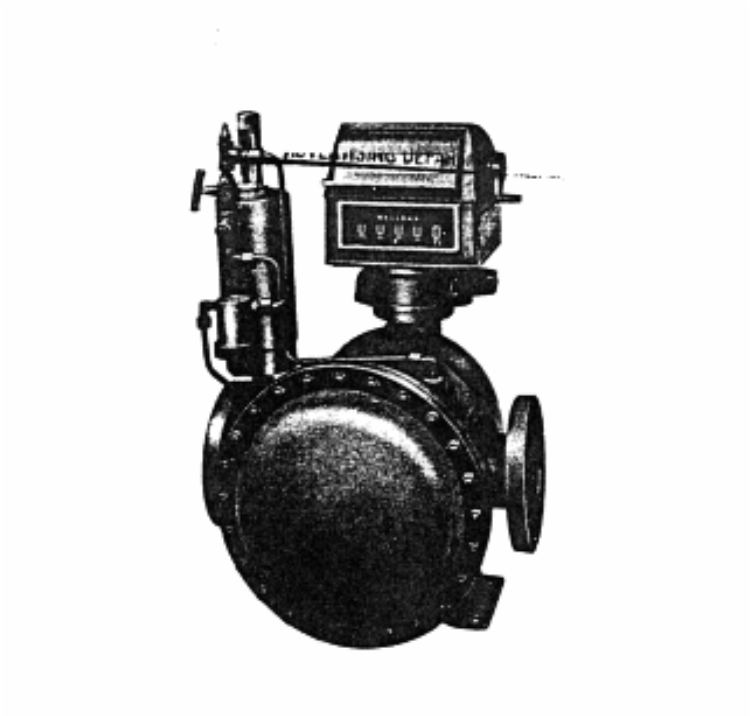
(S) X-(B-173DEB)

INSTALLATION &OPERATING INSTRUCTIONS	APL BiRotor Meters Models B 173-DEB thru B 195-DEB

Revision 01

Automatic Pressure Lubricated Meters



GUARANTEE

If at any time within one year after shipment but not thereafter it is proved that any part of the equipment furnished by us was defective when shipped by us we will replace the same free of charge F. O.B. our plant. Notice of this claim must be made to us within one year after delivery. Our liability is limited to replacement of such defective parts or equipment. There are no guarantees or warranty expressed or implied other than those herein specifically mentioned.

Brodie Meter Co., LLC shall not in any event be liable for any consequential damages, secondary charges, expenses for erection or disconnecting, or losses resulting from any alleged defect in the apparatus.

It is understood that corrosion or erosion of materials is not covered by our guarantee.

CAUTION: It is recommended that this publication be read in its entirety before performing any operation. Failure to understand and follow these instructions could result in serious personal injury and/or damage to the equipment.

Should this equipment require repair or adjustment, contact the nearest District Sales Office. It is important that servicing be performed only by trained and qualified service personnel. If this equipment is not properly serviced, serious personal injury and/or damage to the equipment could result.

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Section 1 INTRODUCTION

1-1 General

The Automatic Pressure Lubricated (APL) BiRotor Meter, hereafter called meter, is a precision made, accurate instrument which uses the positive displacement metering principle to measure flow and is designed to meter liquids with low lubricity such as butane, propane, ethane, natural gasoline or liquids with entrained solids such as crude oil.
Long life and low maintenance are assured with the automatic pressure lubricated system, hereafter called APL, which provides constant clean lubricant to the ball bearings, timing gears and register drive gears of the measuring unit. Bearing and gears are isolated from the flowing stream by mechanical seals

1-2 Description

Meter Assembly

The meter generally consists of four basic components: a measuring unit installed in an outer housing case; the APL unit to provide bearing and gear lubrication; an adjustor for calibrating the meter; and the necessary counter equipment for registering the amount of liquid throughput.
The principle of operation of the meter is embodied in the function of the two rotors which are the only moving parts within the measuring units. They are always dynamically balanced but hydraulically unbalanced. The rotors are not in metal-to-metal contact with one another or with the housing in which they rotate. They are maintained in proper timed relationship with one another by helical gears. They divide the volume being measured into segments, separate each segment from the flowing stream momentarily, then return them to the stream. The segments of flow are counted and the results are transferred to a totalizing register or other flow recording device by means of a gear train.

The BiRotor Meter is unique in that it does not use any sliding vanes or reciprocating parts nor are there any shock loads on the mechanism during operation resulting from the shifting of off-balance masses. An accuracy adjustor, located on the output shaft of the counter drive gearing permits the operator at the time of installation, to adjust the output of the measuring unit to read in an exact number of units of volume. Thus the accuracy adjustor acts as a variable gear changer (similar to the speeding up or slowing down of the timing of a watch) and allows an adjustment of + 3% of meter throughput. The meter may be supplied with any of several accessory items, such as, two stage valve, preset register, high frequency pulse generator, impulse contactor, automatic temperature compensator (ATC), etc. The units provide various functions for local and/or remote control and local and/or remote readout.

NOTE: Before placing the meter into service, refer to the appropriate instruction manual for these accessory units if the meter is so equipped.

The meter has an integral positive lubrication system (APL) to supply constant clean lubricant to the meters bearings, timing gears, counter drive gears and O-rings. The two rotors are the only moving parts subject to the flowing stream. The APL system as illustrated in Figure 1-1 is composed of a hydraulic cylinder, relief valve, needle valve, filling fitting and mechanical isolating seals.

Hydraulic Cylinder

The hydraulic cylinder incorporated in the APL unit acts as a lubricant reservoir and a segregating element between the product being metered and the lubricant. It contains a piston and a rod that extends through the cylinder top for visual indication of the lubricant level. Upstream pipeline pressure (meter inlet) is applied to the side of the piston opposite the lubricant supply, thus pressurizing the lubricant to a value equal to or slightly greater than the internal meter pressure.

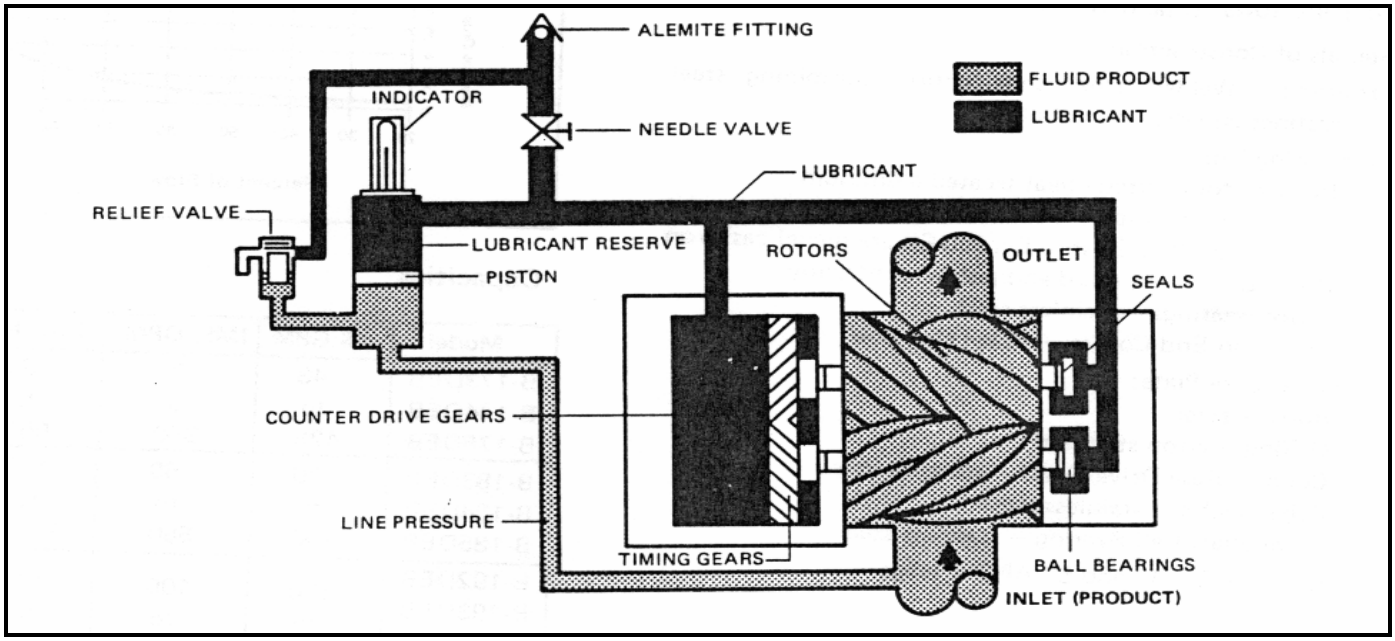


Figure 1-1 APL Principle of Operation Diagram

Relief Valve

The relief valve incorporated in the APL unit serves to protect the meter from excessive pressure when charging the APL system with lubricating oil. This valve will open releasing a small amount of lubricant to atmosphere should the lubricant pressure exceed pipeline pressure by 30 psi (206.8 kPa).

Crane Seals

Mechanical seals located on the rotor shaft between the rotor and rotor bearings, segregate the lubricant from the product being metered. The seals are characterized by their ability to remain effective seals at little or no differential pressure and by their low torque requirement. The low torque characteristic is an important factor in providing accurate metering.

Needle Valve and Lubricant Fitting

The needle valve is utilized only when necessary to refill the APL with lubricant. A hand pump may be attached to the lubricant fitting, the system with lubricant oil. This may be accomplished located between the needle valve and relief valve, for recharging while the system is under pressure.

1-3 Meter Model Number

The model number, serial number, flow range and operating pressure appear on the nameplate attached to the meter body.

1-4 Specifications

The following specifications apply to the meter unless otherwise noted.

CAUTION: Do not use this meter in excess of the below specified values

Specifications (Standard Meters)

Materials of Construction:

Housing: Welded steel construction combining steel castings and drawn steel plate.

Measuring Unit:

Rotors: four fluted - heat treated aluminum three lobe heat treated aluminum, except B-192DEB thru B-195DEB are nickel cast iron

Rotor Shafts—ground and polished nitralloy

Rotor Bearings—stainless steel

Body and End Covers—nickel cast iron

Counter Base Plate:

Body—steel

O-Ring—viton standard

Counter Base Drive Gears—stainless steel

Drive Shafts—stainless steel

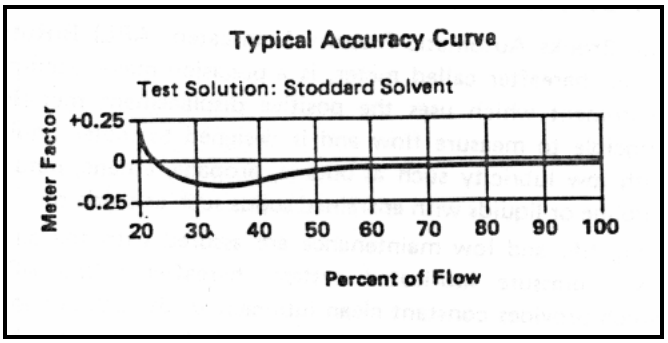
Drive Shaft Ball Bearing—stainless steel

Connections—3", 4" and 6" ANSI Flange

Ratings

Product Temperature Range: -20°F to +150°F
-29°C to +66°C

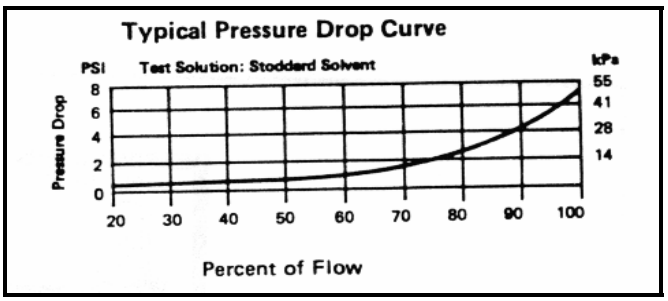
Performance



Connections - Maximum Safe Working Pressure

Model	Flanges (ANSI)	Maximum Safe Operating Pressure
B-173DEB	3" 300 lb.	300 PSI (2068 kPa)
	3" 150 lb.	275 PSI (1896 kPa)
B-174DEB	3" 300 lb.	720 PSI (4964 kPa)
B-175DEB	3" 600 lb.	1440 PSI (9928 kPa)
B-183DEB	4" 300 lb.	300 PSI (2068 kPa)
	4" 150 lb.	275 PSI (1896 kPa)
B-184DEB	4" 300 lb.	720 PSI (4964 kPa)
B-185DEB	4" 600 lb.	1440 PSI (9928 kPa)
B-192DEB	6" 150 lb.	150 PSI (1034 kPa)
B 193DEB	6" 300 lb.	300 PSI (2068 kPa)
	6" 150 lb.	275 PSI (1896 kPa)
B-194DEB	6" 300 lb.	720 PSI (4964 kPa)
B-195DEB	6" 600 lb.	1440 PSI (9928 kPa)

Pressure Drop



Capacities

Model	US GPM	IMP. GPM	BBL/Hr.	Litres/Min.
B-173DEB B-174DEB B-175DEB	43 to 425	35 to 350	60 to 607	160 to 1609
B-183DEB B-184DEB B-185DEB	70 to 700	58 to 580	100 to 1000	265 to 2650
B-192DEB B-193DEB B-194DEB B-195DEB	120 to 1200	100 to 1000	171 to 1714	450 to 4550

Shipping Weight and Volume

Model	Shipping Weight and Volume (Approximate)
B-173DEB	305 lb. @ 11 ft (138 kg @.31 M)
B-174DEB	455 lb. @ 12 ft (206 kg @.34 M)
B-175DEB	565 lb. @ 13 ft3 (256 kg @.37 M)
B-183DEB	535 lb. @ 20 ft (243 kg @.57 M)
B-184DEB	825 lb. @ 22 ft (374 kg @ .62 M)
B-185DEB	915 lb. @ 22 ft (415 kg @.62 M)
B-192DEB	725 lb. @ 24 ft (329 kg @.68 M)
B-193DEB	835 lb. @ 29 ft (379 kg @ .82 M)
B-194DEB	1415 lb. @ 34 ft (642 kg @ .96 M)
B-195DEB	1510 lb. @ 39 ft (685 kg @ 1.10 M)

Section 2 INSTALLATION

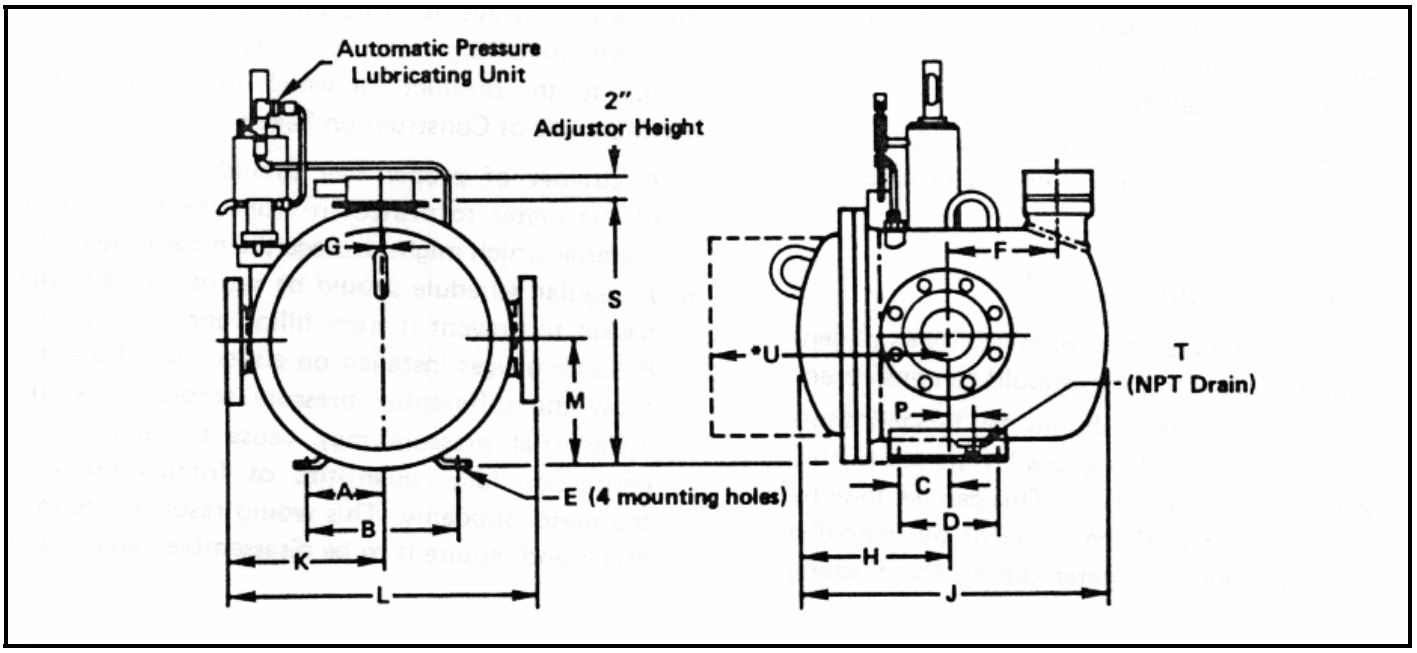
2-1 General

This section contains the procedures for receipt and installation of the meter. Specific instructions are provided for accessory equipment.

2-2 Receipt of Equipment

When the equipment is received, the outside of the packing case should be checked for any damage incurred during shipment. If the packing case is damaged, the local carrier should be notified at once regarding his liability.
A report should be submitted to the Product Service Department, Brodie Meter Co., LLC, Statesboro, Georgia 30458.
Remove the envelope containing the packing list. Carefully remove the equipment from the packing case. Make sure spare or replacement parts are not discarded with the packing material. Inspect for damaged or missing parts.

Figure 1 -2 Dimensions (For Certified dimension Prints Consult Factory)



In many cases the accessory items that form the "stack-up" of the meter have not been shipped assembled to the meter. The "stack-up" assembly will be shipped as a complete unit where possible. If not, it will be broken apart into as few assemblies as is practical. Refer to the Packing List for information as to what is supplied for your particular meter. In the event that any items are missing from your shipment, contact your local Representative or Sales Office. Provide him with the serial number and sales order number.

2-3 Return Shipment

To be able to process returned goods quickly and efficiently, it is IMPORTANT that you provide essential information. Do not return any assembly or part without an "R.M.R." (Return Materials Report) or a letter which describes the problem, corrective action (if any) and the work that is to be performed at the factory. "R.M.R." forms can be obtained from Sales Offices or the Service Department, Brodie Meter Co., LLC, Highway 301 North, Statesboro, Georgia 30458.
Place a copy of either of the above inside the shipping container and attach it physically to the material being returned. A copy of your packing list should be placed inside an envelope and attached to the outside of the shipping container or placed inside the container.
Failure to follow the above procedures could possibly result in considerable delay due to improperly or totally unidentified items.

2-4 Recommended Procedures

Prior to installation of the meter, the following items of general information and recommendations should be considered:

1. On new installations the lines should be flushed thoroughly to rid the pipe of welding bead, pipe scale, etc., before the meter is placed in service. This can be done by using a spool-piece in place of the meter or by removing the measuring unit from the meter during the flushing operation.
2. It is recommended that the meter be mounted in a position that will allow sufficient clearance for removal of the measuring element.
3. All counters can be rotated and secured in any of eight positions.
4. Flow direction is marked on the meter case, near the inlet flange.
5. Install a strainer ahead of the inlet of the meter.
6. The meter may be mounted either horizontally or vertically, but should be level for proper and specified operation. The rotors in the measuring element must be in a horizontal position.
7. Shut-off or control valves should be located downstream of the meter.
8. Do not use guide wires or stabilizing ropes on any part of the stack-up. Some stack-ups will require support by use of support blocks and brackets secured to structural members.
9. Block valves located upstream and downstream of the meter are recommended to isolate the meter from fluid flow.

Section 3 OPERATION

CAUTION: Do not operate this meter in excess of the values listed in Section 14 Specifications.
3-1 General

1. When the meter is first put into operation, or at any time the meter has been drained, it should be started slowly until all air has been exhausted from the outer housing.
2. To prevent high shock pressures or surges, care should be exercised in opening or closing valves when starting or stopping flow through the meter.
3. On new installations, the lines should be flushed thoroughly to rid the pipe of welding bead, pipe scale, etc., before the meter is placed in service. This can be done by using a spool piece in place of the meter.
4. If the meter has been installed before the flushing operation, then measuring unit should be removed from the outer housing while the meter is being flushed.

NOTE: Failure to perform the above procedures could result in serious damage to the meter.
Water should never be used as a flushing medium through this meter. Always use a flushing medium that is compatible with the metallurgy of the meter, its internal parts, and similar to the product for which this meter was intended. See Materials of Construction Page 4.

5. A strainer of proper size should be installed upstream of the meter to protect it from the entrance of foreign material which might damage the measuring unit.
6. A regular schedule should be set up to clean the strainer basket to prevent it from filling and rupturing the screen. Pressure gauges installed on either side of the strainer will show the differential pressure across the strainer. High differential pressure may cause the basket to rupture, permitting large quantities of foreign matter to enter the meter suddenly. This would result in stoppage of the meter and require it to be disassembled and cleaned.

Section 4 MAINTENANCE

CAUTION: Extreme care must be exercised when the measuring chamber is exposed and handled. Hands must be kept clear of the timing gears, rotors and measuring chamber or serious personal injury can occur. Due to the precision balance of the rotors and timing gears, they can be set in motion easily. Keep hands clear of these parts at all times! At no time should hands be used to brace these parts while servicing.

4-1 General

The amount of maintenance necessary for efficient meter performance depends upon such factors as:

1. Continuity of Operation—A meter which operates almost continuously, obviously will require more attention than one on intermittent duty.
2. Rate of Flow—The practical life of any piece of equipment is proportional to its speed of operation. A meter operating at or close to its maximum rating will naturally have a shorter life than one operating at a reduced rate.

3. Lubricating Value of Product—Other factors being equal, a meter handling a light lubricating oil will have a longer life than one measuring a dry motor fuel.
4. Cleanliness of Product—Abrasive solid matter materially accelerates wear.

Meters that are given even a little attention regularly will deliver better performance and have a longer life than those that are given no attention until they have failed. Frequently, a meter's performance will depend, to a considerable extent, upon the proper functioning of the accessory equipment in the piping system. Following are listed some of the conditions and factors influencing meter performance:

a. A meter should be kept filled with the liquid it is measuring. Draining results in the formation of deposits and gums which increase the mechanical friction. Any leaky shut-off valves or check valves which would permit the meter to drain should be repaired or replaced.
b. A petroleum meter should be kept free of water. Usually, regular inspection and draining of storage tanks is sufficient protection.
c. Clean the strainer basket frequently.
d. Soft closing loading valves or shock chambers for eliminating water hammer should be kept in good working order.
e. The valves and operating mechanism of an air eliminator should be given occasional inspection. This is especially true where a critical air condition exists and for this reason, meter performance is very dependent upon proper air elimination. The valves and operating mechanism of an air eliminator are subject to very difficult operating conditions. With some products alternate wetting and drying results in gum formations. The vapors of most petroleum products are more corrosive than the liquids. In some installations salt air is a corrosive factor.
f. The counter of the meter should be given some protection during extreme weather conditions.
g. A meter taken out of service for any length of time should be filled with light lubricating oil.
h. Keep Service Bulletins available for reference.

CAUTION: Before performing any disassembly or reassembly procedures, all flow to meter should be off. All electrical connections to accessories should be disconnected. Service should be performed by trained and qualified personnel only.

i. Meter should be drained as much as possible. The design of these meters makes it possible to completely disassemble and reassemble without removing from line.

4-2 Disassembly—Meter

Cleanliness is of prime importance when working on a precision instrument. The work area should be clean and the meter parts thoroughly washed. All gaskets and O-rings should be removed and replaced. This policy will assure maximum performance from your BiRotor Meter at less expense and with greater accuracy.

Removing Measuring Unit (Refer to Complete Meter Assembly Parts Drawings - Figure 6-1)

1. Remove all accessories.
2. Remove pipe plug (item 22), drain meter and replace pipe plug.
3. Remove adjustor (item 31) and counter base plate assembly (item 27) by removing screws (items 35 and 28).

NOTE: Do not damage counter base plate gasket (item 26) when lifting off the counter base plate.

4. Lift out static seal tube (item 45) with attached O-ring (item 52) from meter housing (item 20).
5. Disconnect tubing (item 46) connected to APL Unit (item 50) and remove.
6. Remove nuts (item 16) to allow separation of housing cover (item 4) from meter housing (item 20).

NOTE: Use care not to damage front dome gasket (item 19) when separating the front dome (item 4) from the meter housing (item 20).

7. Remove tubing (item 46) attached to measuring unit (item 1) and meter housing (item 20) by disconnecting tubing at the connectors.
8. Remove screws (item 3), washer (item 42) and seal washer (item 43) attaching measuring unit assembly (item 1) to meter housing (item 20).
9. Lift measuring unit assembly (item 1) out of the meter housing.
10. The measuring unit may now be inspected. In some cases, a thorough washing in cleaning solvent or kerosene will be sufficient to free the rotors of corrosion or foreign material and the unit may be re-installed without further disassembly. In the event the rotors are blocked with solid matter, it will be necessary to remove the rotors and rear end cover assembly for further cleaning.

CAUTION: Extreme care must be exercised when the measuring unit assembly (item 1) is exposed or handled. Hands must be kept clear of all gears and rotors or serious personal injury can occur. Due to the precision of the rotors and drive gears, they can be set in motion easily. Keep hands clear of these parts at all times. At no time should the hands be used to brace these parts while servicing.

4-3 Measuring Unit Disassembly

1. Place measuring unit in wooden cradle as illustrated in Figure 4-1. Orient measuring unit with front end cover (item 4) upward.
2. Disconnect and remove tubing (item 67) attached between the front bearing caps (items 46 and/or 48) and the rear gear cover assembly (item 2).
3. Remove the two bearing retainer caps (items 46 or 48), by removing screws (item 47) and lockwashers (item 21).

NOTE: Remove gasket or O-ring (item 60) and inspect for damage.

4. Block rotors with a plastic or wooden rod as illustrated in Figure 4-1.
5. Separate bearing retainer (item 7) from end of rotor shafts by removing screws (item 8).

6. Remove ball bearings (item 6), seal retainer (item 62) and crane seals (item 57).

Figure 4-1 Typical Method for Blocking Rotors for Measuring Unit Disassembly

NOTE: Do not remove front end cover (item 4). Ball bearings (item 6) can be removed from end cover by gently tapping or pressing on the inner race of the ball bearings from inside the end cover. Use care not to damage crane seals (item 57) when removing ball bearings.

7. Rotate the measuring unit and remove screws (items 1 and 66). This will enable removing the rear gear cover assembly (item 2).
8. Remove screws (item 5) and separate rear end cover (item 15) from body (item 3).
9. The rotors and rear end cover assembly can now be washed thoroughly with solvent or kerosene and inspected. If the rotors show no evidence of contact with each other, and if the timing gears appear satisfactory, further disassembly will not be necessary.

4-4 Removing Timing Gear and Rotors

Severe scoring of the rotors or grit in the bearings may necessitate removing the rotors from the rear end cover.

1. (Measuring Unit Part Numbers 172205 and 182105) Remove screw (item 43) and locknut retainer (item 42).
2. Place a small piece of rubber between the timing gears (items 17 and 32) and remove locknuts (items 19 and 41) and lockwasher (item 40). Bend tab on lockwasher to remove locknuts.
3. Timing gears are taper fitted to the shafts and can be removed one at a time by striking the face of the gear inside the teeth with a plastic hammer. Be careful not to damage the rotor shaft threads when removing the timing gears.
4. Remove rotor spacers (item 16), ball bearings (item 6' seal retainers (item 62) and crane seals (item 53).

NOTE: Ball bearings (item 6) can be removed from end covers by gently tapping or pressing on the inner race of the ball bearings from inside the end covers. Use care not to damage crane seals (item 57) when removing ball bearings.

5. Separate rotors (items 13 and 33) from the front end cover (item 5) and remove front end cover from meter housing.

4-5 Cleaning Measuring Unit

1. Scored metal should be removed with a scraper or file. Remove only the high points and do not remove any more metal than necessary.
2. Polish rotors with crocos cloth and wash carefully in solvent or kerosene to remove all particles of grit or metal.

3, File lightly the end cover (items 4 and 15) to remove any burrs or high spots. Use fine sandpaper to remove corrosion and burrs from the surface of the bores that carry the bearings.

4. Ball bearings should be cleaned and inspected for wear.
5. All gears and shafts in rear gear cover assembly (item 2) should be inspected. Check all O-rings and gaskets for wear and replace where necessary.

NOTE: Wash all parts thoroughly in solvent, light fuel oil or kerosene. Dry thoroughly with compressed air and/or with lint free wipers.

4-6 Assembly—Measuring Unit

1. Lubricate all bearings and O-rings with a light weight oil
2. Position measuring unit body (item 3) in wooden cradle. Align port openings of the front end plate (item 4) with those of the meter body (item 3) using care to align the three locating dowel screws (item 5) with their corresponding holes. Secure the front end plate (item 4) to the body with the three dowel screws and install the socket head screws (item 12), alternating from one side to another when tightening.
3. Position crane seals (item 57) with rubber face downward into bearing bore on front end plate (item 4).

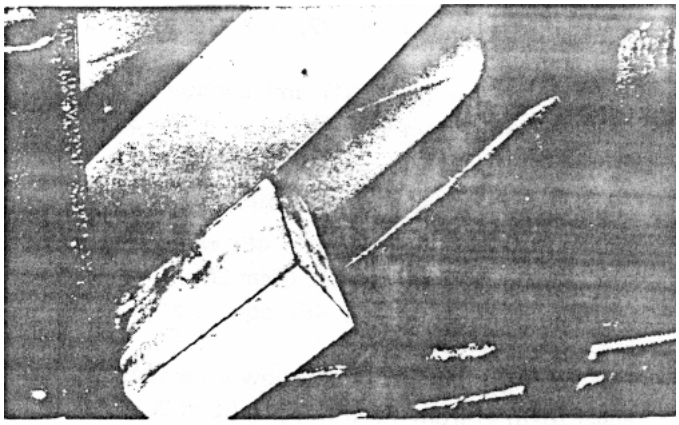
NOTE: Use care not to damage crane seals while installing.

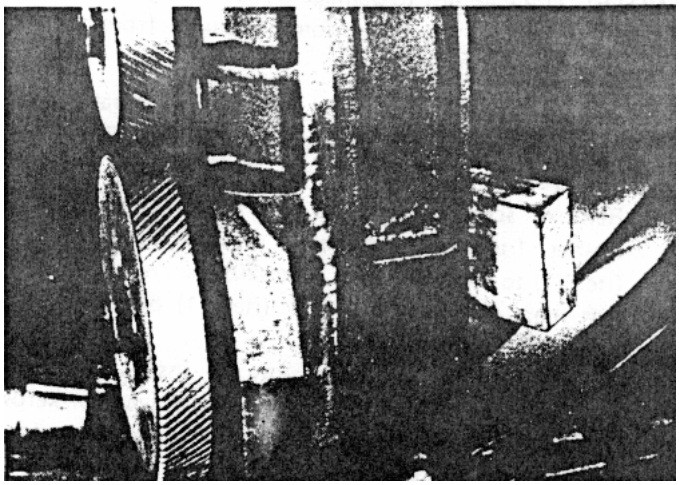
4. Position seal retainer (item 62) with its raised edge upward over the crane seal.

NOTE: The inner hole of the seal retainer (item 62) fits over the dowels of the crane seal and the outer hole fits over the roll pin (item 45) in the bearing bore.

5. Install ball bearings (item 6) within the bearing b the front end plate. Press into place using a sleeve or socket until ball bearings are bottomed.

NOTE: Slot in outer race of ball bearings (item 6) must align with roll pin in the bottom of bearing bore.





6. Rotate housing body (item 3) and insert the rotors (items 13 and 33) into proper slots so that the threaded, tapered rotor shafts protrude from the open end of the measuring unit body.
7. Position and attach rear end cover (item 15) by installing dowel screws (item 5).
8. Replace crane seals (item 57) with rubber face downward into bearing bore on rear end plate (item 15).
9. Position seal retainer (item 62) over the crane seal.

NOTE: The inner hole of the seal retainer (item 62) fits over the dowels of the crane seal and the outer hole fits onto the roll pin (item 45) in the bearing bore.

10. Install ball bearing (item 6) within the bearing bore of the rear end plate (item 15). Press into place using a sleeve or deep socket until ball bearings are bottomed.

NOTE: Slot in outer race of ball bearings (item 6) must align with roll pins in the bottom of bearing bore.

11. Replace rotor spacer (item 16).

NOTE: Make certain that the short dowel pin on the rotor spacer mates properly into the slot on the inner race of the ball bearing.

12. Place the small timing gear (item 17) on the threaded shaft of the three tooth rotor (item 13) and the large timing gear (item 32) on the threaded shaft of the four tooth rotor (item 33). The rotor shafts and timing gear bores are tapered allowing only one manner of assembly.

NOTE: Back out the set screws (item 10) so that the timing gears will be flushed when installed. The long dowel pin on the rotor spacer mates with the hole in the timing gear.

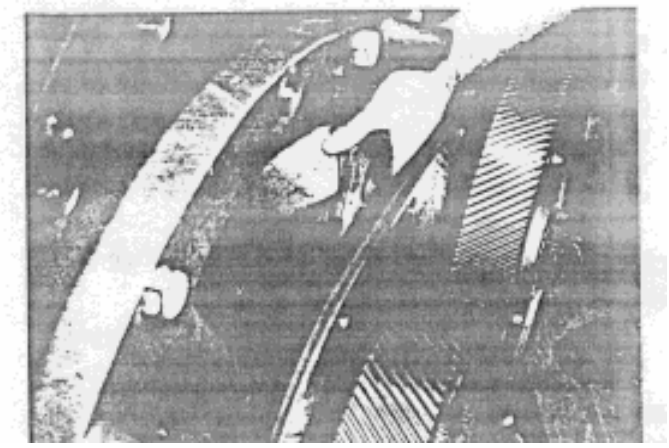
13. Install lockwashers (item 40) over rotor shafts engaging bent tab of lockwasher with hole in the flat side of timing gears. Secure lockwasher by installing jam nuts (items 19 and/or 41). Measuring units 172205 and 182105 will require a locknut retainer (item 42) on the three tooth rotor. Replace the coupling jaw (item 73) on measuring unit 192205 if it was removed in disassembly.
14. Rotate body and install bearing retainer (item 7), lockwasher (item 9) and screws (item 8) onto front end cover (item 4).

NOTE: Roll pin on bearing retainer (item 7) must seat into slot on inner race of ball bearing. Lockwasher (item 9) is used only on measuring unit 192205.

15. Measuring unit must have rotor clearance as described in Sections 4-7 and 4-8.

4-7 Setting End Clearance—(Refer to Figure 4-3)

1. Adjust the two set screws (item 10) located on each of the drive gears (items 17 and 32) until both rotors (items 13 and 33) are flush with the backside of the rear end plate (item 15).
2. (Refer to Figure 4-2) Insert a shim into the outlet port located on the front end plate (item 4) and determine the total distance between the backside of the front end plate and the 3T rotor (item 13). Repeat this procedure for the 4T rotor (item 33).



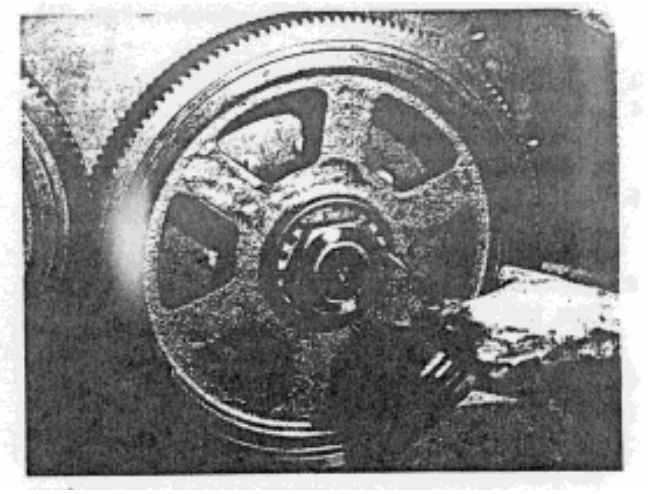


Figure 4-2 Typical Method for Setting Rotor Clearance
Figure 4-3 Typical Method for Setting Rotor End Clearance

3. Adjust the two set screws located on the small drive gear (item 17) until the distance between the backside of the front end plate (item 4) and the 3T rotor is half of the total distance determined. Repeat this procedure for the large drive gear (item 32) and the 4T rotor (item 33).
4. If end clearance is adjusted properly, rotors will spin freely with the meter in any position. If rotors fail to spin freely, repeat procedure for setting end clearance.

4-8 Timing Gear Adjustment

1. Loosen the jam nut (item 41) on the large timing gear (item 32) and with feeler gauges or shims, carefully centralize a lobe of the three tooth rotor in a flute of the 4T rotor. Determine the total distance between the lobe and flute of the two rotors. Set rotor clearance to one-half of the total distance using the appropriate shim.

NOTE: This may be done through the inlet and outlet opening of the unit.

2. Using a piece of rubber between the timing gears, tighten the jam nut (item 41), remove shim and check for freeness of operation. If the rotors contact one another, the timing operation must be repeated.

3. If the rotors were damaged, it will sometimes be found that all of the high spots were not removed. In such cases, it is necessary to find these spots and remove them.
4. When rotor timing is completed, bend one tab of lockwasher (item 40) against side of locknut (item 41). This will secure locknut

4-9 Completion of Measuring Unit Reassembly and Installing Into Meter

1. Replace rear gear cover assembly (item 2) and gasket (item 65), secure with screws (items 1 and 66).

NOTE: The drive shaft assembly (item 22) must mate with the locknut (item 19) or coupling jaw (item 73) on the 3T rotor.

2. Replace front bearing caps (items 46 and/or 48), O-ring or gasket (item 60). Secure with lockwashers (item 21) and screws (item 47).
3. Attach piping to the measuring unit (item 1).
4. Position measuring unit into meter as shown in Figure 6-1 so that the inlet on measuring unit couples with inlet on meter housing.
5, Replace screws (item 3), washer (item 42) and seal washer (item 43) attaching measuring unit to meter housing (item 20).
6. Replace housing cover (item 4) and front dome gasket (item 19). Secure with screws (item 17) and nuts (item 16).

NOTE: A light film of grease will aid in holding front dome gasket in place.

7. Rotate the coupling tube on the pinion shaft assembly of the counter base plate assembly (Item 27) until the drive pin is positioned the same as the slot of the coupling jaw on the counter drive gear train. Secure with screws (item 28).
8. Replace tubing and connect the APL unit (item 50) to meter housing,
9. Re-install other accessories.
10. Refill APL unit with lubricating oil (Refer to Paragraph 4-10).

4-10 Filling APL Unit with Lubricating Oil (Refer to Figure 6-5)

1. Select a hand oil pump with a mating connection compatible with the alemite fitting (item 7) on the APL unit. Lubricating oil used in the APL unit should be a good quality SAE ten weight non-detergent oil.
2. Connect oil pump to alemite fitting (item 7) on the APL unit. Open the needle valve (item 6).
3. Fill the APL unit until the external relief valve (item 12) opens and allows lubricating oil to be expelled to the atmosphere.

NOTE: APL unit can be filled with lubricating oil while meter system is either in service or not in service.

4. Close relief valve (item 12) and disconnect oil pump from alemite fitting (item 7).

NOTE: The indication rod is now at the bottom mark groove located on the hydraulic cylinder (item 1), this indicates the APL unit is full of lubricating oil. Once the indication rod is located near the top mark groove on the hydraulic cylinder (item 1) the APL unit is low of lubricating oil and should be refilled as described above.

Table 4-1 Torque Specifications B-173DEB thru B-195DEB (Refer to Figure 6-1)

Meter	Item Number	Torque
B-173DEB	16	20 FT./Lbs
B-174DEB	16	130 Ft./Lbs.
B-175DEB	16	375 Ft./Lbs.
B-183DEB	16	50 Ft./Lbs.
B-184DEB	16	170 Ft./Lbs.
B-185DEB	16	520 Ft./Lbs.
B-192DEB	16	40 Ft./Lbs.
B-193DEB	16	75 Ft./Lbs.
B-194DEB	16	370 Ft./Lbs.
B-195DEB	16	750 Ft./Lbs.

Section 5 TROUBLESHOOTING

5-1 General

Table 5-1 has been provided to aid in basic troubleshooting. Disassembly procedures are covered in Section 4 Maintenance.
If the flowmeter is found to be in need of repair, it is recommended the user contact the nearest Service Department or Sales Office. It is important that servicing be performed by trained and qualified service personnel.

Section 6 PARTS LIST

6-1 General

This section contains the necessary parts required to makeup any standard unit that is covered in this bulletin. Each parts list contains the recommended spare and replacement parts denoted by an asterisk. For items that are not listed, or additional information, consult factory. When ordering, the following information must be furnished:

1. Part number and description.
2. Model number of flowmeter.
3. Serial number of flowmeter.
4. Quantity required.

When ordering items of a material or special construction not indicated in the Parts List, furnish the following information so that the part number of the item can be determined:

1. Item number and description.
2. Specific material of item.
3, Model number of flowmeter.
4. Serial number of flowmeter.
5. Quantity required.

Table 5-1 TROUBLESHOOTING

Symptom	Possible Cause	Service Required
Meter runs but counter does not register.	Faulty Register.	Remove register and see if output shaft on adjustor rotates with metered fluid flow. If output shaft on adjuster rotates, replace register.
	Faulty adjustor or broken coupling between adjustor and counter base plate.	Remove adjustor and see if output shaft on counter base plate rotates with metered fluid flow. If output shaft of counter base plate assembly rotates, then inspect the following: 1. Check coupling on input shaft of adjustor to see if it is broken. If broken, replace coupling. 2. If coupling is not broken, replace adjustor.
Meter runs but is noisy.	Meter Is not timed properly.	Check rotor clearances as described in Section 4-8. If discrepancy is found, time rotors.
	Damaged rotors.	Remove rotors as described in Section 4-4. If rotors are scored or galled, clean them as described in Section 4-5. If rotors are damaged beyond repair, replace with a new set. Install rotors as described in Section 4-6.
	Worn ball bearings.	Remove ball bearings as described in Sections 4-3 and 4-4. Check to see if ball bearings turn freely with no free play. If discrepancy is found, replace ball bearings and install as described.
	Damaged gears in counter base plate assembly.	Disassemble counter base plate assembly. Check gears for worn or damaged teeth. Replace gears as necessary and assemble counter base plate assembly.
Samples of lubricating oil in automatic pressure lubricating system found in metered fluid.	Damaged crane seals.	Disassemble measuring unit and Inspect crane seals for damage or wear. Replace crane seals if necessary.

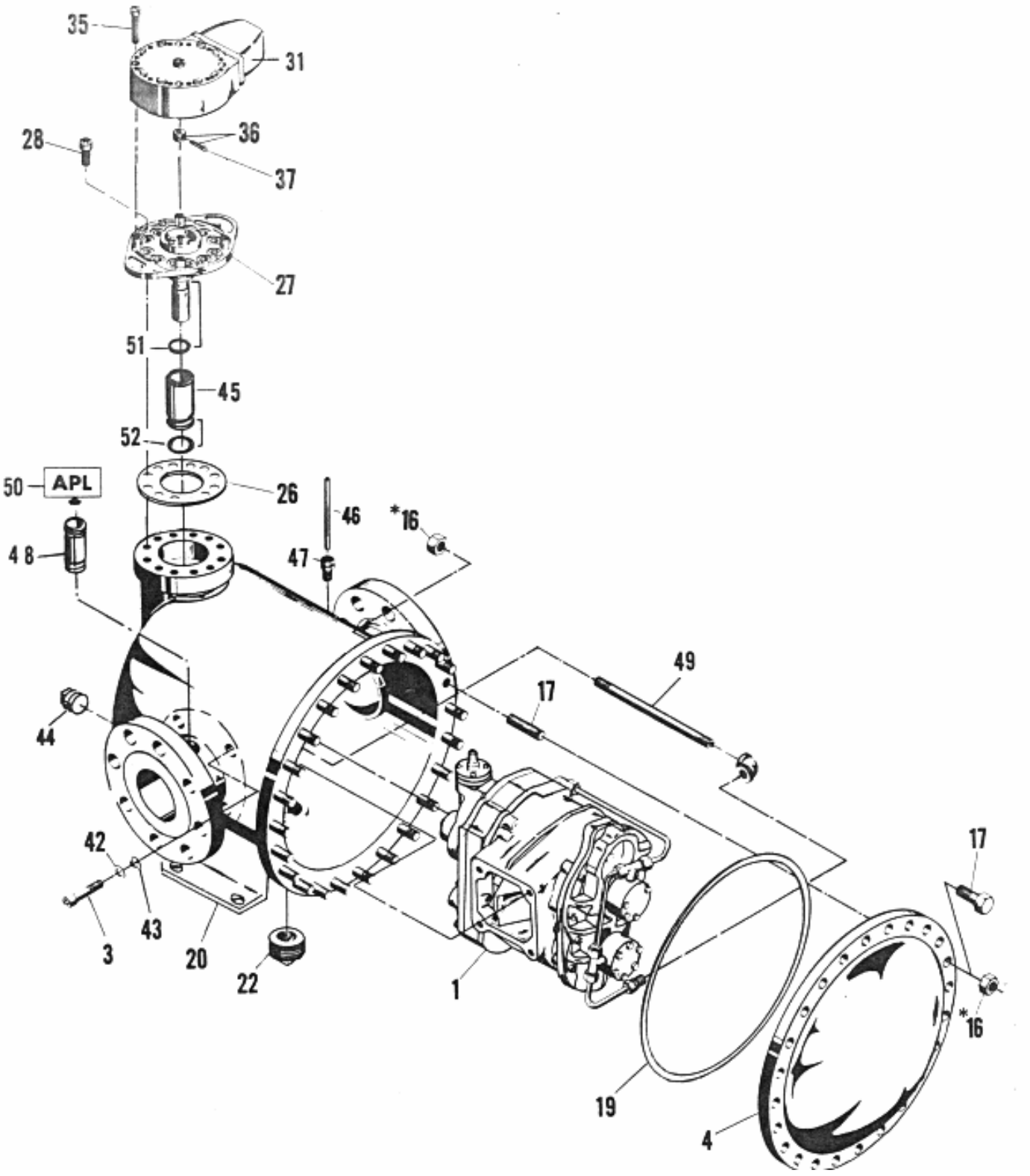


Figure 6-1 Complete Meter Assembly
***See Table 4-1 Torque Specifications**

Table 6-1 Complete Meter Parts List - Models B-173DEB, B-174DEB and B-175DEB (Reference Figure 6-1)

Item	Description		Qty. Req.	B- 173DEB	B- 174DEB	B- 175DEB
	Complete Meter Assembly	10 GPR		173400-006	174400-006	175400-006
		10 LPR		173400-007	174400-007	175400-007
		HTT 200°F10 GPR		173400-210	174400-310	
1	Measuring Unit	10 GPR	1	172205-006	172205-006	172205-006
		10 LPR	1	172205-007	172205-007	172205-007
		HTT 200°F10 GPR	1	172205-210	172205-210	
3	Screw		4	151026	151053	151053
4	Housing Cover		1	73430	74430	75430
16	Nut		24	151555		
			15		151559	151562
17	Stud		24	151386		
			15		151393	151396
*19	Gasket		1	73434	74434	75434
20	Housing Assembly		1	173415	174415	175415
22	Pipe Plug		1	154784-024	154784-024	154784-024
*26	Gasket		1	53156	53156	53156
27	Counter Base Plate Assembly		1	184150	184150	184150
28	Screw		12	151015	151015	151015
*31	Adjustor		1	4200	4200	4200
35	Screw		4	150565	150565	150565
*36	Coupling with item 37		1	W-4125	W4125	W4125
37	Cotter Pin		1	153901	153901	153901
42	Washer		4	151882	151882	151882
*43	Seal Washer		4	152034	152034	152034
44	Pipe Plug		1	154711 -024	154711 -024	154711 -024
45	Static Tube Seal		1	184151	184151	184151
46	3/8" Tubing (Cut to Fit)		1	157546	157546	157546
47	Connections (1/4P to 3/8T)		1	157410-019	157410-019	157410-019
48	Pipe Nipple—1 x 3-3/4" Steel		1	157659	157659	157659
49	1/4" Tubing (Cut to Fit)		1	154797	154797	154797
50	APL Unit		1	203485	203485	203485
*51	O-Ring		1	152099	152099	152099
*52	O-Ring		1	152092	152092	152092

*Recommended Spare Parts

Table 6-2 Complete Meter Parts List - Models B-183DEB, B-184DEB and B-185DEB (Reference Figure 6-1)

Item	Description		Qty. Req.	B-183DEB	B-184DEB	B-185DEB
	Complete Meter Assembly	10 GPR		183400-010	184400-010	185400-010
		10 LPR		183400-020	184400-020	185400-020
		HTT 200°F 10 GPR		183400-210		
1	Measuring Unit	10 GPR	1	182105-010	182105-010	182105-010
		10 LPR	1	182105-020	182105-020	182105-020
		HTT 200°F 10 GPR	1	182105-210		
3	Screw		4	151023	151047	151047
16	Housing Cover		22	151551	84430-001	85430
			20	151389	151559	151562
17	Stud		20	150892	151397	
*19	Gasket		1	83434	157326	85434
20	Housing Assembly		1	183415	184415	185415
22	Pipe Plug		1	154784-024	154784-024	154784-024
*26	Gasket		1	53156	53156	53156
27	Counter Base Plate Assembly		1	184150	184150	184150
28	Screw		12	151015	151015	151015
*31	Adjustor		1	4200	4200	4200
35	Screw		4	150565	150565.	150565
*36	Coupling with item 37		1	W-4125	W4125	W-4125
37	Cotter Pin		1	153901	153901	153901
42	Washer		4	151872	151872	151872
*43	Seal Washer		4	152033	152033	152033
44	Pipe Plug		1	154711-024	154711-024	154711-024
45	Static Tube Seal		1	184151	184151	184151
46	3/8" Tubing (Cut to Fit)		1	157546	157546	157546
47	Connector (1/4P to 3/8T)		2	157410-019	157410-019	157410-019
48	Pipe Nipple—1 x 3-3/4" Steel		1	157543	157543	157543
49	1 /4" Tubing (Cut to Fit)		2	154797	154797	154797
50	APL Unit		1	203485	203485	203485
*51	O-Ring		1	152099-022	1 52099-022	152099-022
*52	O-Ring			152092-022	152092-022	152092-022

*Recommended Spare Parts

Table 6-3 Complete Meter Parts List - Models B-192DEB, B-193DEB, B-194DEB and B-195DEB (Reference Figure 6-1)

Item	Description		Qty. Req	B-192DEB	B-193DEB	B-194DEB	B-195DEB
	Complete Meter Assembly	10 GP R		192400-010	193400-010	194400-010	195400-010
		1 B P R		192400-020	193400-030	194400-030	195400-030
		100 LPR		192400-044	193400-007	194400-044	195400-044
1	Measuring Unit	10 GPR	1	192205-010	192205-010	192205-010	192205-010
		1 B P R	1	192205-030	192205-030	192205-030	192205-030
		100 LPR	1	192205-044	192205-044	192205-044	192205-044
3	Screw		7	151054	151054	151100	151054
4	Housing Cover		1	92430	93430	94430-001	95430
16	Nut		20			151560	
			26				151563
			32	151558	151558		
17	Stud		20			150891	
			26				151399
			32	150847	151391		
*19	Gasket		1	92434	93434	157307	95434
20	Housing Assembly		1	192415	193415	194415	195415
22	Pipe Plug		1	154784-024	154784-024	154784-024	154784-024
*26	Gasket		1	51156	53156	53156	53156
27	Counter Base Plate Assembly		1	192150	194150	194150	194150
			9	151251			
28	Screw		12	151015	151015	151015	
*31	Adjustor		1	4200	4200	4200	4200
35	Screw		4	150565	150565	150565	150565
*36	Coupling with Item 37		1	W-4125	W-4125	W-4125	W-4125
37	Cotter Pin		1	153901	153901	153901	153901
42	Washer		7	151903	151903	151903	151903
*43	Seal Washer		7	152031	152031	152031	152031
44	Pipe Plug		1	154711 -024	154711-024	154711-024	
45	Static Tube Seal		1	194151	194151	194151	194151
46	3/8" Tubing (Cut to Fit)		1	157546	157546	157546	157546
47	Connector (1 /4P to 3/8T)		1	157403-019	157403-019	157410-019	157410-019
48	Pipe Nipple—1 x 3-3/4" Steel		1	157543	157543	157543	157543
49	1 /4" Tubing (Cut to Fit)		1	154797	154797	154797	154797
50	APL Unit		1	203485	203485	203485	2034 85
*51	O-Ring		1	152099	152099	152099	152099
*52	O-Ring		1	152092	152092	152092	152092
*53	Adaptor Gasket		1	52146	52146	52146	

* Recommended Spare Parts

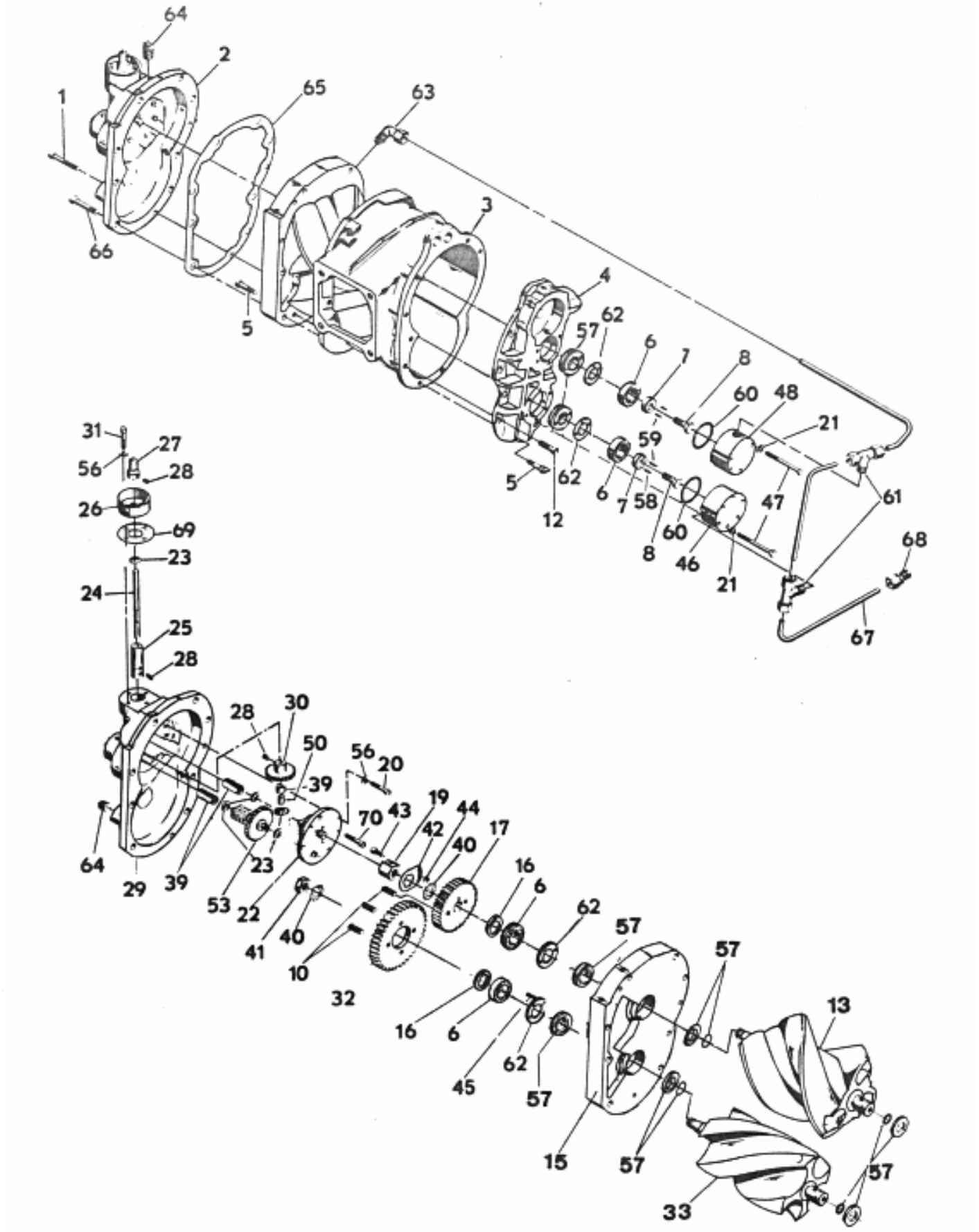


Figure 6-2 Measuring Unit Assembly - Models B-173DEB thru B-175DEB

Table 6-4 Measuring Unit Parts List - Models B-173DEB, B-174DEB and B-175DEB
(Reference Figure 6-2)

Item	Description	Part No.	Req.		Item	Description	Part No.	Req.
1	Screw	151073	8		**33	Rotor(4T)	172286-005	1
2	Rear Gear Cover Assy. 10 GPR	172675-006	1			HTT 200°F	172286-305	1
	10 LPR	172675-007	1		*39	Bearing	155169	3
3	Meter Body	72211	1		*40	Lockwasher	51593	2
4	Front End Cover	172231-005	1		41	Locknut	60592	1
5	Dowel Screw	51567	6		42	Locknut Retainer	172274	1
*6	Ball Bearing	154952	4		43	Screw	151029	1
7	Bearing Retainer	172237	2		44	Lockwasher	152105	1
8	Screw	151066-014	2		45	Roll Pin	153548	4
10	Set Screw	150986	4		46	Front Bearing Cap	172233-005	1
12	Screw	151037	5		47	Screw	150716	10
**13	Rotor (3T)	172276-005	1		48	Front Bearing Cap	172243-005	1
	HTT 200°F	172276-305	1		50	Bushing	172659	1
15	Rear End Cover	172266-005	1		52	Dowel Pin (not shown)	153687	1
16	Rotor Spacer	172295	2		53	Worm Shaft Assy.10 GPR (4T/45T)	172610-006	1
**17	Drive Gear (3T)	70291-029	1			10 LPR (7T/38T)	62665005	1
* 19	Locknut	172279	1		56	Lockwasher	152259	11
20	Screw	150536	5		*57	Crane Seals	152049	4
21	Lockwasher	152259	10		58	Roll Pins	153630	2
22	Drive Shaft Assy. 10 GPR	172615-006	1		59	Set Screw	150988	4
	10 LPR	172615-007	1		*60	O-Rings	152092	2
*23	Washer 151901		5		61	Tee (1/4P to 3/8T)	157419-019	2
24	Worm Wheel Shaft	172689	1		62	Seal Retainer	172604-005	4
25	Spacer	172691	1		63	Elbow (1/4P to 3/8T)	157410-019	1
26	Bearing Retainer Assy.	194660	1		64	Pipe Plug	154783	2
27	Coupling Jaw	92663	1		*65	Rear Gear Cover Gasket	172602	1
28	Set Screw	150975	6		*66	Screw	151012	2
29	Rear Gear Cover	172601	1		67	3/8" Tubing	157546	A/R
30	Worm Wheel 10 GPR (37T)	172646	1		68	Pipe Connector	157403-019	1
	10 LPR (28T)	172686 005	1		*69	Gland Gasket	92664	1
31	Screw	151031	4		70	Screw	150581	2
**32	Drive Gear(4T)	70296-029	1					

*Recommended Spare Parts **NOTE: Items 13 and 33 are supplied as a set.
Items 17 and 32 are supplied as a set.

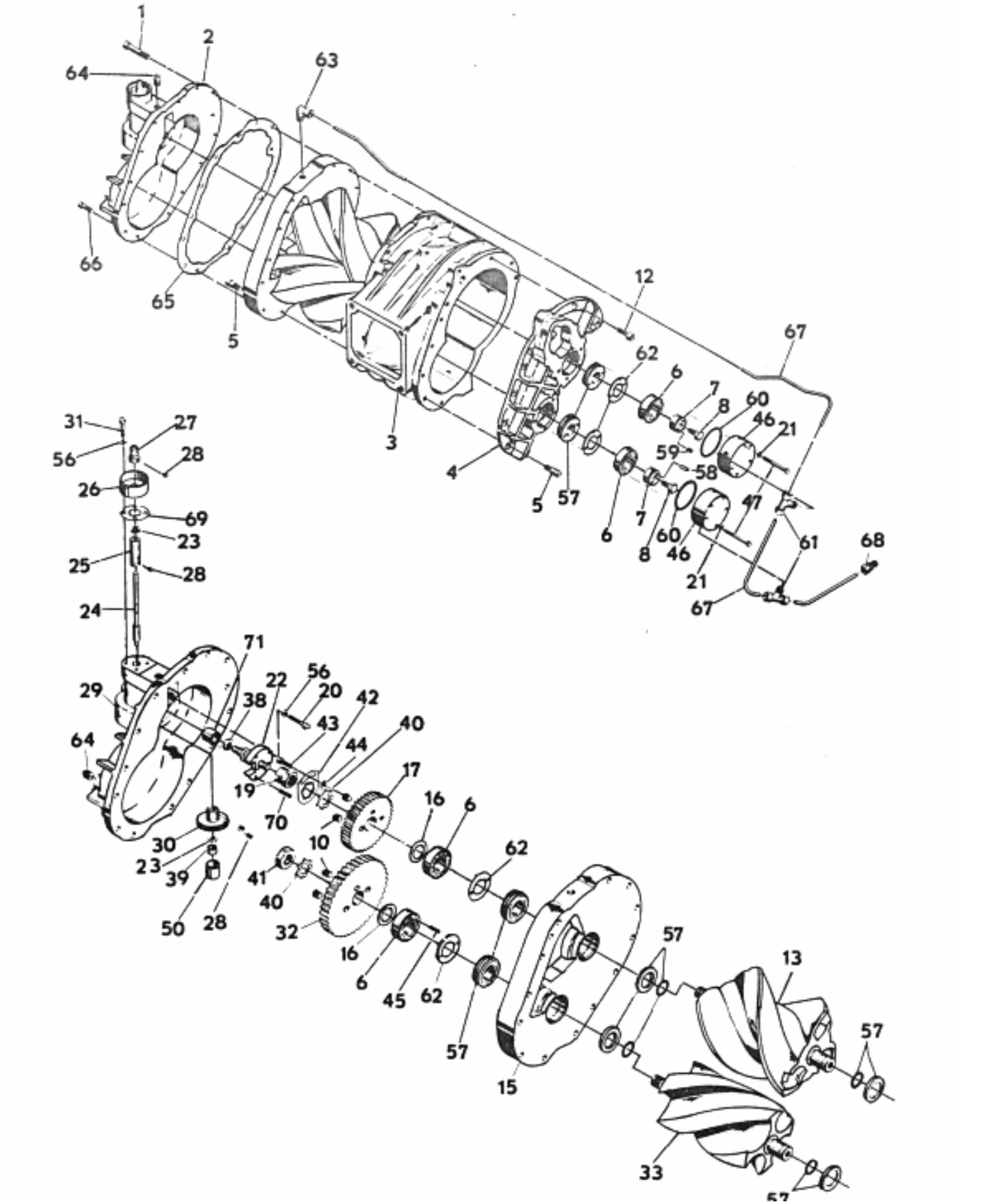


Figure 6-3 Measuring Unit Assembly · Models B-183DEB thru B-185DEB

Table 6-5 Measuring Unit Parts List - Models B-183DEB, B-184DEB and B-185DEB (Reference Figure 6-3)

Item	Description	Part No.	Req.		Item	Description	Part No.	Req.
1	Screw	151074	11		**32	Drive Gear(4T)	80296-029	1
2	Rear Gear Cover Assy.10 GPR	182675-006	1		**33	Rotor{4T)	182286	1
	10 LPR	182675-007	1			HTT - 200° F	182286-300	1
3	Meter Body	82816	1		38	Thrust Washer	92669	1
4	Front End Cover	182231-005	1		*39	Bearing	155169	3
5	Dowel Screw	92567	6		*40	Lockwasher	82593	1
*6	Ball Bearing	154951	4		41	Locknut	82592	1
7	Bearing Retainer	182237	2		42	Locknut Retainer	182274	1
8	Screw	150766	2		43	Screw	151029	1
10	Set Screw	150987	4		44	Lockwasher	152105	1
12	Screw	151017	6		45	Roll Pin	153548	4
**13	Rotor	(3T)182276	1		46	Front Bearing Cap	182239-005	2
	HTT- 200°F	182276-300	1		47	Screw	150716	10
15	Rear End Cover	182266-005	1		50	Bushing	182659	1
16	Rotor Spacer	182293	2		56	Lockwasher	152259	10
**17	Drive Gear(3T)	80291-029	1		*57	Crane Seals	152054	4
* 19	Locknut	182279	1		58	Roll Pins	153517	2
20	Screw	150538	4		59	Set Screws	150989	4
21	Lockwasher	152259	10		*60	O-Ring	152061	2
22	Drive ShaftAssY.10GPR	182625-006	1		61	Tee	157419-019	2
	10 LPR	182625-007	1		62	Seal Retainer	182604-005	4
*23	Thrust Washer	151901	2		63	Elbow	157410-019	1
24	Worm Wheel Shaft	182689	1		64	Pipe Plug	154783	2
25	Spacer	172691	1		*65	Rear Gear Cover Gasket	182602	1
26	Bearing Retainer Assy.	194660	1		66	Screw	151072	3
27	Coupling	92663	1		67	3/8" Tubing	157546	A/R
28	Set Screw	150975	8		68	Pipe Connector	157403-019	1
29	Rear Gear Cover	182601	1		*69	Gland Gasket	92664	1
30	Worm Wheel 10 GPR (39T)	182626-006	1		70	Screw	150581	2
	10 LPR (31T)	102686-006	1		*71	Bearing	155168	1
31	Screw	151031	4					

* Recommended Spare Parts

NOTE: Items 13 and 33 are supplied as a set.
Items 17 and 32 are supplied as a set.

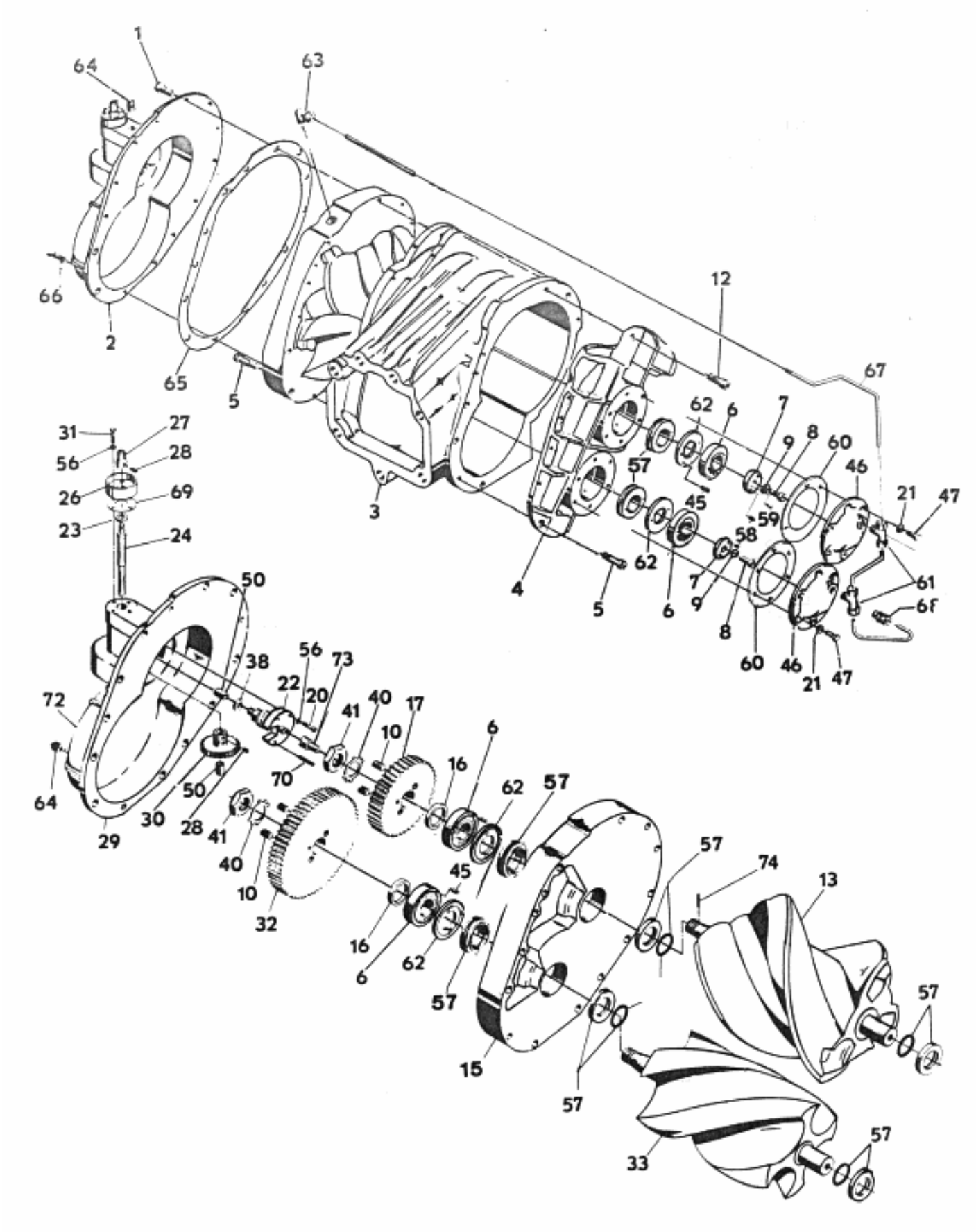


Figure 6-4 Measuring Unit Assembly - Models B-192DEB thru B-195DEB

Table 6-6 Measuring Unit Parts List - Models B-192DEB, B-193DEB, B-194DEB and B-195DEB
(Reference Figure 6-4)

Item	Description	Part No.	Req.
1	Screw	151044	11
2	Rear Gear Cover Assy.10 GPR	193675-006	1
	1 BPR	193675	1
	100 LPR	193675-007	1
3	Meter Body	92211	1
4	Front End Cover	192231-020	1
5	Dowel Screw	92567	6
*6	Ball Bearing	154957	4
7	Bearing Retainer	192602	2
8	Screw	151055-014	2
9	Lockwasher	152110	2
10	Set Screw	150986	4
12	Screw	151040	6
**13	Rotor (3T)	92276-001	1
15	Rear End Cover	192266-020	1
16	Rotor Spacer	192295	2
**17	Drive Gear (3T)	192291	1
20	Screw	150538	4
21	Lockwasher	152108	12
22	Drive Shaft Assy.10 GPR	92665-006	1
	1 BPR	92680	1
	100 LPR	92665-007	1
*23	Thrust Washer	151901	1
24	Worm Wheel Shaft	92689	1
26	Bearing Retainer Assembly	194660	1
27	Coupling	92663	1
28	Set Screw	150975	6
29	Rear Gear Cover	193601	1
30	Worm Wheel (43T)10 GPR	92686-006	1
	(54T) 1 BPR	92676	1

Item	Description	Part No.	Req.
31	Screw	151031	4
**32	Drive Gear (4T)	192296	1
**33	Rotor (4T)	92285	1
38	Thrust Washer	92669	1
*40	Lockwasher	92593	2
41	Locknut	92592	2
45	Roll Pin	153512	4
46	Front Bearing Cap	193529	2
47	Screw	150728	12
50	Bushing	92657	2
56	Lockwasher	152259	10
*57	Crane Seals	152047	4
58	Roll Pins	153524	2
59	Set Screws	150989	4
*60	O-Rings (Gasket)	193538	2
61	Tee	157419-019	2
62	Seal Retainer	192604	2
63	El bow	157410-019	1
64	Pipe Plug	154783	2
*65	Rear Gear Cover Gasket	193602	1
66	Screw	151058	3
67	3/8" Tubing	157546	3
68	Pipe Connector	157403-019	1
*69	Gland Gasket	92664	1
70	Screw	150581	2
72	Bushing	92657	2
*73	Coupling Jaw	92279	1
74	Roll Pin	153523	1

*Recommended Spare Parts

NOTE: Items 13 and 33 are supplied as a set.
Items 17 and 32 are supplied as a set.

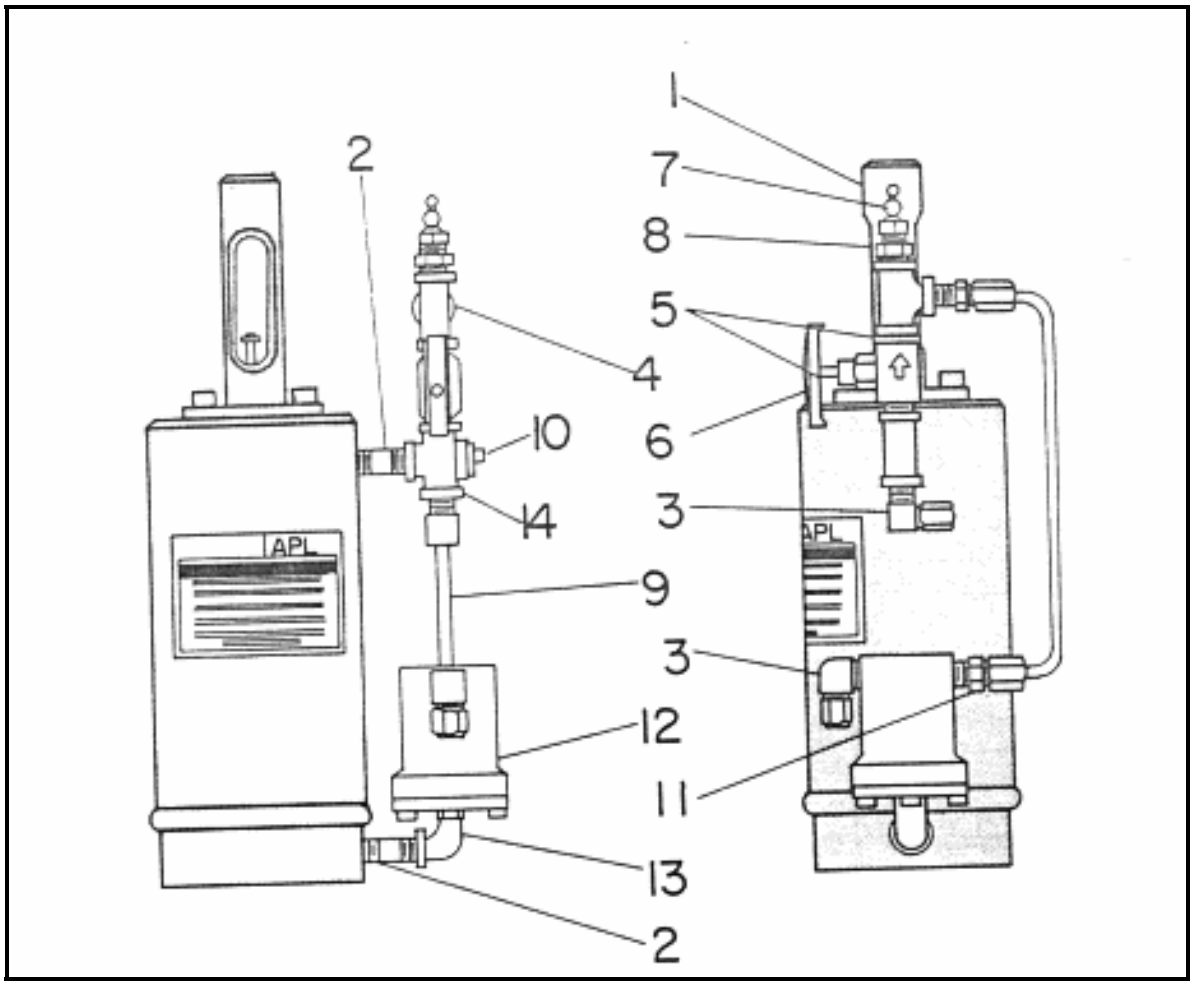


Figure 6-5 APL Unit Assembly

Table 6-7 Automatic Pressure Lubrication Assembly
Part No. 203485 (Reference Figure 6-5)

Item	Description	Part No.	Req.
1	Hydraulic Cylinder	172560	1
2	1 /4" Nipple - 1 -1 /2" Long	154792	2
3	1/4" P. to 3/8 T. Connector	157410-019	2
4	1/4 " Pipe Tee	154793	1
5	1/4" Close Nipple	154696	2
6	Needle Valve	157542	1
7	Alemite Fitting	154971	1

Item	Description	Part No.	Req.
8	1 /4" x 1 /8" Bushing	154697	1
9	3/8" Tubing - Length to suit	157546	1
10	1 /4" Pipe Plug	154783	1
11	1/4" P. to 3/8" T. Connector	157403-019	2
12	External Relief Valve	6020	1
13	1/4" Street Ell.	154789	1
14	1/4" Cross	157536	1

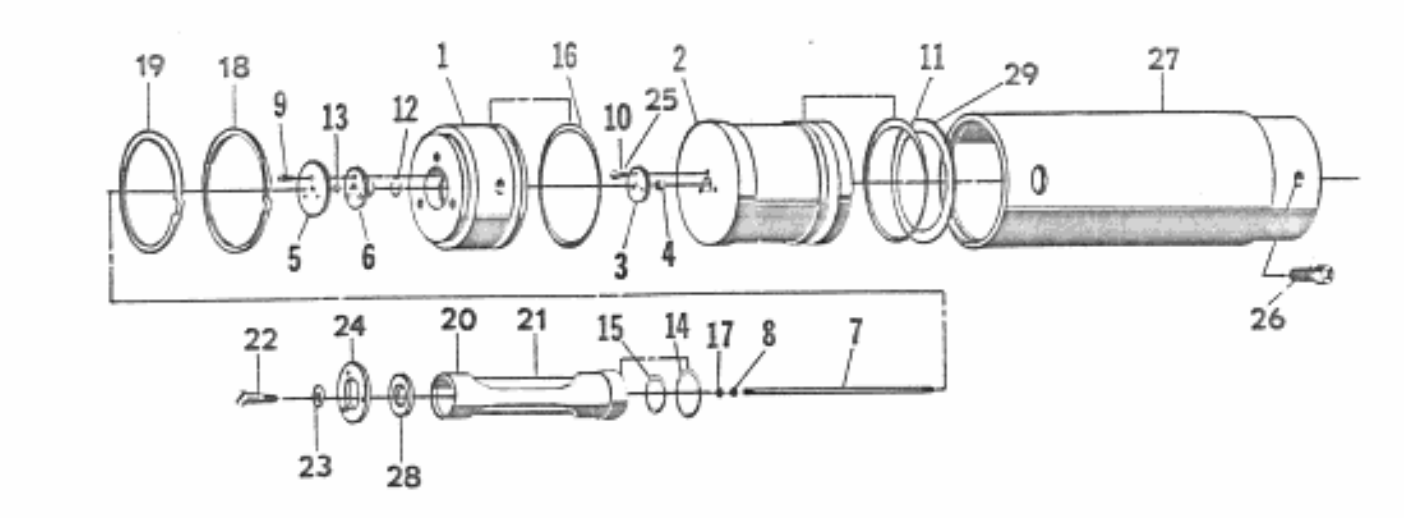


Figure 6-6 Hydraulic Assembly

Table 6-8 Hydraulic Cylinder (Reference Figure 6-6)

Item	Description	Model 172560 Part No.	Req.
1	Cylinder Head	172558	1
2	Piston	172559	1
3	Indicator Retainer	172544	1
4	Rod Lock Nut	151524	2
5	Gland Retainer	172546	1
6	Packing Gland	172547	1
7	indicator Rod	172551	1
8	Indicator Button	172552	1
9	Screw	150348	3
10	Screw	150117	3
*11	O-Ring	157096-022	1
*12	O-Ring	1 52086	1
*13	O-Ring	152062-022	
*14	O-Ring	152099	1
*15	O-Ring	152069	1
*16	O-Ring	157032	1
17	Retainer Ring	156512	1
18	Retainer Ring	156491	1
19	Retainer Ring	156492	1
20	Gauge Housing	172557	1
21	Sight Glass Assembly	172550	1
22	Screw	151017	3
23	Lockwasher	152110	3
24	Retainer Ring	172556	1
25	Lockwasher	152103	3
26	Pipe Plug	154783	2
27	Cylinder and Base Assembly	172555	1
28	Retainer Ring	156513	1
29	Glyde Ring	157171	1

*Recommended Spare Parts

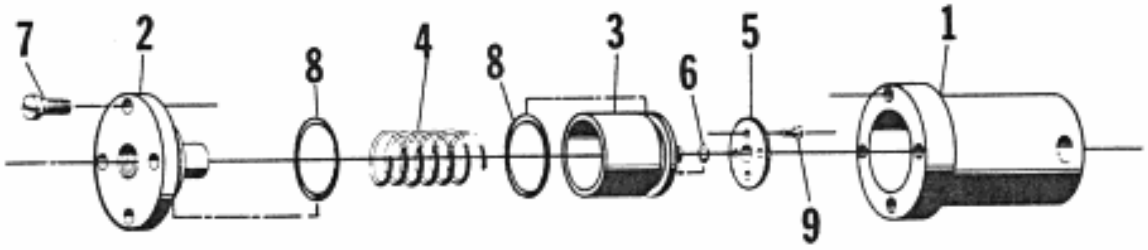


Figure 6-7 External Relief Valve

Table 6-9 External Relief Valve Assembly Part No. 6020 (Reference Figure 6-7)

Item	Description	Part No.	Req.
1	Housing	6019	1
2	Cover	6021	1
3	Piston	6022	1
4	Spring	6023	1
5	O-Ring Retainer	6024	1
*6	O-Ring	152064	1
7	Screw	150552	4
8	O-Ring	1 52097	2
9	Screw	150022	4

*Recommended Spare Parts

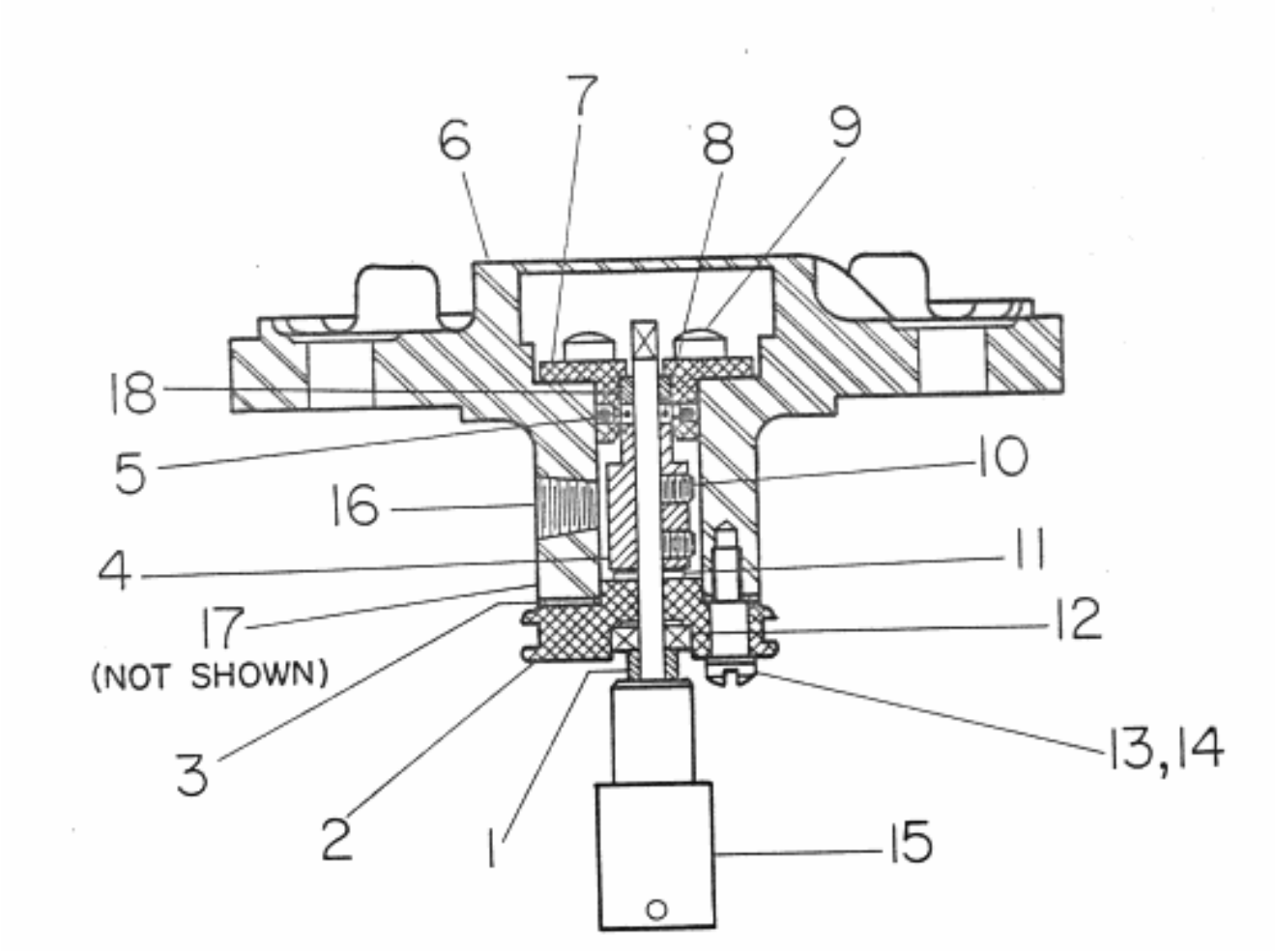


Figure 6-8 Counter Base Plate Assembly

Table 6-10 Counter Base Plate Assembly (Reference Figure 6-8)

		Part Number			
Item	**Description**	**184150**	**192150**	**194150**	**Req.**
1	Spacer	74166	74166	74166	1
2	Bearing Housing	194177	194177	194177	1
3	Gasket	194178		194178	1
			194178		2
4	Packing Shaft Positioner	93152	92152	93152	1
*5	O- Ring	152070-022		152070-022	1
6	Counter Base Plate	53151	72751	53151	1
7	Packing Gland Assembly	43175	52153-100	43175	1
*8	O-Ring	150264-022	152064-022	152064-022	1
9	Screw	151029		151029	4
			150526		2
10	Set Screw	150969	150969	150969	2
11	Washer	151891	151891	151891	1
* 12	Ball Bearing	155195	155195	155195	1
13	Lockwasher	152259	152259	152259	3
14	Screw	150537	150582	150537	3
15	Coupling Tube	173155	92155	92155	1
16	Steel Pipe Plug	154720		154 720	1
17	Bearing Housing Spacer	192179			1
18	Gland Spacer		52152		1

*Recommended Spare Parts