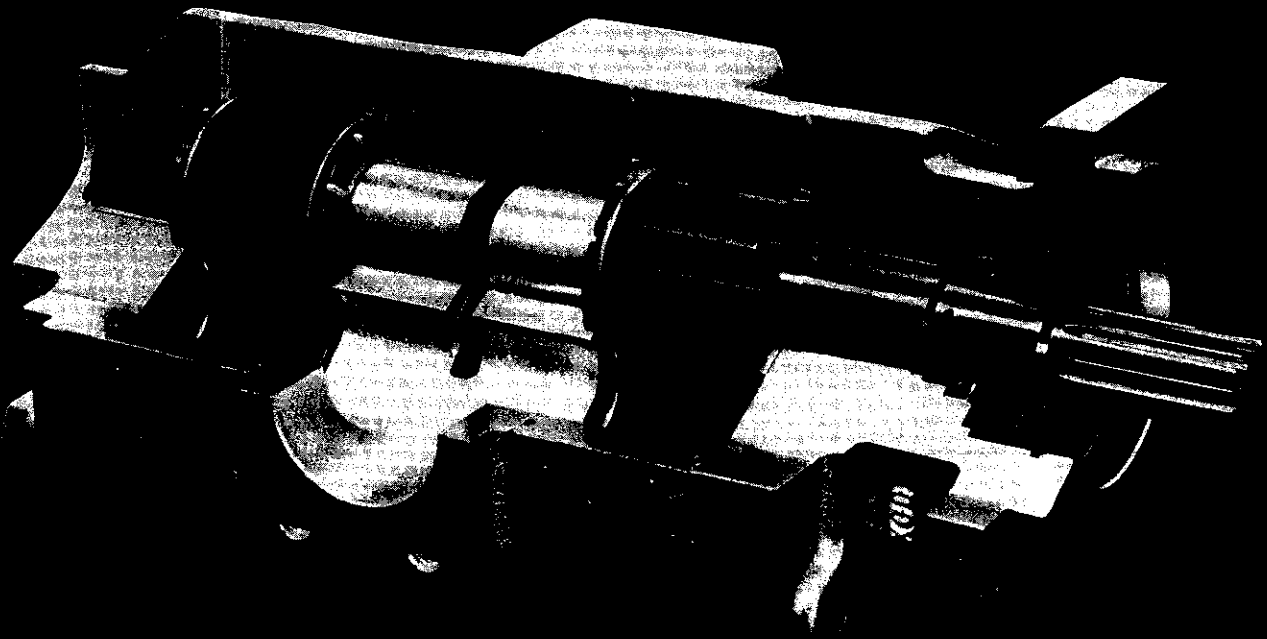
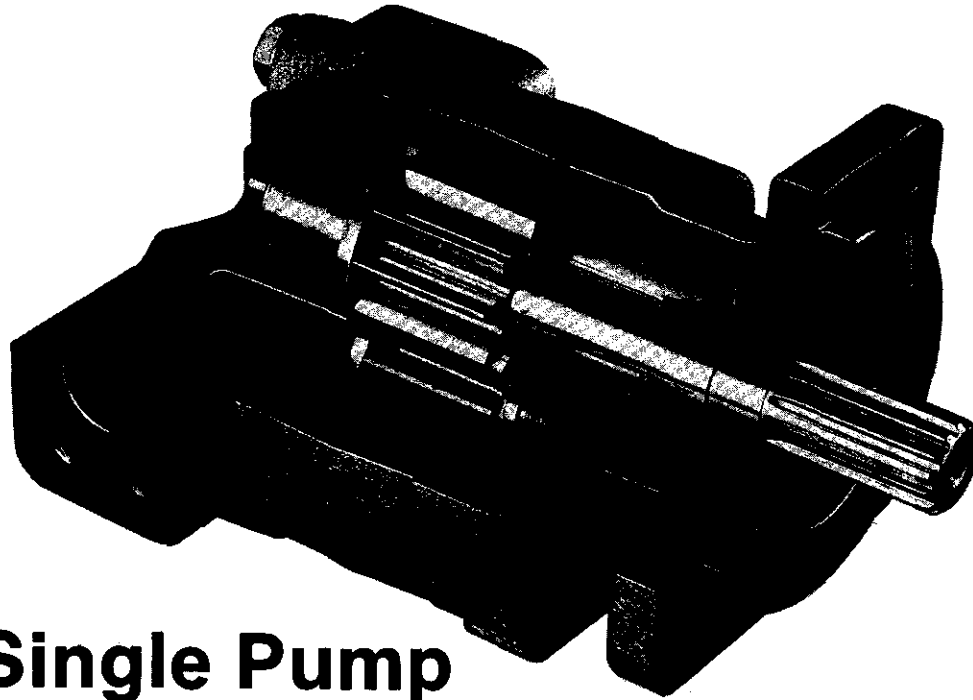


P330/P350 P365 PUMP SERVICE MANUAL

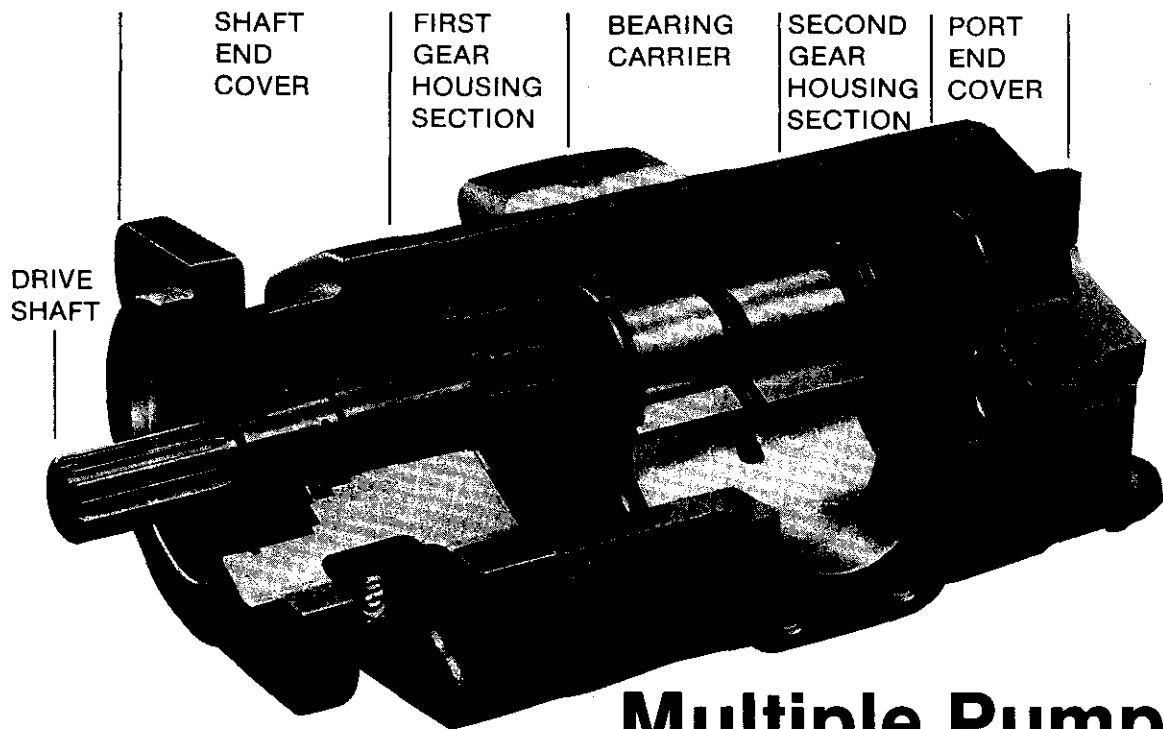
single
and tandem
oil hydraulic
pumps

Erratum: pg. 4, tool list item 4, bearing puller, is incorrect. Correct tools are three largest collets of Owatonna Tool Company blind hole puller set 981 or equivalent.





Single Pump



Multiple Pump

**Use Genuine Commercial
Replacement Parts**

P330/P350/P365 pump service instructions

GENERAL INSTRUCTIONS

These service instructions will familiarize you with Commercial's single and multiple pumps — their component parts — the relative position of each part — proper methods for assembly or disassembly of the units — care and use of these oil hydraulic power units — so that best performance and longer working life will result for your benefit.

To facilitate the repair of these units — and before any work is done — we suggest that you first read all of the steps used in disassembly and all of the steps used in building up the unit.

Dirt is the enemy of any hydraulic system. The first requirement of good maintenance of hydraulic equipment is cleanliness. **MAKE SURE YOU DISASSEMBLE AND ASSEMBLE YOUR HYDRAULIC EQUIPMENT IN A CLEAN AREA.**

Our pictures show a Model 365. Notes in the text cover variations between this unit and the other models.

It is important to airblast all parts and wipe them with a clean, lintless cloth before assembly.

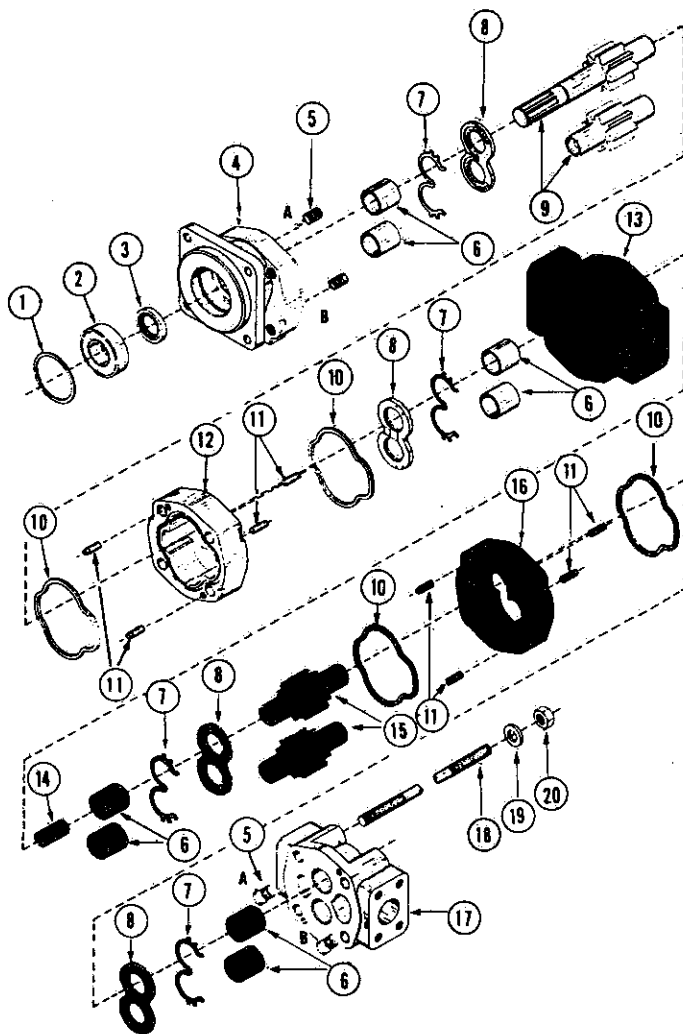
USE CAUTION IN GRIPPING ALL PARTS IN THE VISE TO AVOID DAMAGING MACHINED SURFACES.

A pump must be driven in the direction of rotation for which it was built; otherwise, pressure will blow the shaft seal. Check the exploded view and notes at right for proper direction of rotation.

COMMERCIAL'S REPLACEMENT PARTS

Commercial's replacement parts are of original equipment standards. For assured quality of material and workmanship, and for compatibility in assembly, **USE ONLY GENUINE PARTS FROM COMMERCIAL.**

Check all replacement parts before installing them to be certain they were not damaged in shipment.



NOTE:

For P330 only — plug 5 required in position A and position B.

FOR P350 and P365:

Plug 5 in position B gives clockwise rotation. Plug 5 in position A gives counterclockwise rotation.

PARTS LIST

- | | |
|--------------------------------------|---|
| 1. Snap Ring | 11. Dowel Pins (Solid for P330 and P350, Hollow for P365 - Only.) |
| 2. Outboard Bearing | 12. Gear Housing |
| 3. Seal | 13. Bearing Carrier |
| 4. Shaft End Cover | 14. Connecting Shaft |
| 5. Plug | 15. Matched Gear Set |
| 6. Bushings | 16. Gear Housing |
| 7. Channel Seal | 17. Port End Cover |
| 8. Thrust Plates | 18. Studs or Cap Screws |
| 9. Integral Drive Shaft and Gear Set | 19. Washers |
| 10. Gasket Seal | 20. Nuts |

ITEMS SHADED APPLY TO MULTIPLE ASSEMBLIES ONLY.

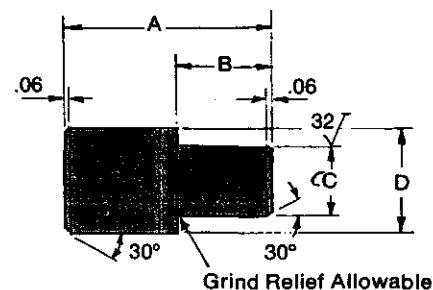
tool list

- Arbor Press
- Awl
- 1 1/2" Dia. Steel Ball
- Bearing Puller (Owatonna Tool Co. MD-956 or equivalent)
- Bushing Removal Tool (see sketch)
- Clean Lintless Cloths
- Deburring Tool (an old file with the cutting teeth ground off)
- Machinist's Hammer
- Soft Hammer
- Permatex Aviation Form-A-Gasket No. 3 Non-hardening Sealant or Equivalent
- Medium Grit Carborundum Stone
- Seal Removal Tool (see sketch)
- Oil and Grease
- Snap Ring Pliers
- Prick Punch
- Bushing Installation Tool (see sketch)
- Scale (1/32" or 1/64" graduations)
- Small Screwdriver
- Torque Wrench
- Vise with 6" Minimum Open Spread
- Bar for Lip Seal Installation
Note: For P330 use 1 3/4" dia. by 2" bar.
For P350 use 2 1/2" dia. by 2" bar.
For P365 use 2 1/2" dia. by 2" bar.
- Special Steel Sleeve (see sketch)

Seal removal tool can be easily made from an old screwdriver. Heat the tip and bend as shown. Grind off the tip to fit the notch behind the shaft seal.



Bushing Installation Tool A.I.S.I. 8620 Bearing Quality Steel Heat Treated



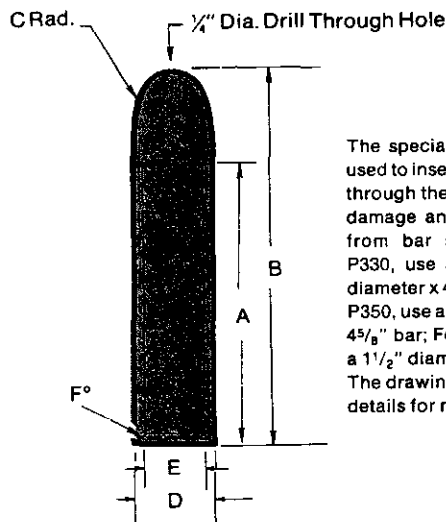
	A	B	C Dia.	D Dia.
P330	3.00	1.47	1.054 ^{+.000} / _{-.002}	1.250
P350	3.00	1.47	1.282 ^{+.000} / _{-.002}	1.625
P365	3.25	1.73	1.492 ^{+.000} / _{-.002}	1.750

Bushing Puller: The bushings in P330, P350 and P365 pumps may be removed from their bores using blind hole collet-type bushing pullers similar to those manufactured by Owatonna Tool Co. The table below illustrates the modifications necessary to adapt the OTC collets to this task. Equivalent pullers from other suppliers may be modified in similar fashion.

Pump	Modify Collet as Shown	Dimensions	Make From OTC Collet
P330	 C = .015" R. Maximum	A = $\frac{.980}{.970}$ B = $\frac{.875}{\text{(Ref.)}}$ C = $\frac{.100}{.090}$	33863
P350	 C = .015" R. Maximum	A = $\frac{1.122}{1.112}$ B = $\frac{1.000}{0.990}$ C = $\frac{.072}{.052}$	33864
P365	 C = .015" R. Maximum	A = $\frac{1.382}{1.372}$ B = $\frac{1.260}{1.250}$ C = $\frac{0.100}{0.120}$	33865

	A	B	C Radius	D Dia.	E Dia.	F° chamfer
P330	3 3/8"	4 1/2"	9/16"	1.065 ^{+.000} / _{-.002}	1.002 ^{+.002} / _{-.000}	.015" x 45°
P350	3 3/8"	4 1/2"	9/16"	1.290 ^{+.000} / _{-.002}	1.250 ^{+.002} / _{-.000}	0.15" x 60°
P365	3 3/8"	4 1/2"	9/16"	1.377 ^{+.000} / _{-.002}	1.250 ^{+.002} / _{-.000}	.063 x 60°

All external surfaces must be free of scratches and burrs.



The special steel sleeve is used to insert the drive shaft through the lip seal without damage and can be made from bar stock: For the P330, use a 1 1/8" or 1 1/4" diameter x 4 5/8" bar; For the P350, use a 1 3/8" diameter x 4 5/8" bar; For the P365, use a 1 1/2" diameter x 4 5/8" bar. The drawing and chart give details for making this tool.

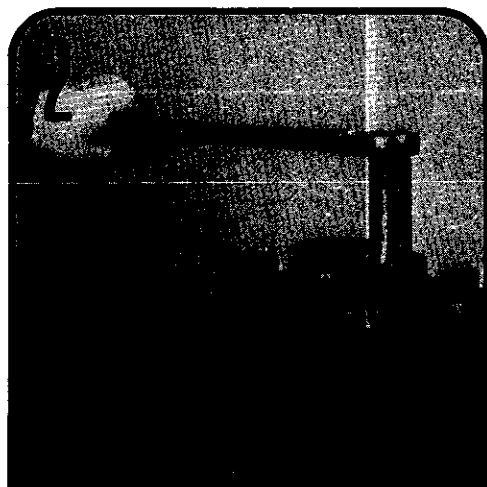
CAUTION:

1. If prying off sections becomes necessary, take extreme care not to mar or damage machined surfaces. Excessive force while prying can result in misalignment and seriously damage parts.
2. If parts are difficult to fit during assembly, tap gently with a soft hammer (never use an iron hammer).
3. Gears are closely matched, therefore they must be kept together as sets when removed from a unit. Handle with care to avoid damage to the journals or teeth. Avoid touching gear journals.
4. Never hammer bushings into bores, use an arbor press.

start disassembly here



Place the pump in a vise with the drive shaft pointing down. Caution: **DO NOT GRIP ON OR NEAR ANY MACHINED SURFACES DURING ASSEMBLY OR DISASSEMBLY.** Match-mark all sections. Be sure to align these marks when reassembling.



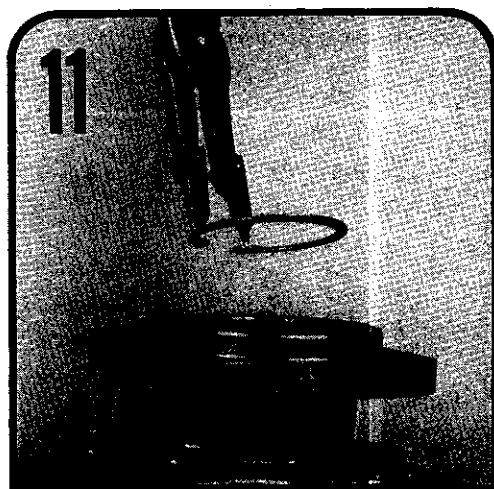
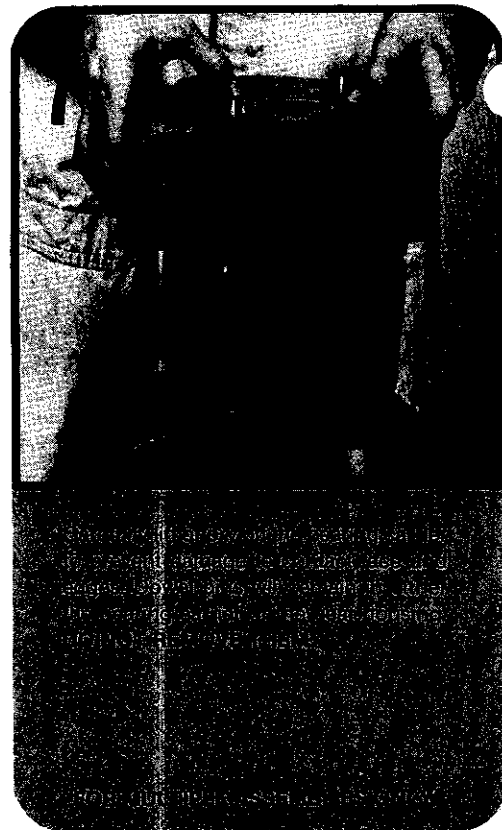
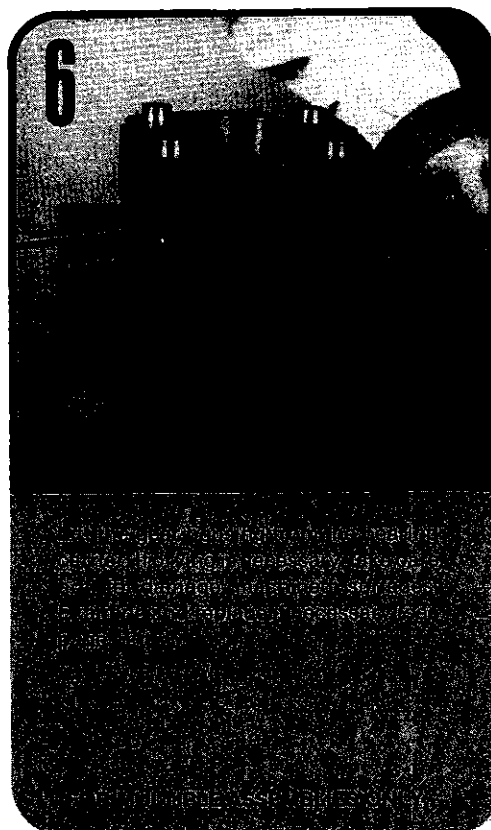
Use a socket wrench to remove the 4 cap screws on single units or the 4 hex nuts, studs and washers of multiple units.



Lift off the port end cover. If prying is necessary, be careful not to damage the machined surfaces. Dowel pins will remain in either port end cover or gear housing. **Do not remove.**



Remove the thrust plate. Examine and replace if necessary. See wear guide page 12.



If the pump is equipped with an out-board bearing, place the shaft end cover in the vise with the mounting face up. Remove the snap ring with snap ring pliers. If unit is equipped with a spiral lock retaining ring, remove with a small screwdriver or awl.



Use a bearing puller to remove the out-board bearing.



Grip the shaft end cover in a vise with the mounting face down. Remove double lip seal by inserting the special seal removal tool (see Tool List) into the notch between the double lip seal and the shaft end cover. Tap the seal out and discard. Remove and discard all rubber and polymer seals.



Remove the connecting shaft. Remove the thrust plate. Examine and replace if necessary. (See page 12). Remove the driven gear and the integral gear and drive shaft. Keep these together as they are a matched set. Examine and replace if necessary. *See page 12. Be careful not to damage the machined surfaces of the gears.

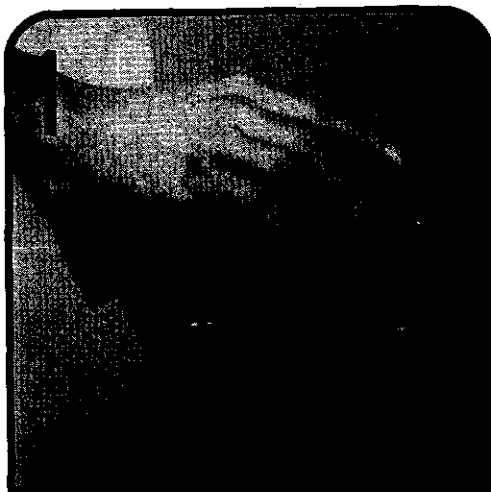


Lift or pry off the first section gear housing. Be careful not to damage machined surfaces. Examine and replace if necessary (see page 12).

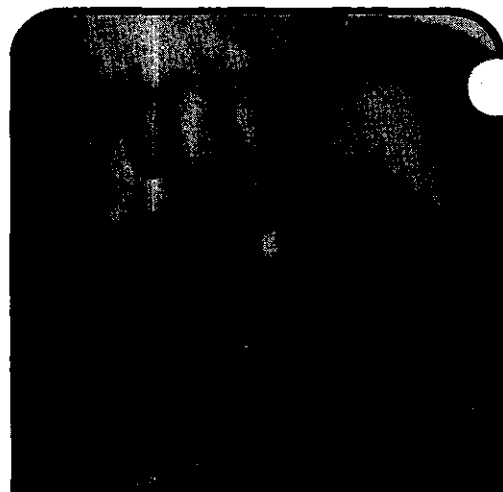


Inspect all bushings for scoring or discoloration and replace if necessary. Use a bushing puller as shown in the tool list to remove bushings (see page 12).

start assembly here



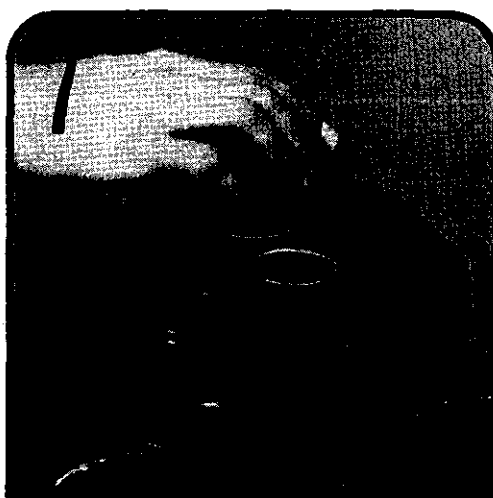
Stone all machined surfaces with a medium grit carborundum stone.



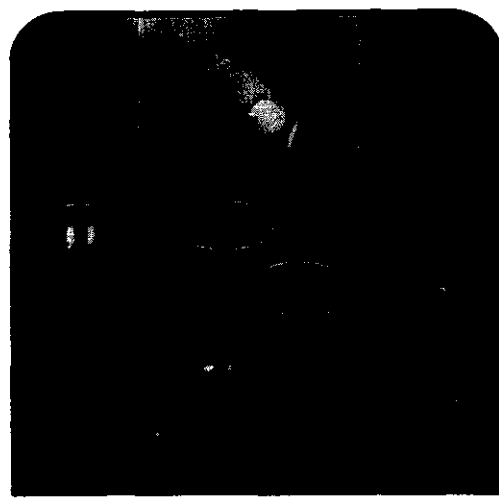
If bushings have been removed, deburr the bushing bores with emery cloth. Rinse parts in a solvent. Air blast all parts and wipe with a clean lintless cloth before starting assembly.



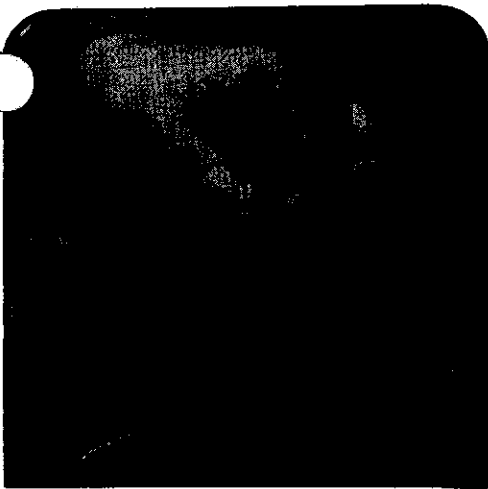
Bushings should be pressed into the bores, one at a time using the special installation tool and an arbor press. Be sure the grooves are positioned as stated in Step #5. Bushings must be pressed into the bores flush with the casting face. Be sure to support the castings so they are square and level.



Repeat Steps 1 and 2, stone and rinse parts.

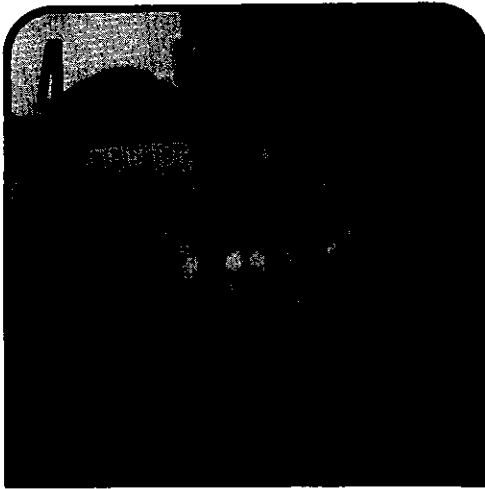


See that dowel pins are in place in any new castings. Examine all dowels. (See page 12). Before inserting make certain the hole is clean and free from burrs. Gently start pin straight into hole and tap lightly with a soft hammer.



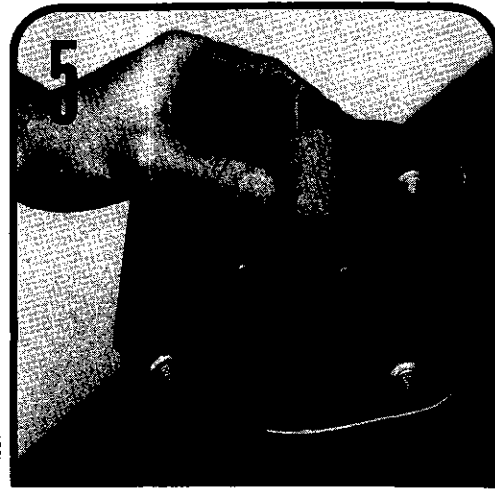
Grip shaft end cover in vise with mounting face down. Examine plug or plugs* to be sure they're tightly in place. Replacement is necessary only if parts are damaged. Remove with screwdriver.

*P330 has two plugs in both the shaft end and port end covers. P350 and P365 have one plug on the outlet side of their shaft end and port end covers.



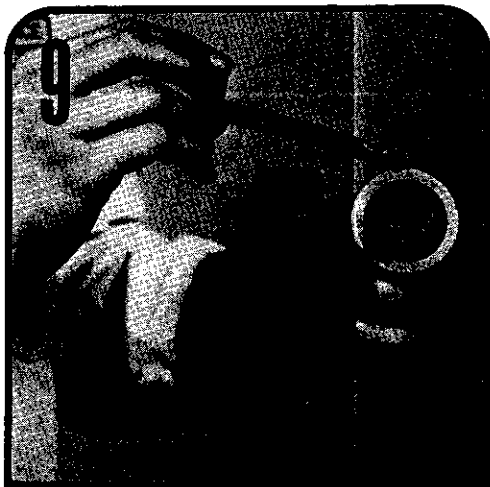
New plugs should be screwed in tightly. Stake plug with prick punch at both ends of screwdriver slot and around edges. Peen edge of hole $\frac{1}{32}$ " to $\frac{1}{16}$ " with $1\frac{1}{2}$ " diameter steel ball.

NOTE: If new plug or plugs are being installed coat threads with Loctite thread sealant.



ASSEMBLY STEPS 5, 6, 7 AND 8 APPLY TO SHAFT END COVER, BEARING CARRIERS AND PORT END COVER.

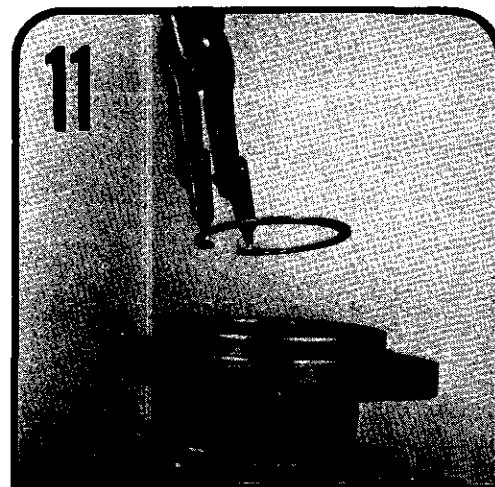
Any bushings removed from the shaft end cover, port end cover or bearing carrier should be assembled in drive bores with groove to the top of unit (12 o'clock). Assemble bushings in driven bores with the groove to bottom of unit (6 o'clock).



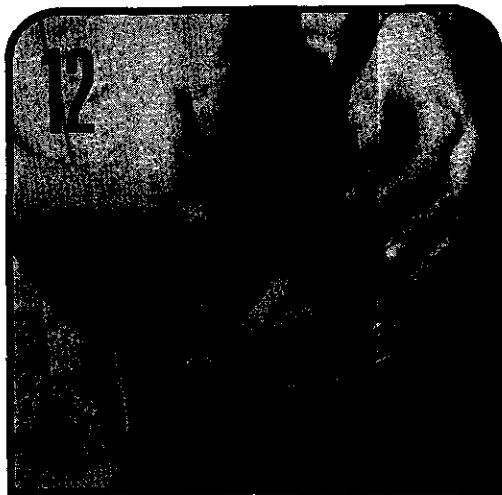
Before inserting a new lip seal in the shaft end cover, coat the outer edge of the lip seal and its recess with Permatex Aviation Form-A-Gasket No. 3 non-hardening sealant or equivalent. With the metal side of the lip seal up, press it into the mounting flange side of the shaft end cover with an arbor press and bar (see Tool List). Be careful not to damage the lip of the seal. Press in until flush with the recess. Wipe off excess sealant.



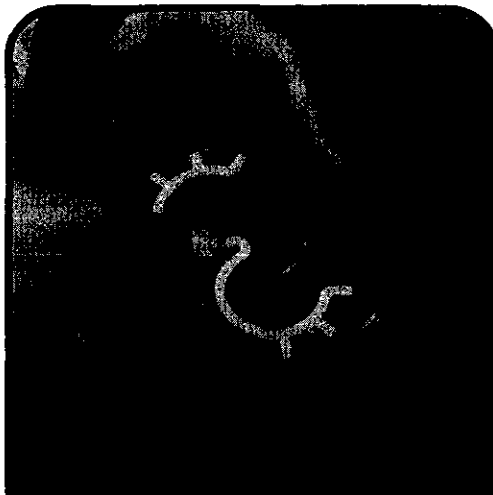
If the unit is equipped with an outboard bearing, guide the bearing into its recess in the shaft end cover. This is a light press fit. It may be necessary to lightly tap the bearing into the bore.



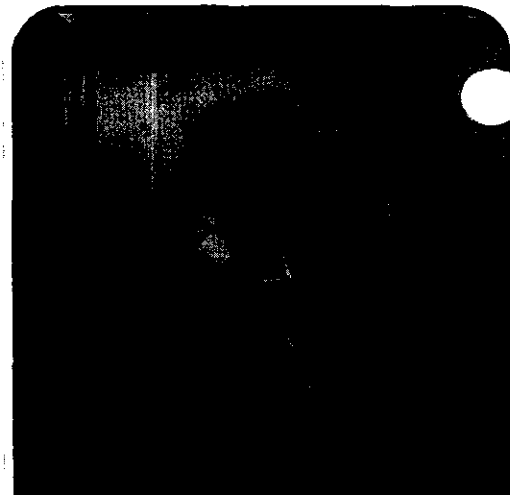
If the pump is equipped with an outboard bearing, place the shaft end cover in the vise with the mounting face up. Remove the snap ring with snap ring pliers. If unit is equipped with a spiral lock retaining ring, remove with a small screwdriver or awl. Install the snap ring in the groove to retain the outboard bearing.



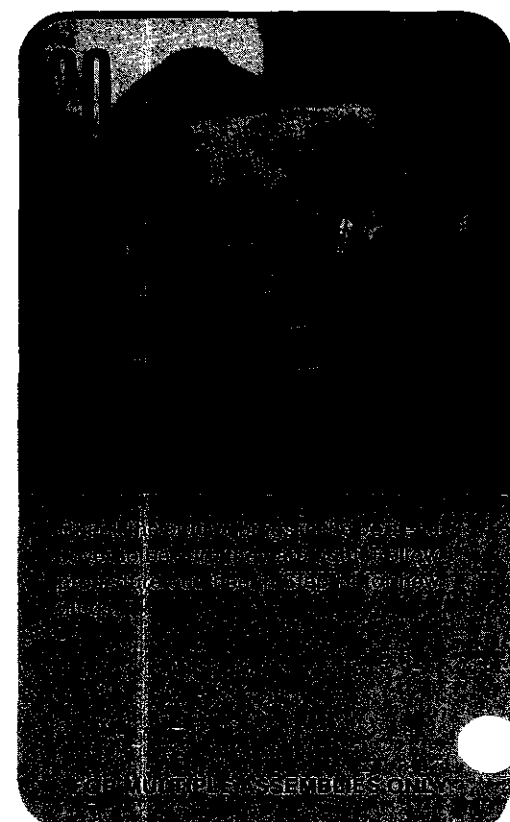
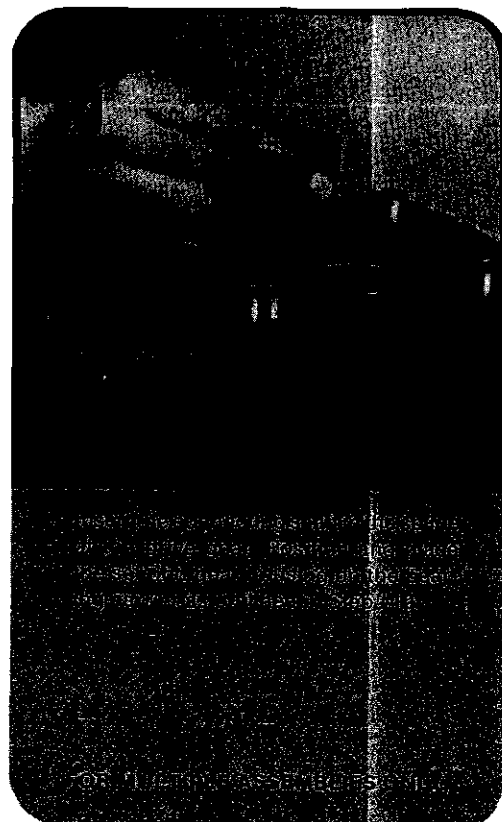
Grease the new gasket seals and insert them into the grooves in both sides of all gear housings. Position the first gear housing over the shaft end cover and dowels. Tap it with a soft hammer until it rests tightly against the shaft end cover. Be careful not to pinch the gasket seal. Also be sure the large rounded core is on the inlet side.

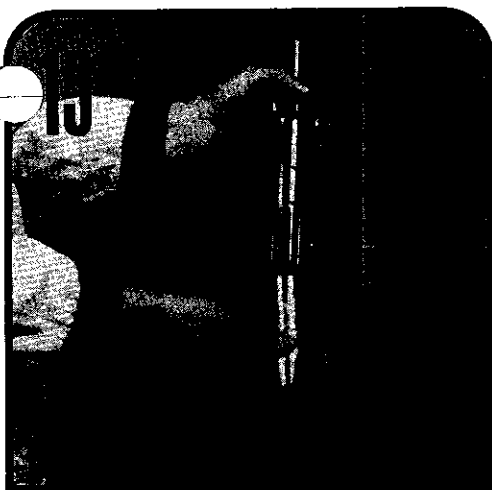


Assemble the channel seals into the grooves in the thrust plates with the flat side of the seal facing away from the thrust plate as shown below.

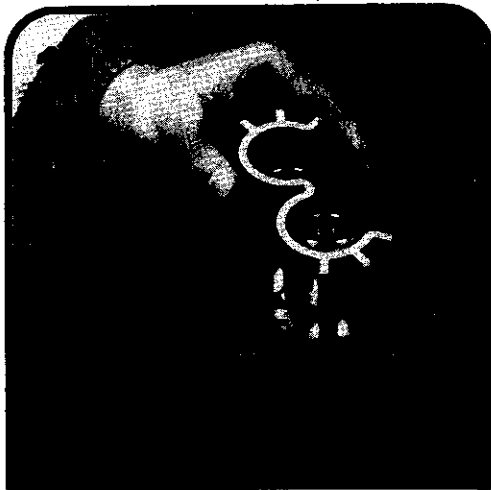


Gently slip the thrust plate through the gear housing and into place on the shaft end cover. The channel seal from Step #13 should face the shaft end cover. The relief groove in the plate should face the outlet side of the pump.

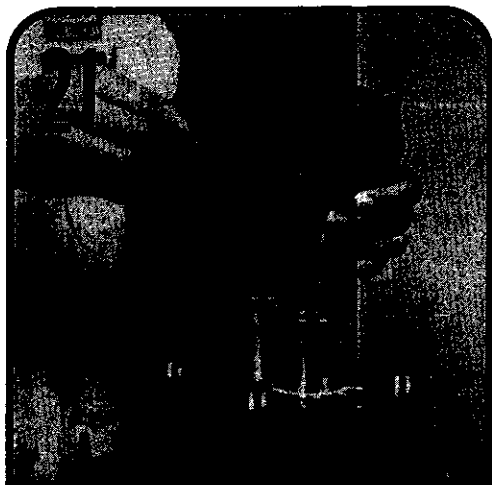
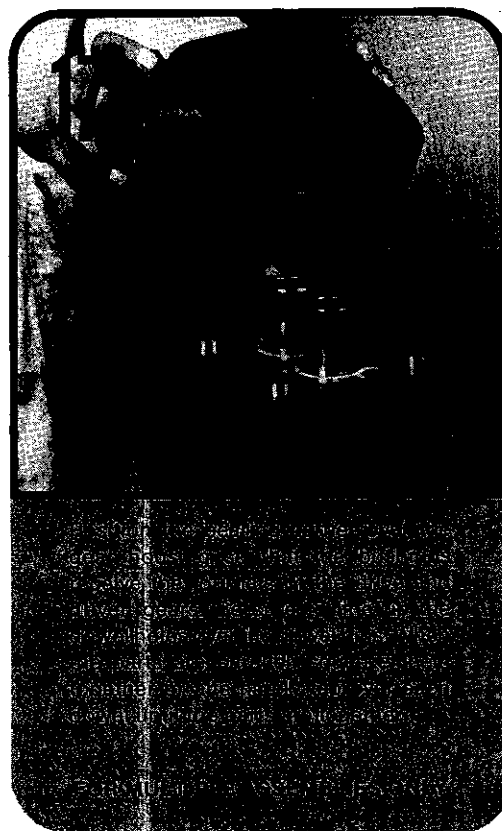




Slide the driven gear through the housing and into the bushing in the shaft end cover. Coat the steel sleeve tool with grease. Place the lightly greased drive shaft inside the sleeve and slide both through the shaft end cover with a twisting motion until the integral gear rests against the thrust plate. Avoid damaging the double lip seal. Remove the steel sleeve. Squirt clean oil over the gears.



Slip thrust plate with seal over gear journals and into housing bore. The flat side of the seal should face up with the relief groove facing the outlet side. For single pump assemblies go directly to Step #21 as your next step.



Place the port end cover over the gear journals. Align the dowels with the holes in the mating casting. Being careful not to pinch the gasket seal, tap the port end cover lightly in the center between bearing bores to engage the dowels and to move parts together in final seating.



Thread the 4 fasteners (cap screws and washers, or studs, washers, and nuts) into the shaft end cover and tighten alternately or cross-corner. Rotate the drive shaft with a 6" wrench to make certain there is no binding in the pump. After the fasteners are tight and you are sure there is no internal binding, torque the diagonally opposite fasteners to 200 ft. lbs. (2400 in. lbs.).

***As a guide in answering the question, "How much wear is allowed before the part should be replaced?",**

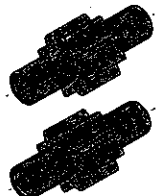
We offer the following suggestions...



GEAR HOUSINGS:

Wear in excess of .005" cut-out necessitates replacement of the gear housing. Place a straight-edge across bore. If you can slip a .005" feeler gage under the straight-edge in the cut-out area, replace the gear housing.

Pressure pushes the gears against the housing on the low pressure side. As the hubs and bushings wear, the cut-out becomes more pronounced. Excessive cut-out in a short period of time indicates excessive pressure or oil contamination. If the relief valve settings are within prescribed limits, check for shock pressures or tampering. Withdraw oil sample and check it, and tank, for dirt. Where cut-out is moderate, .005" or less, gear housing is in good condition and may be reused.



GEARS:

Any scoring on gear hubs necessitates replacement. Scoring, grooving, or burring of outside diameter of teeth requires replacement. Nicking, grooving, or fretting of teeth surfaces also necessitates replacement.



DRIVE SHAFTS:

Replace if there is any wear detectable by touch in the seal area or at the drive coupling. .002" wear is the maximum allowable.

Wear in the shaft seal area indicates oil contamination. Wear or damage to splines, keys, or keyways necessitates replacement.



THRUST PLATES:

The thrust plates seal the gear section at the sides of the gears. Wear here will allow internal slippage, that is, oil will bypass within the pump.

A maximum of .002" wear is allowable. Replace thrust plates if they are scored, eroded or pitted.

Check center of thrust plates where the gears mesh. Erosion here indicates oil contamination.

Pitted thrust plates indicate cavitation or oil aeration.

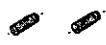
Discolored thrust plates indicate overheating, probably insufficient oil.



DOWEL PINS:

If either the dowel or dowel hole is damaged, the dowel or machined casting, or both, must be replaced.

If more than reasonable force is required to seat dowels, the cause may be poorly deburred or dirty parts; cocking of dowel in the hole; or improper pin-to-hole fit.



BUSHINGS:

If gears are replaced, bushings must be replaced. Bushings should fit into bore with a heavy press fit.



SEALS AND GASKETS:

Replace all rubber and polymer seals, including all "O" rings, thrust plate channel seals, shaft seal and gasket seals.



PLUGS:

Examine the plugs in the shaft end and port end cover to make sure they are in the proper position and tight. The P330 should have two plugs in both the shaft end and port end. The P350 and P365 have one plug in their shaft and port ends high pressure side only.



Lubrication and oil recommendations

All parts, with the exception of the outboard bearing, are lubricated by the hydraulic oil in the circuit. Particular attention must be paid to keep the oil in the circuit system clean. Whenever there is a pump or motor failure, and there is reason to feel that metal particles may be in the system, the oil must be drained, the entire system flushed clean, and any filter screens thoroughly cleaned or replaced. New oil should be supplied for the entire system. Oil suitable and recommended for use in circuits involving Commercial's pumps and motors should meet the following specifications:

- Viscosity:**
- 50 SSU minimum @ operating temperature
 - 7500 SSU maximum @ starting temperature
 - 150 to 225 SSU @ 100° F. (37.8° C.) (generally)
 - 44 to 48 SSU @ 210° F. (98.9° C.) (generally)

Oil Grade	Approximate SSU at...	
	100° F. (37.8° C.)	210° F. (98.9° C.)
SAE 10	150	43
SAE 20	330	51

Viscosity Index: 90 minimum

Aniline Point: +175° F. (80° C.) minimum

Recommended Additives: Foam depressant, rust and oxidation inhibitors.

Filtration: 10 micron recommended for maximum pump life.

Other Desirable Characteristics:

- Stability of physical and chemical characteristics.
- High demulsibility (low emulsibility) for separation of water, air and contaminants.
- Resistant to the formation of gums, sludges, acids, tars and varnishes.
- High lubricity and film strength.

General Recommendations:

A good quality hydraulic oil conforming to the characteristics listed above is essential to satisfactory performance and long life of any hydraulic system.

Oil should be changed on regular schedules in accordance with the manufacturer's recommendations and the system periodically flushed.

Oil temperature in reservoir must not exceed 200° F., (93.3° C.) with a maximum temperature of 180° F. (82.2° C.) recommended. Higher temperatures will result in rapid oil deterioration.

Reservoir capacity should equal in gallons the pump output in gpm or the total gpm of all pumps where there is more than one in the system.

Oil poured into the reservoir should pass through a 100 mesh screen. Pour only clean oil from clean containers into the reservoir. A 100 mesh screen may be used in the suction line leading to the pump. A suction filter should be of sufficient size to handle twice the pump capacity. It must be cleaned and checked regularly to avoid damage due to contamination and cavitation.

Normal Temperatures:

0° F. (—18° C.) to 100° F. (37.8° C.) Ambient
100° F. (37.8° C.) to 180° F. (82.2° C.) System

Be sure your oil is recommended for the temperatures you expect to encounter.

Cold Weather Operation:

Oils for use in cold weather should have a viscosity not exceeding 7500 SSU at the minimum start-up temperature. A pour point of at least 20°F. below start-up temperature is recommended. Start-up procedures should allow for a gradual warm-up until the oil reaches a reasonably fluid state.

The Use of Other Fluids:

- Automatic Transmission Fluid (ATF): General experience here has been satisfactory; however, ATF oils are sometimes too expensive for normal use in hydraulic systems.
- Diesel Fuel or Kerosene (Coal Oil): Sometimes used as dilutants for cold weather operations but are not recommended as they are not sufficiently refined products.
- Fire Resistant Fluids: DO NOT USE ANY FIRE RESISTANT FLUIDS OR NON-PETROLEUM OILS WITHOUT CONSULTING OUR TECHNICAL SERVICE DEPARTMENT.
- These suggestions are intended as a guide only. OBTAIN YOUR FINAL FLUID RECOMMENDATIONS FROM YOUR FLUID SUPPLIER.

recommended start-up procedure for new or rebuilt pump

Before installing a new or rebuilt pump, back off the main relief valve until the spring tension on the adjusting screw is relieved. This will avoid the possibility of immediate damage to the replacement unit in the event that the relief valve setting had been increased beyond the recommended operating pressure prior to removing the old unit.

Before connecting any lines to the pump, fill all ports with clean oil to provide initial lubrication. This is particularly important if the unit is located above the oil reservoir.

After connecting the lines and mounting the replacement unit, operate the pump at least two minutes at no load and at low rpm (400 min.) During this break-in period, the unit should run free and not develop an excessive amount of heat. If the unit operates properly, speed and pressure can then be increased to normal operating settings.

Reset the main relief valve to its proper setting while the pump is running at maximum operating engine (motor) speed for the vehicle.

**ALWAYS USE AN ACCURATE GAGE WHEN ADJUSTING
THE RELIEF VALVE PRESSURE SETTING.**

recommended test procedure

Be sure there is an adequate supply of oil for the pump, at least one gallon of oil for each gpm of pump capacity.

If one section of a tandem pump is being tested, make sure that all other sections not being tested are adequately supplied with oil. If any of the other sections run dry, or if plugs are left in ports, serious and permanent damage will result.

The oil should be a good quality hydraulic oil rated at 150 SSU at 100° F., with the oil temperature held at 120° F. plus or minus 5° F. (Test procedures are described in detail in SAE handbooks; see Hydraulic Power Pump Test Procedure, SAE J745c.)

The feed line must be of adequate size with no more than 5" mercury vacuum adjacent to the pump inlet. As a rule, the feed line must provide a feed flow velocity not in excess of 8 feet per second.

Feeding hot oil into a cold pump may cause the pump to seize. Jog the pump by momentarily starting the driving engine or motor to gradually equalize pump and oil temperatures.

Run the pump at least two minutes at no load and moderate speed (not over 1500 rpm). If the pump becomes excessively hot, shut down immediately and locate the problem source.

Gradually increase pressure on pump, in 500 psi increments until the desired test pressure has been reached. This should take about five minutes.

Delivery should run close to rated catalog performance figures which are averaged from testing several pumps. Something like a 5% lower reading may be used as a rated minimum if new or relatively new parts have been used. When rebuilding the pump with parts from the original pump, which, while worn, appear satisfactory for reuse, a 10% or 15% lower reading may be permitted, depending on the performance expected from the equipment. One's own experience will prove the best guide here.

Many repairmen measure the output at normal operating speed and at zero pressure, then again at 1000 psi (or the operating pressure of the equipment) and allow a volume decrease approximating the listing below. It is a suggested reference only which makes allowance for reused parts.

GPM DELIVERY at 1800 rpm	GPM DROP OFF AT...		
	1000 psi/70 bar	2000 psi/140 bar	3000 psi/210 bar
10-30	1½-3	2-3½	2½-4
30-50	2-3	2½-4	3-4½
50-70	2½-3½	3-5	3½-5½

At test speeds other than 1800 rpm, gpm delivery will vary almost proportionately, but the same (drop-off) figures should be used.

Be sure to run the pump in the direction for which it was designed and built. Driving pump in the wrong direction will build up pressure behind shaft seal, damaging it and necessitating replacement.

After completing testing procedures, pump is ready for installation and immediate duty operation on equipment. Again, it must be remembered that to prevent seizure, hot oil must not be fed into a cold pump.

8. The following information is provided for the year ended 31/12/2014:
 9. The following information is provided for the year ended 31/12/2014:
 10. The following information is provided for the year ended 31/12/2014:
 11. The following information is provided for the year ended 31/12/2014:

the 1990s, the number of people in the world who are illiterate has increased from 750 million to 850 million. The number of illiterate people in the world is projected to increase to 900 million by the year 2015. The number of illiterate people in the world is projected to increase to 950 million by the year 2020. The number of illiterate people in the world is projected to increase to 1 billion by the year 2025. The number of illiterate people in the world is projected to increase to 1.1 billion by the year 2030. The number of illiterate people in the world is projected to increase to 1.2 billion by the year 2035. The number of illiterate people in the world is projected to increase to 1.3 billion by the year 2040. The number of illiterate people in the world is projected to increase to 1.4 billion by the year 2045. The number of illiterate people in the world is projected to increase to 1.5 billion by the year 2050. The number of illiterate people in the world is projected to increase to 1.6 billion by the year 2055. The number of illiterate people in the world is projected to increase to 1.7 billion by the year 2060. The number of illiterate people in the world is projected to increase to 1.8 billion by the year 2065. The number of illiterate people in the world is projected to increase to 1.9 billion by the year 2070. The number of illiterate people in the world is projected to increase to 2 billion by the year 2075. The number of illiterate people in the world is projected to increase to 2.1 billion by the year 2080. The number of illiterate people in the world is projected to increase to 2.2 billion by the year 2085. The number of illiterate people in the world is projected to increase to 2.3 billion by the year 2090. The number of illiterate people in the world is projected to increase to 2.4 billion by the year 2095. The number of illiterate people in the world is projected to increase to 2.5 billion by the year 2100.

