NOT be placed into another chamber for use; the meter will not meet W&M accuracy specifications.

The piston is covered with a special coating that increases the lubricity and makes the surface more impervious to damage by contaminants. Because it is hard, the coating is also brittle. Take care in the handling of the piston to avoid chipping the coating.

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.*

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. Have a replacement gasket ready before opening the flowmeter.
2. Loosen the two clamp screws on the lower front of the register. Lift the register off. On Preset models the valve linkage must first be disconnected. (Remove cotter pin and washer at valve end.)
3. Remove the flowmeter cover taking care not to injure the gasket.
4. Lift the measuring chamber from the flowmeter casing.
5. Remove the upper cylinder head by removing the screws and then tapping on the lugs protruding at the sides. Be careful not to scratch or nick any part of the chamber.
6. Lift out the piston by its spindle. If care is taken to draw it straight, it should come out easily. Do not force it.
7. Remove the control roller, seal pin, and diaphragm from the lower cylinder head.

MEASURING CHAMBER MAINTENANCE

Measuring Chamber Removal and Disassembly

To Clean the Measuring Chamber

The parts may be easily cleaned of scale, etc., by means of a good, coarse, stiff bristle (not wire) brush and a petroleum solvent. All foreign matter, except deeply embedded chips or heavy corrosion due to water, may be removed in this manner. *Do not use abrasives*, such as emery cloth or sand paper. When the piston is badly corroded, the whole chamber should be replaced.

The parts of the measuring chamber which may show wear after long periods of service are the diaphragm and control roller. These parts will not require replacement until the accuracy begins to fall off at low rates of flow. To change these parts, merely substitute the new for the old, when the flowmeter has been taken down for cleaning. Experience has shown that the sliding surfaces between the chamber and piston wear little if any.

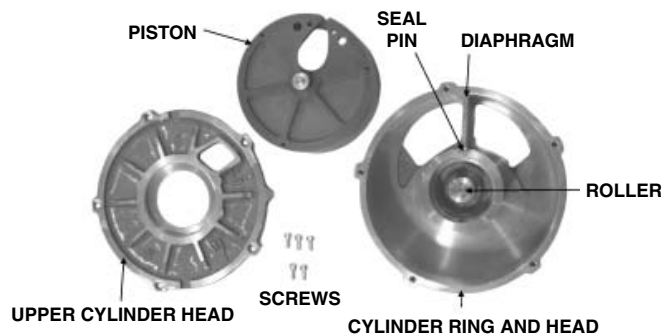


FIGURE 18
MEASURING CHAMBER ASSEMBLY



FIGURE 19
CHECKING THE PISTON MOVEMENT

To Reassemble the Chamber in the Flowmeter

Before reassembling the flowmeter, rinse all parts in a petroleum solvent. 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 clean and free from nicks.

1. Assemble the diaphragm to the lower cylinder head.
2. Replace the seal pin. Place the control roller on its pin and see that it will rotate freely.
3. Replace the piston and oscillate it carefully by hand; it should move easily without binding. If it sticks, do not force it, but remove and locate the cause. Do not file down the roller as this will impair the accuracy of the flowmeter.

Measuring Chamber Cleaning and Inspection

To Reassemble the Chamber in the Flowmeter

4. Replace the upper cylinder head and again oscillate the piston to make sure that it is free.
5. When replacing the measuring chamber in the casing, be sure that the seat is clean and free from nicks. Make sure that dowel pin in the main casing enters the slot in the bottom cylinder head properly and allows the chamber to rest on its seat.
6. Before replacing the cover, first be sure the chamber is properly seated and inspect the gasket. Then set the arm of the gear train so that it will not come down on the piston spindle.
7. Make sure that the cover is down on its seat before tightening the bolts.

D. GEAR TRAIN MAINTENANCE (General)

The Actaris 2" Type 4-MT, MTSC and Type 4D-MT have the same gear train design and metallurgy. The procedures for repair and replacement of these gear trains are exactly the same.

To Repair Leaking "U" Cup Seal Stuffing Box

Keep dirt out of register and avoid injury to gasket.

Remove the register. If tightening the stuffing box nut with the fingers does not stop this leak, replace "U" cup shaft seal. It may also be necessary to replace "U" cup shaft seal and to replace the gear train.

1. Remove the register. On flowmeters with compensator, disassemble to compensator. On flowmeters without compensator, remove the register and the flowmeter cover.
2. Remove the star connection (1), using a No. 8 Allen wrench.
3. Unscrew the stuffing box nut (2).
4. Remove shaft seal (3). Inspect upper end 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. Remove the clamp nut (6); gear train assembly can be removed from underside of flowmeter cover or compensator.
5. Replace shaft seal with new part. Be sure expander (4) and spring (5) are in position before inserting new seal.
6. Assemble nut and tighten down all the way.

To Replace Gear Train

1. Remove the register.
2. Remove the star connection (1), using a No. 8 Allen wrench.
3. Remove the flowmeter cover, with gear train assembly attached. Keep dirt out of flowmeter and avoid injury to the cover gasket.
4. Unscrew the stuffing box nut.
5. Remove clamp nut (6); gear train assembly can be removed from underside of flowmeter cover.

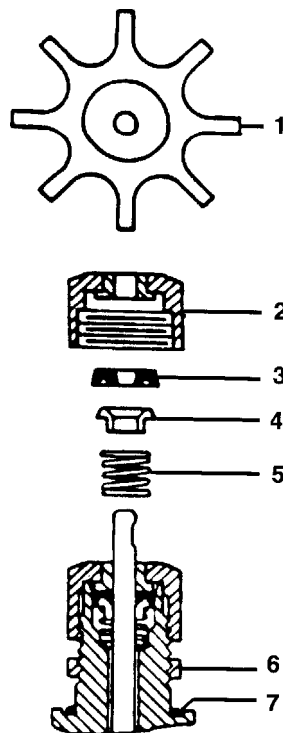


FIGURE 20
GEAR TRAIN ASSEMBLY

GEAR TRAIN MAINTENANCE To Repair Leaking "U" Cup Seal Stuffing Box

To Replace Gear Train

E. TEMPERATURE COMPENSATOR MAINTENANCE (General)

Most 2" Type 4D-MT LP-Gas meters are purchased with temperature compensation devices, also called ATC. Some 2" Type 4-MT petroleum meters are also being purchased with ATC, mostly in areas where the local W&M authority permits the temperature compensated delivery of petroleum products. The information following may be used for maintenance of ATCs on either type of meter.

The Compensator is designed to give long and dependable service when properly installed. The unit has been thoroughly performance-tested prior to shipment, and in normal service requires no further lubrication.

Maintenance of the compensator should be limited to those operations outlined below. If it becomes apparent that the unit is in need of repair, the compensator should be returned to the nearest authorized Actaris distributor.

To Remove Compensator

1. Remove the register.
2. Remove cover bolts at the base of the compensator and lift the unit off, taking care not to damage the gasket.

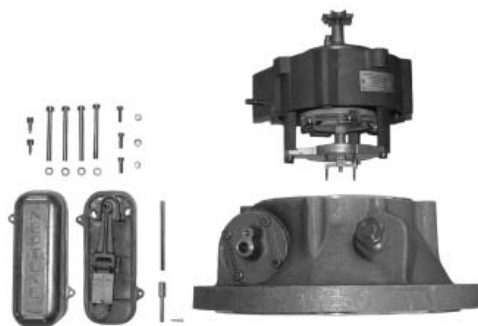
To Replace Compensator

1. Mount the compensator with the cover toward the front of the flowmeter. Care should be exercised to set arm of compensator gear train so that it will not come down on top of the piston spindle.
2. Make sure that compensator is down on gasket before tightening bolts.
3. Tighten all bolts (NOTE: See Torque Requirements and anti-seize compound recommendations on Page 29).

To assemble a compensator on uncompensated flowmeters follow above steps after first removing main case cover and replacing gasket, if necessary. Re-use bolts taken from main case cover.

To Remove Compensating Mechanism

1. Remove two seal screws and take off "Neptune" cover.
2. Withdraw anchor pin after removing cotter pin.
3. Remove three screws and take off lever arm plate.
4. Remove four screws around top edge of compensator and lift off upper housing.



**FIGURE 21
AUTOMATIC TEMPERATURE
COMPENSATOR COMPONENTS**

TEMPERATURE COMPENSATOR MAINTENANCE

To Repair Compensator

To Remove Compensator

To Replace Compensator

To Remove Compensating Mechanism

To Replace Thermostat

1. Perform Steps 1–3 found under “To Remove Compensating Mechanism.”

CAUTION

Before opening any part of the flowmeter, close valve between supply tank and flowmeter. Disconnect coupling vent line at vapor release cover. Perform the following outdoors, away from building or sources of ignition:

Open valve slowly at end of delivery hose or other outlet piping. After pressure is dissipated unscrew Vent Valve (hex. nut) slowly (maximum 3 turns) on top of Vapor Release to depressurize product in flowmeter.

2. Remove four screws and lift off thermostat cover.
3. Lift out thermostat being careful not to damage thermostat gasket.

F. PETROLEUM METER MAINTENANCE

1. DOUBLE TRIP MAINTENANCE (PETROLEUM METERS)

To Disassemble and Assemble Double Trip Valve

1. Remove valve from flowmeter.
2. Remove two screws (A) holding retaining ring (B) at inlet of valve. (Caution: End plate should be held by hand when removing screws because of spring tension beneath the plate.) All internal parts of the valve can now be removed with the exception of the operating shaft mechanism. The removal of the internal parts from the valve body may be assisted by operating the valve handle as when operating the valve.
3. Disassemble piston and throttling ring assembly (items F to K). Inspect valve seats, “O” ring gaskets, piston ring (D), and cylinder (C) for damaged surfaces. Replace all defective parts with new parts.
4. Reassemble piston and throttling ring assembly. Apply Loctite Black Max 380 to bond the disc (G) to the piston (F), and allow 24 hours to cure before placing in service. Apply Loctite Threadlocker 242 under heads of three piston assembly screws (H).
5. Assemble pilot valve (E) on pilot valve rod (J). Place assembly into valve body.
6. Place one end of spring over pilot valve boss.
7. Place other end of spring over boss in cylinder (C) and press cylinder down over piston (F). Back of cylinders should be below flange face for proper assembly.
8. Hold cylinder in place, place “O” ring in body recess and attach retaining ring (B) with two screws (A).
9. Open valve as far as possible — make sure that valve is not being stopped by set screw (L).

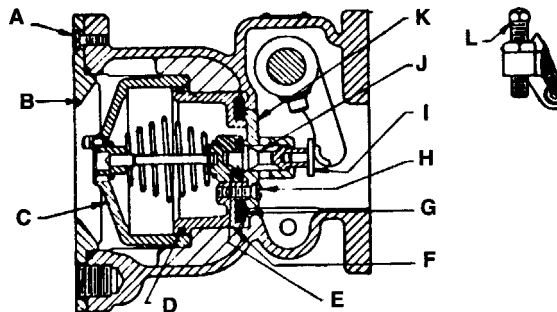


FIGURE 22
VALVE ASSEMBLY

To Replace Thermostat

DOUBLE TRIP MAINTENANCE

To Disassemble and Assemble Double Trip Valve

2. OPERATING SHAFT MAINTENANCE (PETROLEUM METERS)

To Inspect Operating Shaft Seals of Preset Valve

The following steps should be followed if it becomes necessary to disassemble the operating shafts because of leakage. Shaft seal cannot be corrected by tightening of the bearing bracket screws. In this case new "O" rings are usually required. (See parts list for 2" Type 1A Double Trip Preset Valve.)

1. Remove valve handle (A), connecting rod arm, (I), two stop plates (B) and (H) and two roll pins (C). Remove eight screws and pry off two shaft bearing brackets (D). Do not damage gaskets (G).
2. The two "O" ring seals (E) can be inspected for damaged surfaces. Replace any defecting "O" rings.
3. To remove the operating shaft (J) and two shaft bearings (D), first remove the two screws in the valve operating cam (K). Inspect the shaft for score marks and replace if necessary. New "O" ring seals are worthless if used with a badly scored shaft.
4. Remove retainer (F), replace "O" rings (G) and reinstall shaft bearings (D).
5. Reassemble the operating shaft and cam.
6. Replace rings, flat gaskets, two roll pins, two stop plates, connecting rod arm and valve handle.

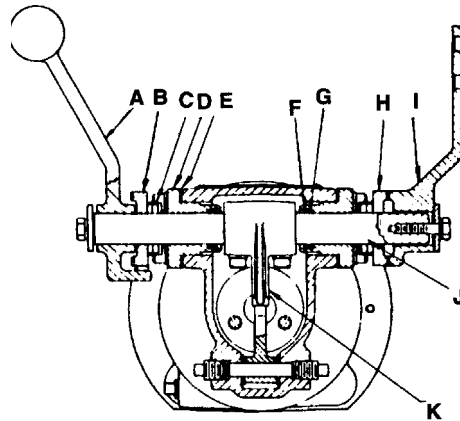


FIGURE 23
SHAFT ASSEMBLY

3. AIR RELEASE MAINTENANCE (PETROLEUM METERS)

General Note — "O" Ring Gaskets

1. The groove in which the "O" ring is located must be free of dirt.
2. The flat face against which the "O" ring seats must be clean and free of nicks or dents which will allow pressure to leak between the gasket and the metal.

Optional Adjustable Back Pressure Valve

The 2" Type 4-MT back pressure valve is designed as an adjustable two position valve. The valve is factory set at 7.5 psi cracking pressure for most applications including gasoline, fuel oil, and other light oils. It is recommended that this lower setting be used to reduce strain on the system. For special applications, such as lube oils or other heavy oils, it can be easily adjusted in the field to 15 psi cracking pressure by compressing a spring and inserting a cotter pin at the pre-defined location. It is important to note that the higher cracking pressure will significantly reduce the flow rate.

This compact valve adds only $\frac{1}{4}$ " to the height of the meter, without adding to lay length or requiring additional connections. It is designed to add back pressure to the meter to increase air elimination during split compartment testing. In some applications, however, the increase in back pressure may increase spitting, so special consideration of individual conditions should be used before installing this valve.

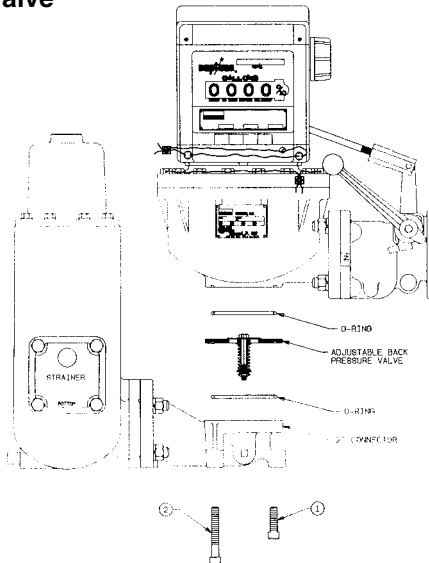
OPERATING SHAFT MAINTENANCE To Inspect Operating Shaft Seals of Preset Valves

AIR RELEASE MAINTENANCE

General Note — "O" Ring Gaskets

To Install Adjustable Back Pressure Valve

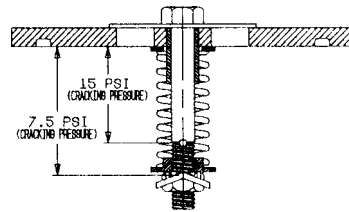
1. Remove existing socket head cap screws (1) and (2).
2. Carefully separate the top half of the meter from the 2" connector as shown in illustration.
3. After properly setting the back pressure valve to the desired cracking pressure, (see Fig. 25 for adjustment instructions), insert O-ring into groove on under side of back pressure valve as shown in illustration and then align back pressure valve onto the 2" connector.
4. Insert second O-ring into groove on under side of maincase and carefully set maincase onto back pressure valve plate, aligning holes properly so that new socket head cap screws can be reinstalled.



**FIGURE 24
BACK PRESSURE VALVE**

Adjusting the Adjustable Back Pressure Valve

1. As shown in drawing, the valve is set at 7.5 psi (cracking pressure). This is done by turning the slotted hex nut which compresses the spring until the end hole position is located and secured with the cotter pin.
2. The valve may also be set at 15 psi (cracking pressure) by turning the slotted hex nut which compresses the spring until the second hole position is located and secured with the cotter pin.



**FIGURE 25
BACK PRESSURE VALVE**

To Remove Standard Back Pressure Valve

The back pressure valve is located at the bottom of the air release and strainer unit. To remove it:

1. Remove air release and strainer unit from the line by unbolting at inlet and outlet flanges.
2. Remove both strainer sleeves and air release valve.
3. Hold block of wood (2⁵/₁₆" diam.;;) against back pressure valve by inserting it through the top of the housing and knock the valve out.

G. LP-GAS METER MAINTENANCE

1. DIFFERENTIAL VALVE MAINTENANCE (LP-GAS METERS)

CAUTION

Before opening any part of the flowmeter, close valve between supply tank and flowmeter. Disconnect coupling vent line at vapor release cover. Perform the following outdoors, away from building or sources of ignition:

Open valve slowly at end of delivery hose or other outlet piping. After pressure is dissipated unscrew Vent Valve (hex. nut) slowly (maximum 3 turns) on top of Vapor Release to depressurize product in flowmeter.

To Install Adjustable Back Pressure Valve

Adjusting the Adjustable Back Pressure Valve

To Remove Standard Back Pressure Valve

DIFFERENTIAL VALVE MAINTENANCE

To Disassemble

1. Remove connecting tube at top of unit.
2. Remove 10 of the 12 cover bolts leaving 2 screws on opposite sides in place.
3. Slowly remove last 2 screws while holding cover down to oppose internal spring.
4. Disassemble diaphragm assembly as necessary to replace parts.

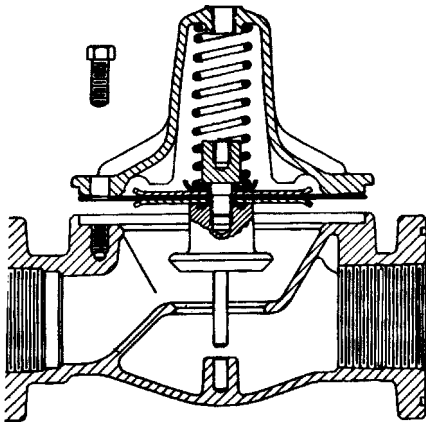


FIGURE 26
DIFFERENTIAL VALVE

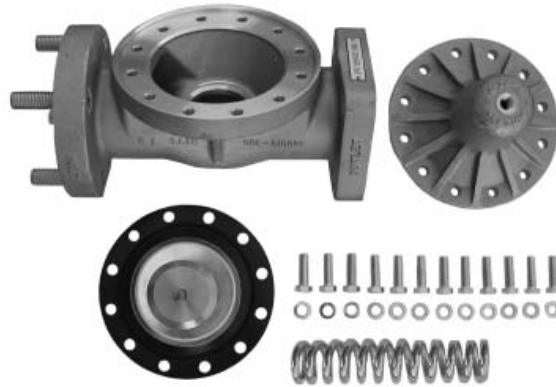
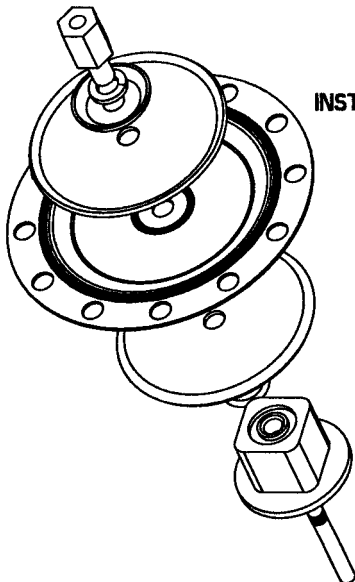


FIGURE 27
DIFFERENTIAL VALVE COMPONENTS

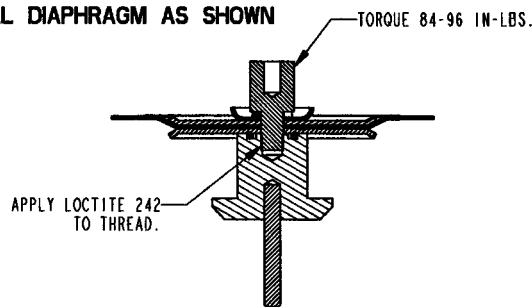
To Reassemble

1. Assemble diaphragm assembly.
2. Insert spring and diaphragm assembly into cover.
3. Align bolt holes in diaphragm with those in cover using 2 screws on opposite sides, and engage threads of screws.
4. Mount cover assembly on valve body and assemble and tighten 12 screws evenly.; Do not exceed 18 ft-lbs. torque, using a star tightening pattern. **Then retighten torque specification in a circular pattern.**
5. Install connecting tube to elbow fitting.

Diaphragm



INSTALL DIAPHRAGM AS SHOWN



NOTES:

1. IF EXISTING DIAPHRAGM ASSEMBLY HAS PERMATEx FORM-A-GASKET ON BOTH SIDES OF DIAPHRAGM, THEN APPLY A SMALL AMOUNT OF PERMATEx FORM-A-GASKET TO BOTH SIDES AROUND CENTER HOLE OF NEW DIAPHRAGM.
2. IF EXISTING DIAPHRAGM ASSEMBLY HAS NO PERMATEx FORM-A-GASKET ON DIAPHRAGM, THEN NEW REPLACEMENT DIAPHRAGM DOES NOT REQUIRE PERMATEx FORM-A-GASKET.

To Disassemble Differential Valve

To Reassemble Differential Valve

Installation of Diaphragm

VI. TROUBLESHOOTING

A. LP-GAS METERS

1. 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.

2. Leakage at the Stuffing Box

Worn shaft seal or spindle.

3. Chronic Leakage at the Main Case Gaskets

Dirty or defective seat or excessive shock pressure.

Defective gasket or loose bolts.

4. 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.

Note: The pump must have sufficient capacity and efficiency 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 of bypass relief valve or restriction in suction line.

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 build up 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.

Pressure build-up on vent line.

5. Under-Registration — Erratic

Dirt in the measuring chamber.

Badly worn control roller or diaphragm.

Main casing damaged.

Dirt under seat of measuring chamber (after cleaning).

6. Over-Registration — Erratic

Diaphragm in differential pressure valve ruptured.

Vapor release valve remaining closed, allowing vapor to pass through flowmeter.

7. Consistent Over- or Under-Registration

Flowmeter in need of calibration.

8. Printing Not Clear in Cold Weather

Ticket carbon not suitable for cold weather use.

B. PETROLEUM METERS

1. Register Not Working When Liquid is Flowing

Bypass around flowmeter not shut off.

Ice inside register.

-
- Loose register driving arm.
Register in need of repair.
Sheared key on Change Gear — caused by ice in register.
- 2. Leakage at the Stuffing Box**
Worn shaft seal or spindle.
- 3. Chronic Leakage at the Main Case Gaskets**
Excessive line or shock pressure.
Defective gasket or loose bolts.
- 4. Reduction in the Rate or Complete Stoppage of Flow**
Pump bypass stuck open.
Air release valve fails to close allowing liquid to escape through the air vent.
An open valve in piping allowing liquid to circulate around pump.
Worn pump.
Blocked strainer due to sediment or frost.
Piston in flowmeter stuck, caused by dirt. Check strainer and clean measuring chamber.
On gravity operation back pressure valve not removed from air release unit.
- 5. Under-Registration — Erratic**
Dirt in the measuring chamber.
Badly worn control roller or diaphragm.
Flowmeter casing distorted or damaged.
Dirt under seat of measuring chamber at the outlet port (after cleaning).
Leakage around the flowmeter due to partly open valve.
On gravity systems leakage around the flowmeter throughout the air vent line.
- 6. Over-Registration — Erratic**
Leaking valve in empty compartment causing an emulsion of air and liquid.
Air release valve jamming, allowing air to pass through the flowmeter.
Vent line from the air release valve plugged causing air to pass through the flowmeter.
Leaks in the suction line such as at valve stems, pump packing or flange gaskets.
Air pockets in closed-end piping in the suction line.
Manifold or compartment valves only partly open causing excessive suction.
Suction piping too small causing excessive suction.
- 7. Consistent Over- or Under Registration**
Flowmeter in need of calibration.
- 8. Liquid Leaking Out of the Air Release Vent**
Improper operation.
Worn, damaged or defective valve unit.
- 9. Printing Not Clear in Cold Weather**
Ticket carbon not suitable for cold weather use.
- 10. Valve Will Not Latch Open**
Adjust valve connecting link.
- 11. Cut Off is Not Accurate/Preset Valve Closes Too Soon**
Adjust the tripping point.
Adjust valve linkage.
- 12. Preset Valve Fails to Close**
Dirt in valve piston.
Improper linkage.
-

Torque Requirements

The 2" Type 4-MT, MTSC and 4D-MT primary components (maincase, air/vapor release and valves) are made of cast aluminum alloy. The bolts used to assemble these components are made of steel, with a special zinc plating to help resist corrosion. Aluminum is lightweight and durable for this truck delivery application; however aluminum is sensitive to bolt and component overtorquing and overtightening. To avoid problems associated with these conditions, follow the guidelines given below for all bolt tightening for these two meters:

BOLT SIZE AND THREADS PER INCH	TORQUE	
	IN .-LBS.	FT.-LBS.
7/16-14	264-336	22-28
3/8-16	264-336	22-28
5/16-18	144-192	12-16
1/4-20	96-144	8-12

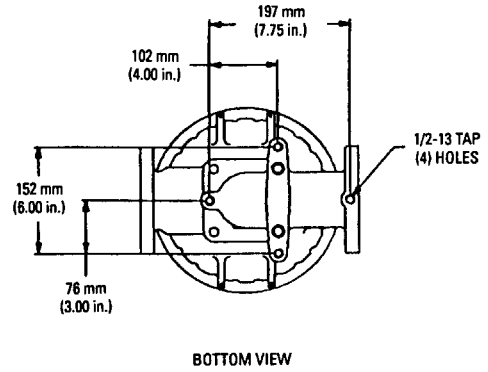
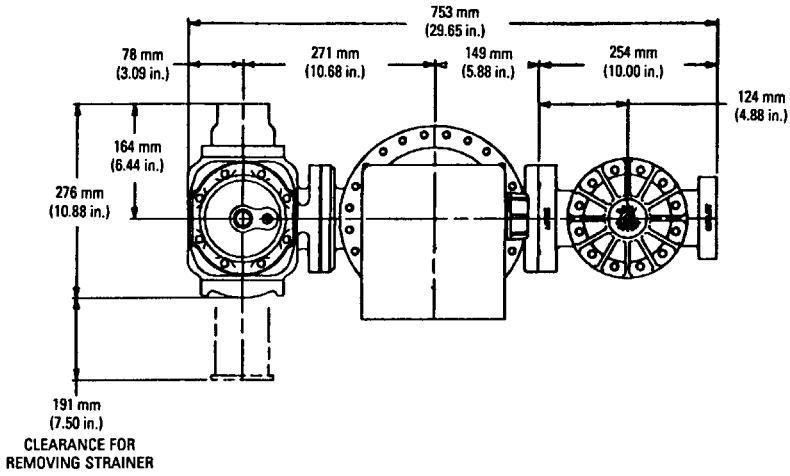
Aluminum itself is relatively impervious to corrosion, much more so than cast iron or non-stainless steel alloys. To prevent possible seizing of the bolts, Loctite® Anti-Seize Thread Compound No. 767 is applied to bolts during the factory assembly of the meter.

Make sure that this or equivalent anti-seize compound is used when the meter parts are reassembled after service to prevent bolt seizing.

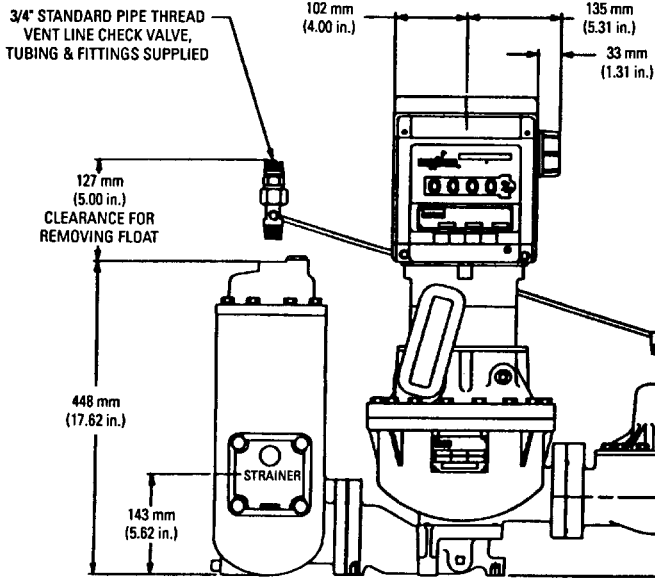
NOTE: Vent line check valve should be assembled with loctite 567 thread sealant or equivalent at a torque of 25-35 ft.-lbs.

**Torque Requirements for Bolts
Used in 2" Type 4-MT and Type
4D-MT Aluminum Meters****Recommended
Anti-Seize Compound**

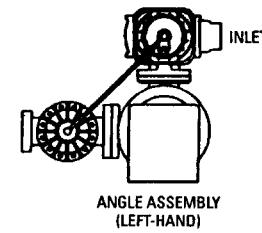
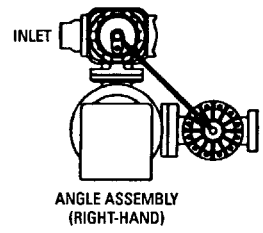
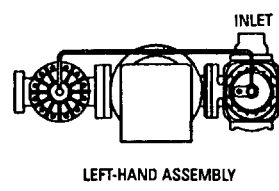
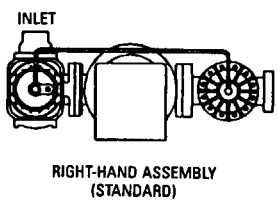
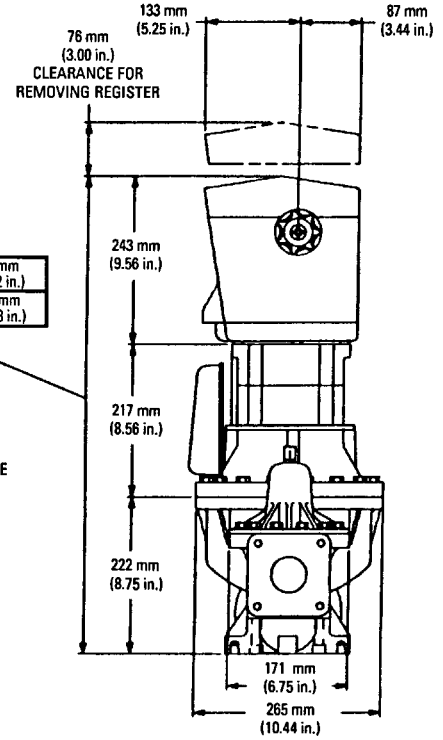
2" TYPE 4D-MT LP-GAS METER DIMENSIONAL INFORMATION



3/4" STANDARD PIPE THREAD
VENT LINE CHECK VALVE,
TUBING & FITTINGS SUPPLIED

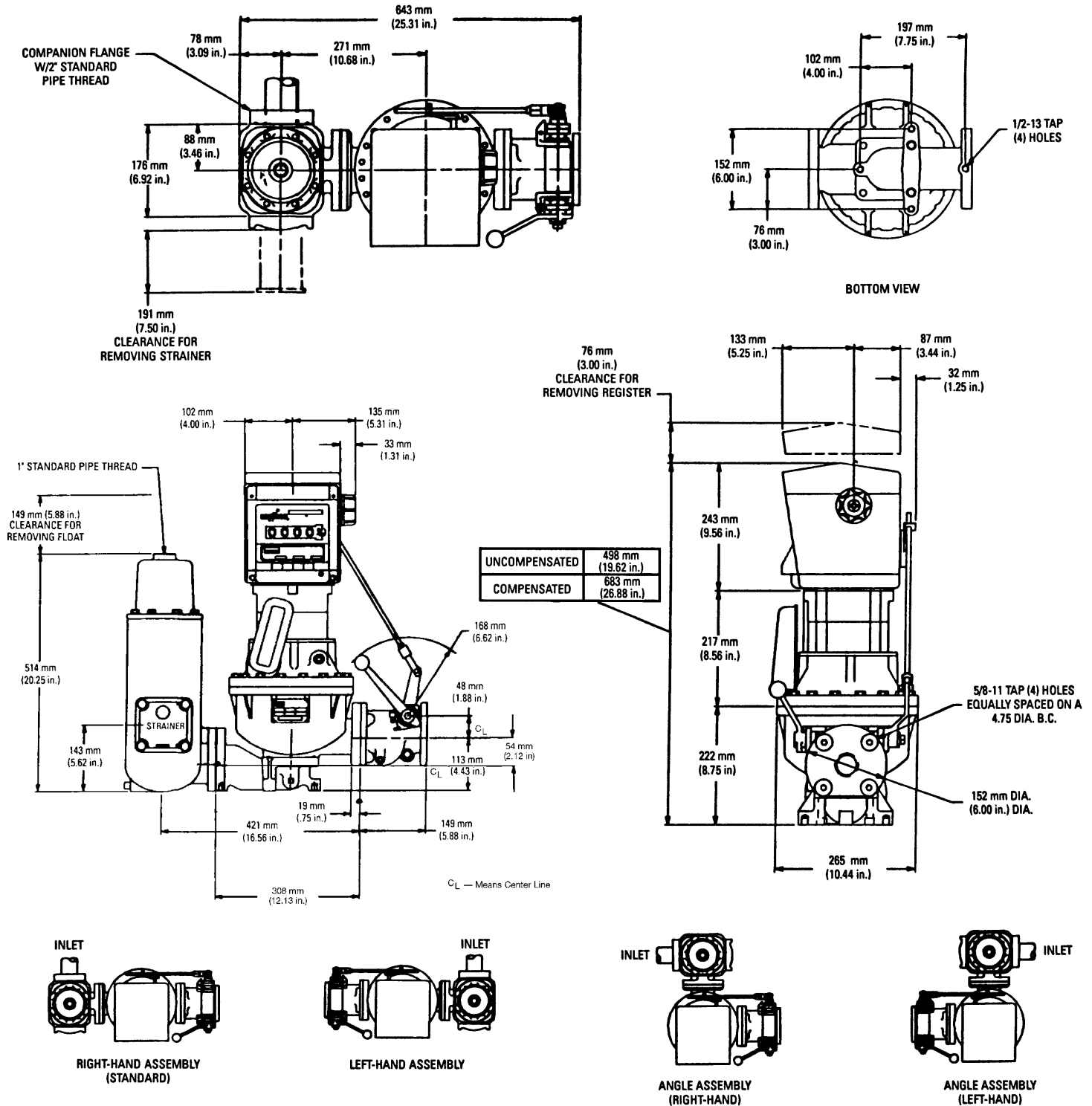


UNCOMPENSATED	498 mm (19.62 in.)
COMPENSATED	683 mm (26.88 in.)



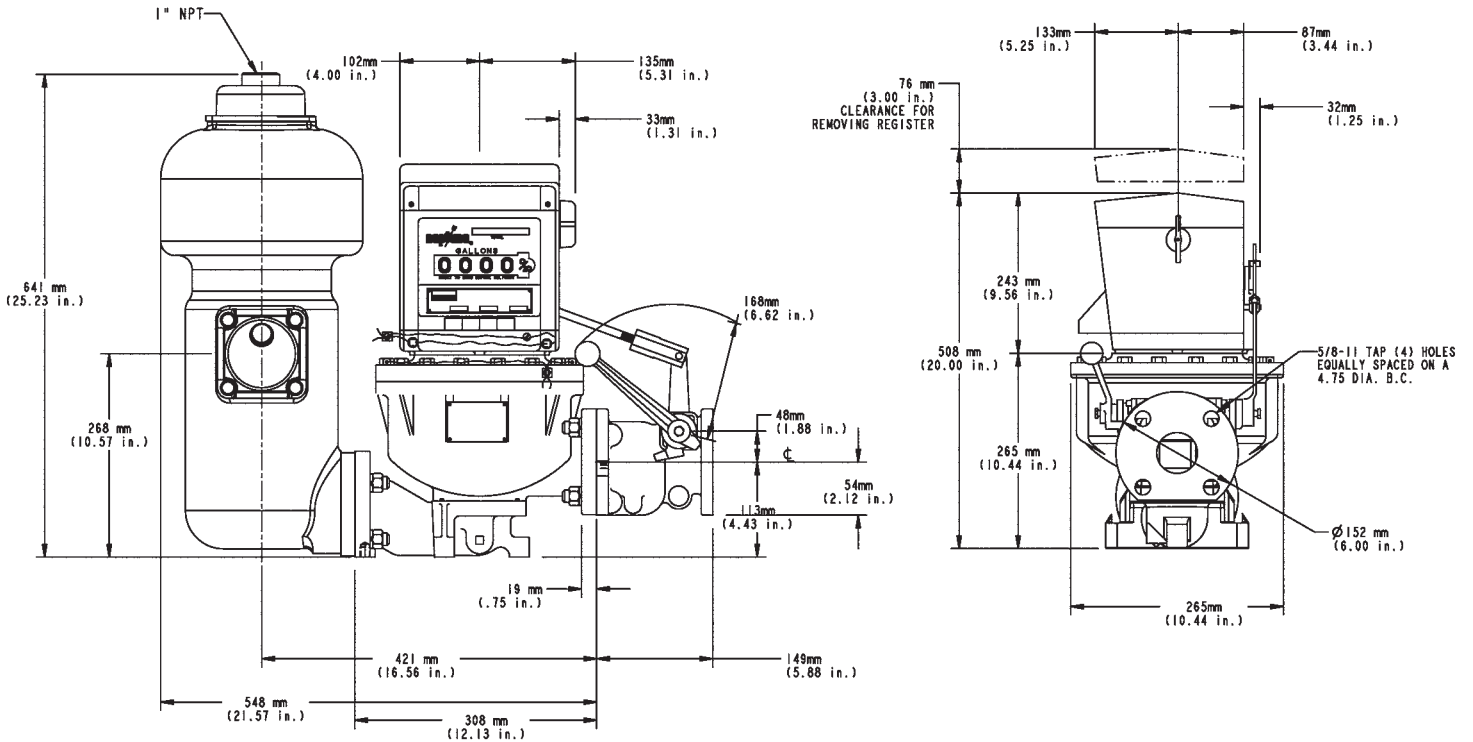
Accuracy of all Actaris Type 4D Custody Transfer Meters for use with LP-Gas and Butane meets or exceeds U.S. Department of Commerce Standards Division Handbook 44 Parameters.

2" TYPE 4-MT PETROLEUM METER DIMENSIONAL INFORMATION



Accuracy of all Actaris Type 4 Custody Transfer Meters for use with Petroleum Products meets or exceeds U.S. Department of Commerce Standards Division handbook 44 Parameters.

2" TYPE 4-MTSC PETROLEUM METER DIMENSIONAL INFORMATION



4028 - 7th Street S.E., Calgary Alberta T2G 2Y8
 Phone: (403) 243-1425 Fax: (403) 243-6577
 Toll Free: 1-800-921-ACCU(2228), sales@accuflo.com

U.S.A./International
 1310 Emerald Road
 Greenwood, SC 29646-9558
 Tel.: Toll-Free (800) 833-3357
 (864) 223-1212
 Fax: (864) 223-0341



RED SEAL
MEASUREMENT

Specifications subject to change without prior notification.