How To Treat Your Type P Triplex Mud Pump

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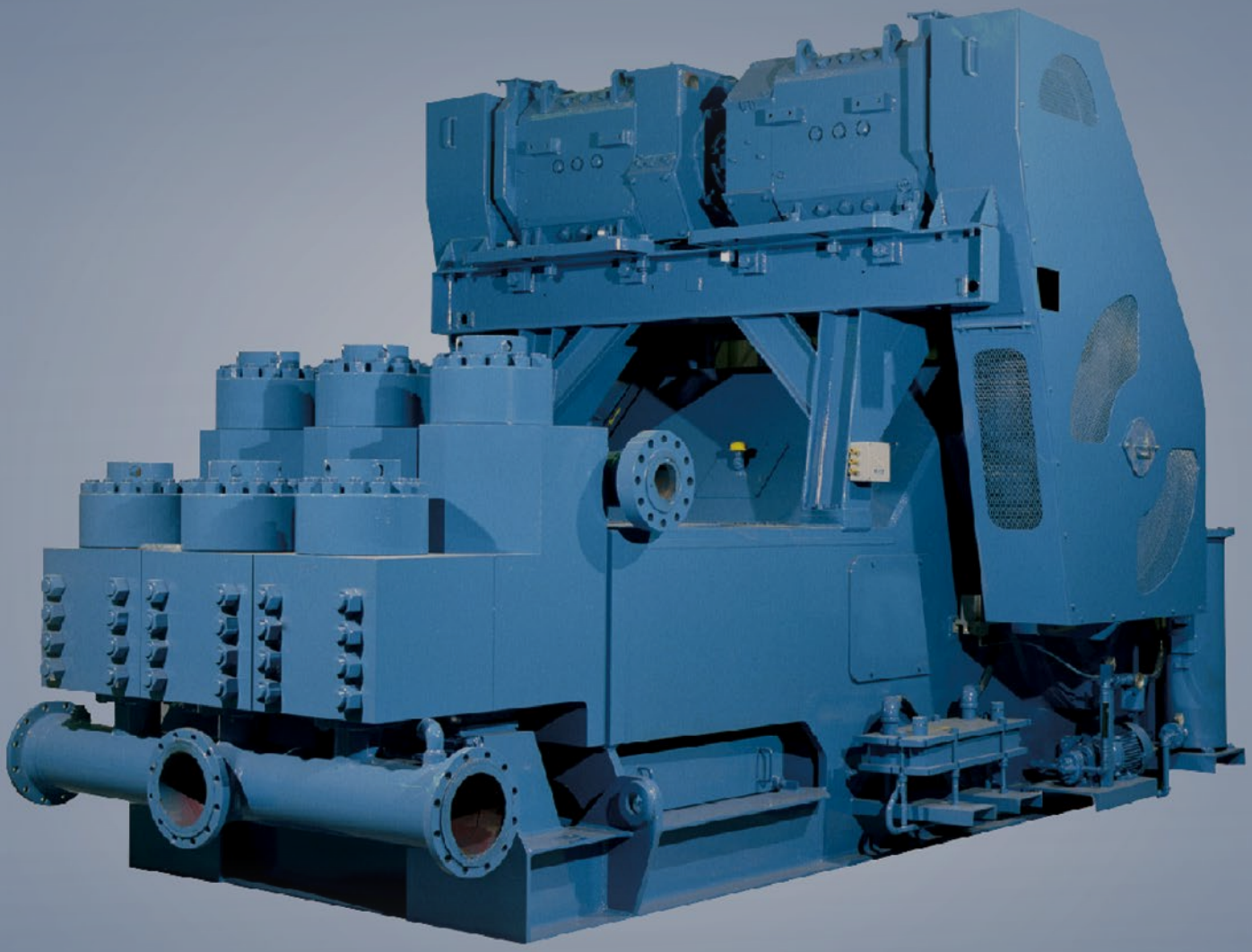

NOV

How to Treat Your Type P Triplex Mud Pump

This manual outlines the proper care of NOV Type P Triplex Mud Pumps and MISSION™ Fluid End Parts. It will help ensure efficient performance, long service life, and low maintenance costs.

NOV Type P Mud Pumps are exceptionally durable. But like other well-engineered and precisely manufactured machinery, you get more for your pump dollar with proper, scheduled maintenance. These recommendations can help you minimize costly downtime and achieve maximum performance from your pump and fluid end parts.

Only knowledgeable, experienced service personnel should perform maintenance procedures. If in doubt, contact NOV Service Department for assistance. The pictures, photographs, charts, diagrams, drawings, and specifications contained herein are not to be construed as giving rise to any warranty on the part of NOV. NOV makes no warranty, either expressed or implied, beyond that stipulated in NOV's Standard Terms and Conditions of Sale.

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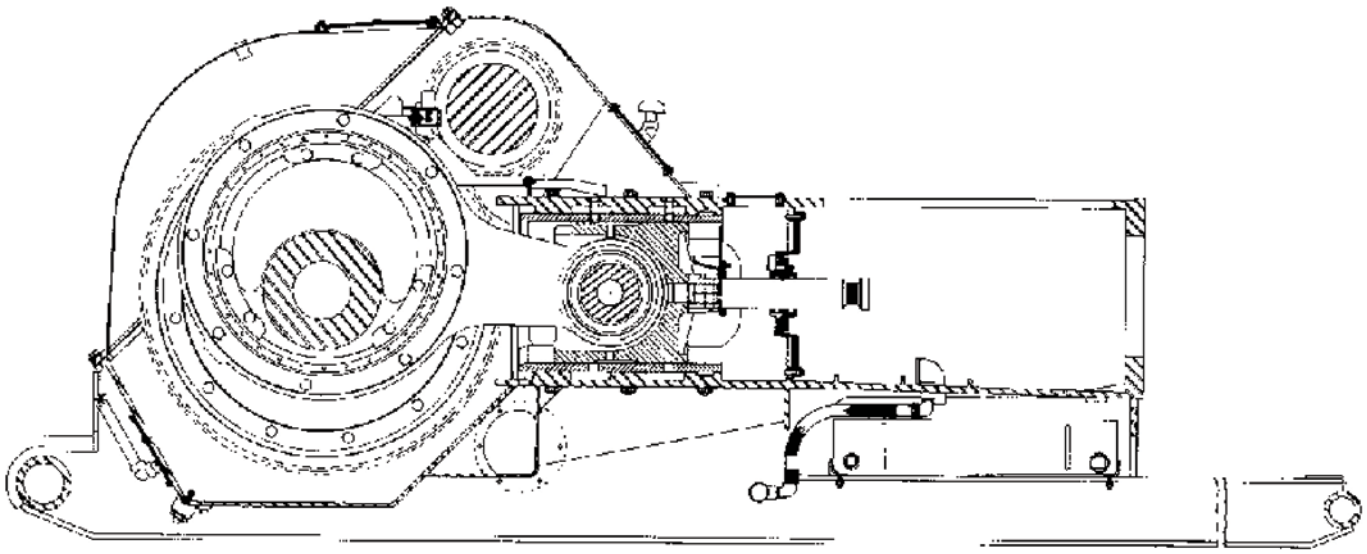
Power End

The power end of a single-acting triplex mud pump is a speed reducer-slider crank mechanism using gears, bearings, crossheads, and crosshead liners. Reliable, long-life service primarily depends on proper lubrication. Routine power end maintenance must focus on the pump's lubrication system as well as the care and periodic inspection of associated components.



Lubrication System

All NOV Type P Triplex Mud Pumps have a splash-gravity flow lubrication system. It relies on the rotation of the crankshaft gear to pick up lubricant from the sump. Wiper arms mounted adjacent to the gear catch oil from the gear and distribute it to the bearings and crossheads. On the largest pump (14-P-220), an electrical lube pump facilitates the splash system by supplying oil at low revolutions per minute (less than 20 RPM).

The pump can operate as slow as 5 strokes per minute (SPM) (except where noted on the 14-P-220) and still achieve proper lubrication of the power end components. However, whenever the pump operates between 5 and 30 SPM, remove the crosshead hand hole covers on each side of the pump and check to see that the crossheads have gear oil. If sufficient lubricant is not flowing over the crossheads, readjust the wiper arms 1⁄16 to 1⁄32 in. away from the side of the gear.

Check the wiper arms, lubrication trough, and fastener tightness at every routine oil change.

Recommended Lubricants for Power End

Fill the power end of the pump with industrial-type extreme pressure gear oil of suitable viscosity for the air temperature surrounding the power end, as indicated below.

U.S. Units of Measure	
Temperature	**AGMA Industrial EP Gear Oil**
+50°F to +155°F	AGMA #7 EP or ASTM/ISO-VG Grade 460 (Viscosity 2214 - 2719 SSU @ 100°F)
+20°F to +100°F	AGMA #6 EP or ASTM/ISO-VG Grade 320 (Viscosity 1533 - 1881 SSU @ 100°F)
-20F to +60°F	AGMA #2 EP or ASTM/ISO-VG Grade 68 (Viscosity 318 - 389 SSU @ 100°F)

Metric Units of Measure	
Temperature	**AGMA Industrial EP Gear Oil**
+10°C to +68°C	AGMA #7 EP or ASTM/ISO-VG Grade 460 (Viscosity 414 - 506 cSt @ 40°C)
-7°C to +38°C	AGMA #6 EP or ASTM/ISO-VG Grade 320 (Viscosity 288 - 352 cSt @ 40°C)
-29°C to +16°C	AGMA #2 EP or ASTM/ISO-VG Grade 68 (Viscosity 61.2 - 74.8 cSt @ 40°C)

Before starting the pump for the first time or after storage, open the inspection covers and pour oil into the pinion-bearing oil trough and the crosshead oil reservoir to ensure immediate lubrication.

Gear Oil Capacities

Oil capacities for pumps are as follows:

Pumps	Oil Capacity	
	Gallons	Liters
7-P-50	70	265
8-P-80	85	322
9-P-100	95	360
10-P-130	90	341
12-P-160	130	492
14-P-220	175	662

Gear Oil Change Interval

Change gear oil every six months or as needed to maintain a clean, sludge-free condition. Change or filter the gear oil in a new pump through a 100-micron or finer filter after a one-month break-in period.

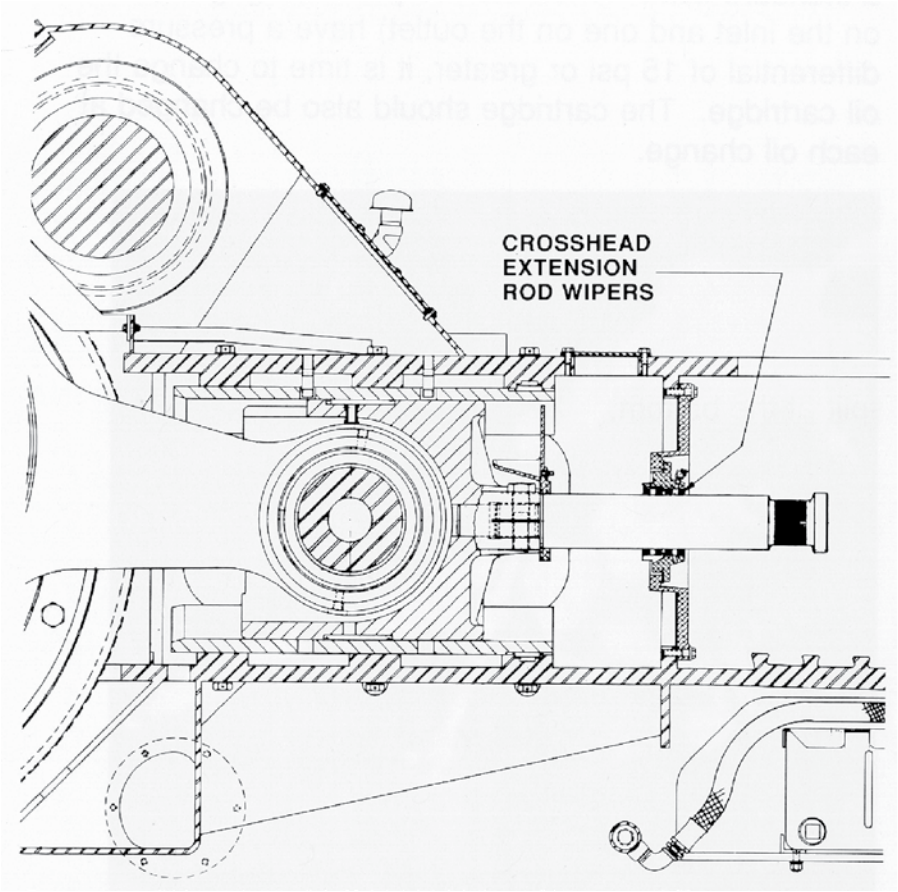
Magnets

Magnet assemblies installed at various locations in the power end collect ferrous iron particles, which may wear from the load-carrying surfaces of moving components. Remove and clean the multiple magnet assembly attached to the sump drain plug and the magnet installed in both upper lubrication troughs near the pinion shaft bearings during every routine power end oil change.

Note: On the 14-P-220, an external oil cartridge filter is a standard item. When the two pressure gages (one on the inlet and one on the outlet) have a pressure differential of 15 psi or more, it is time to change the oil cartridge. Also, change the cartridge at each oil change. There is also a magnetic filter mounted between the gear pump and filter.

Crosshead Extension (Pony) Rod Wipers

Crosshead extension rod wipers are the vital barrier between the power end and piston rod chambers. They confine gear oil to the power end and the splashing or spraying water and drilling mud to the rod chamber. All pumps have four wipers on each extension rod. A grease fitting is provided for pumping grease between the seals to form an additional barrier against mud entering the power end.



Inspect the crosshead extension rod wipers daily and replace them when there are signs of fluid leakage, lip damage, or wear. To maximize protection of the power end, change these wipers at least once a year. The grease fitting installed at the top of the wiper housing should be greased daily with one or two strokes of a hand grease gun filled with NLGI No. 1 multipurpose lithium base grease.

Follow the procedure below to change the wipers on the 7-P-50 through 12-P-160 models:

1. Loosen the two crosshead extension rod locking screws at the threaded end of the crosshead.

2. Remove the crosshead extension rod. Do not force wipers over the flanged end of the crosshead extension rod. They will not fit.

3. Install replacement wipers in the same quantity and position. Install the spacer with a split at the bottom.

4. Wipers must be clean and dry when installed in housing. Do not grease the wiper's outer diameter.

5. Grease pack new wipers to lubricate during run-in.

Follow the procedure below to replace the rod wipers on the 14-P-220 pump:

1. Remove the piston sub-rod.

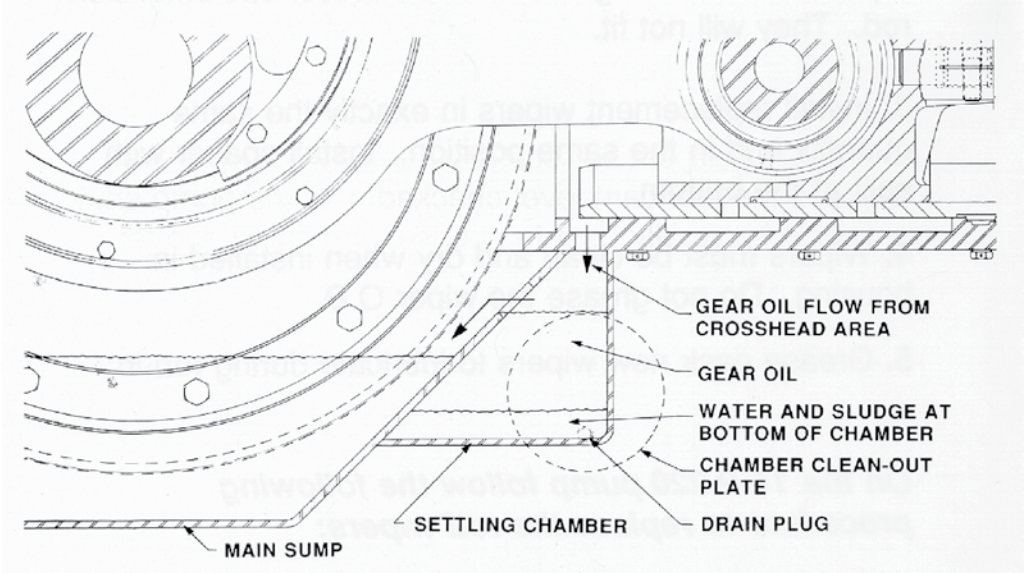
2. Remove the wipers over the beveled crosshead extension rod and install replacement wipers in the same quantity and position.

3. Wipers must be clean and dry when installed in housing. Do not grease the wiper's outer diameter.

4. Grease pack new wipers to lubricate during run-in.

Settling Chamber

A lubricant settling chamber located beneath the crossheads and forward of the lube oil sump collects and segregates water and contaminants from the gear oil.



The settling chamber has clean-out plates and drain plugs on each side of the pump. Once a week, pull the drain plug so any water accumulation in the chamber drains off. During routine power end oil changes, remove the clean-out plates and thoroughly clean the chamber of all sludge and sediment.

Gear Oil Sump

Thoroughly clean the gear oil main sump during every regular oil change. Remove accumulations of drilling mud and sludge to avoid contaminating the new gear oil. Also, routinely clean the sump and power end frame walls to facilitate the proper dissipation of heat from the lubricant into the air surrounding the sump. Remove the dipstick cover plate from the sump to allow cleaning.

Dipstick

Pull the gear oil dipstick at least once a day and check the lubricant level with the pump shut down.

Wait several minutes after shutting the pump down to allow the lubricant level to stabilize in the sump and permit accurate readings.

Fluid End

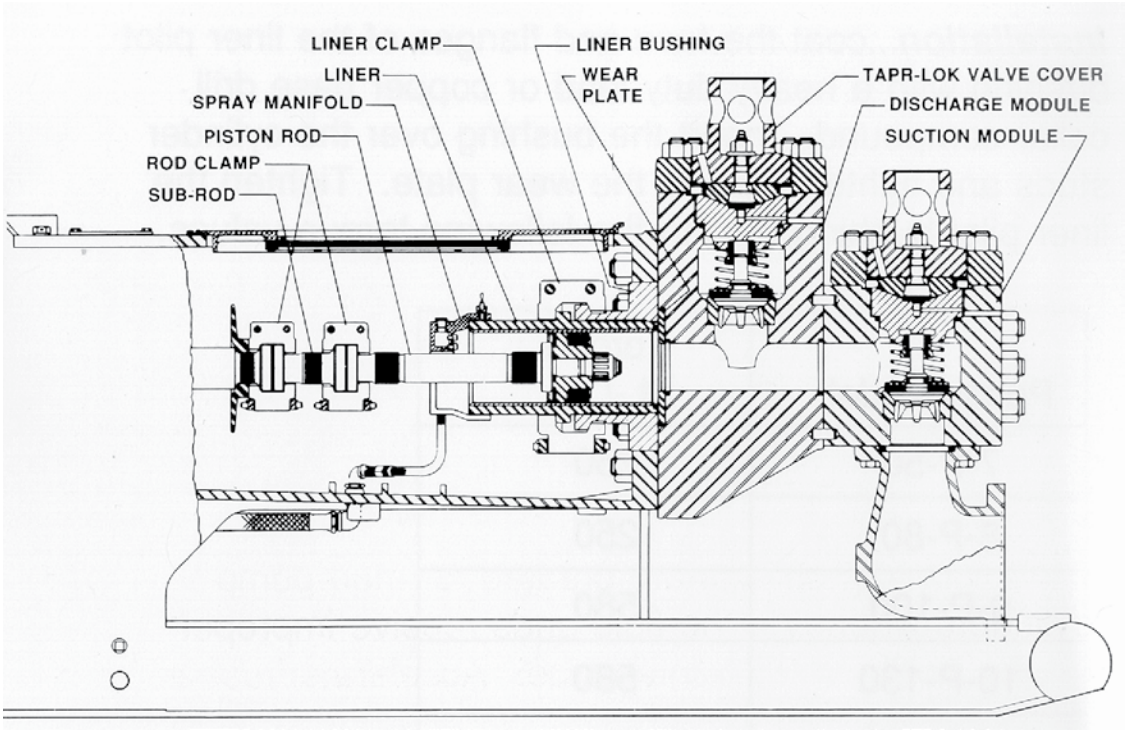
Economical and reliable service from triplex mud pump fluid cylinders and expendables also depends on a continuous and thorough maintenance program.

The current trend is toward higher pump pressures, faster speeds, reduced rig turnaround times, more corrosive drilling muds, and extended drilling duration due to improved bit performance. All these factors expose mud pump fluid ends to higher stress levels and fatigue life problems.

Fluid ends that receive improper and/or insufficient maintenance create additional problems for mud pump cylinders. Accelerated use of fluid end expendables, broken valve covers and cylinder studs, washouts, and unrepairable cracks in the cylinders are frequently symptoms of poor fluid end maintenance.

Each component and the maintenance requirements will be discussed to ensure dependable performance from pump fluid ends and assist the crew members in developing proper servicing procedures.

Note: Before working on the fluid end of an operating pump, close the shut-off valve in the discharge line and open the bypass line to the mud tanks. This relieves any pressure in the cylinders and eliminates the danger of opening a valve pot or removing a liner clamp while the part is still under load.



Cylinders

NOV Triplex Mud Pump cylinders are of modular construction. There are three discharge modules and three suction modules. The modules are interchangeable so that the discharge and suction modules will fit the right-hand, center, or left-hand positions on the pump.

Liner Pilot Bushing

Removal: Remove the piston rod, liner, and liner clamp from the rod chamber. Remove the six nuts that attach the liner bushing to the discharge module. Attach the pilot bushing removal tool to the bushing and piston rod hub. Rotate the pinion shaft of the pump with the pinion adapter to pull the bushing.

Installation: Coat the face and flanges of the liner pilot bushing with a heavy-duty, copper-based drill collar compound. Insert the bushing over the cylinder studs and tighten against the wear plate. Tighten the liner pilot bushing nuts to the following torque values.

Pump Model	Torque Ft.-Lbs.
7-P-50	250
8-P-80	250
9-P-100	580
10-P-130	580
12-P-160	780
14-P-220	1100

Wear Plate

Removal: Remove the liner pilot bushing. Install two ½- x 1½-in. screws (⅜- x 1½-in. screws for the 7-P-50 pump) into the tapped holes of the wear plate. Tightening the screws against the discharge module will force the wear plate out.

Installation: Install a new lightly greased seal in the counterbore of the discharge module. Follow with the wear plate.

Note: You can install a new wear plate on either side against the seal. If a used wear plate is reinstalled in the cylinder, keep the same side of the wear plate against the seal as originally installed. Never turn over or reverse a wear plate after use.

Suction Module

Removal: You can remove the suction module portion of the two-piece cylinder modules without disturbing the discharge module. Remove the cap screws connecting the suction module to the suction manifold and the nuts from the six studs holding it to the discharge module.

Replacement: Install a new, lightly greased seal in the packing counterbore of the discharge module. Slip the suction module into position against the discharge module with the two piloting dowel pins aligning the modules' mating faces. Torque the six stud nuts, which connect the suction module to the discharge module, to the following values, then mark the position of the nuts and tighten an additional two flats (one-third turn) past the mark.

Pump Model	Initial Torque Ft.-Lbs.	Final Torque
7-P-50	300	Additional Two Flats (One-Third Turn)
8-P-80	300	
9-P-100	300	
10-P-130	300	
12-P-160	500	
14-P-220	500	

Tighten the suction manifold to suction module cap screws to 380 ft.-lbs.

Discharge Module

Removal: You can remove the discharge module portion of the two-piece cylinder module without disturbing the adjacent modules. Remove the suction module and liner pilot bushing as previously described, remove the discharge connector screws, and slide the appropriate discharge connectors into the cylinder bores to provide clearance.

Remove the nuts holding the discharge module to the frame and slide it out over the suction manifold.

Replacement: Thoroughly grease the discharge connector and/or adapter and slide the packing into the groove on the outside diameter. The center discharge module uses connector adapters. The outside discharge module on the side facing the center module uses a drilled flange charge connector. Grease the bores in the cylinder modules and install the connectors and/or adapters in the appropriate modules. Position the adapters all the way into the center module. Push the connector in far enough to clear the center module at assembly.

Install the discharge module onto the frame and tighten the nuts finger tight. Do not tighten securely at this time.

Next, install the suction module, wear plate, and liner pilot bushing as previously described. Tighten the suction manifold to suction module cap screws to 380 ft.-lbs.

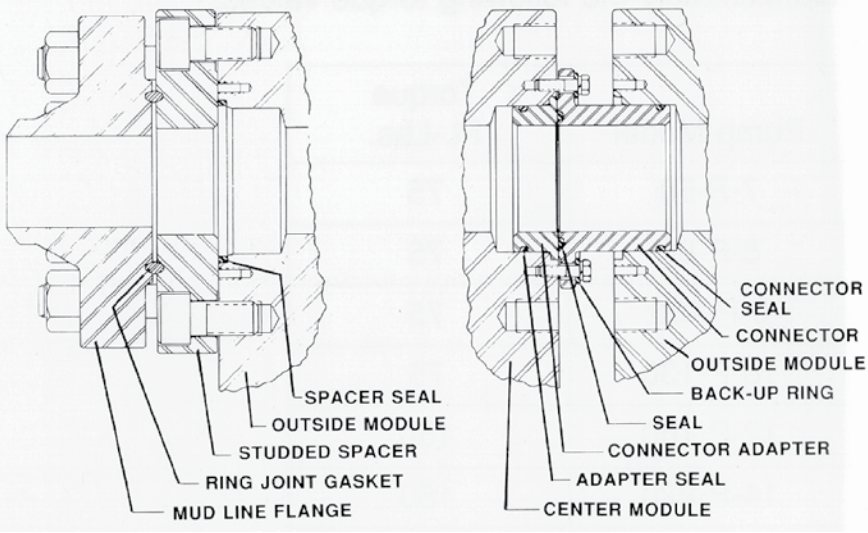
Tighten the discharge module on the frame face, torquing the nuts to the following values.

Pump Model	Torque Ft.-Lbs.
7-P-50	580
8-P-80	780
9-P-100	1100
10-P-130	1750
12-P-160	1460
14-P-220	1750

Note: The optional Jib Crane cannot lift the suction or discharge modules, it is for maintenance of expendable components. Refer to the Jib Crane load rating plate for weight limits.

Bring the drilled flange connector in the outside cylinder module against the center module, as shown below, trapping the packing in the groove of the connector flange next to the face of the adapter in the center cylinder module. Tighten in place using the segmental backup ring under the cap screws. Use approximately 75 ft-lbs. of torque on these cap screws.

Always tighten the discharge connectors last after securely tightening the suction manifold to the cylinders and the cylinders to the frame. This allows proper alignment of discharge connectors with the center cylinder module.



Piston Rods and Sub-Rods

There is a short sub-rod between the piston rod and the crosshead extension rod, so you can remove, inspect, or replace the piston without disturbing the liner. Since this adds another connection, alignment between the three rods becomes very important. Dowel fit pilots on each end of the sub-rod secure this alignment. They fit close tolerance holes in the ends of the crosshead extension and piston rods.

Handling these pilots and pilot holes with care is vital to avoid damage. Aside from making assembly and disassembly difficult, nicks and burrs could throw the piston rod off-center and cause rapid liner and piston wear. In making the crosshead extension rod-sub-rod-piston rod connections, coat the inside of the clamps with a heavy-duty, copper-based drill collar compound to forestall corrosion and make later disassembly easier. Tighten the clamp bolt. The clamp faces should never meet metal-to-metal. Tighten the bolt to approximately the following torque values.

Pump Model	Torque Ft.-Lbs.
7-P-50	75
8-P-80	75
9-P-100	75
10-P-130	75
12-P-160	150
14-P-220	150

Installation of Piston Onto Rod

When installing pistons onto piston rods, remove all mud and scale from the hubs and rods. Use a new, lightly greased packing ring between the piston hub and piston rod flange.

Slide the piston tight against the rod flange and then liberally oil the piston rod threads. Tighten the piston hub nut securely, but do not over-tighten. Use no more than one man on a 5-ft extension.

Replace the piston nuts after using them three or four times. The plastic locking element in the nut loses its ability to grip the rod threads if re-used too often. The nut could also back-off and damage the piston, piston rod, and/or wear plate.

Piston-Liner Installation

For a new installation or a liner and piston replacement, it may be more convenient to install the piston and rod into the liner outside the pump, then install the assembly into the pump as a unit. This is particularly true if the mud pump has an optional small hoist.

Thoroughly grease the inside of the liner and outside of the piston with cup grease. **Do not** use a metallic-base thread compound. Install the piston in the liner so that the piston nut is toward the end of the liner with the packing counterbore.

Remove all paint from the two pilot diameters on the outside of the liner. Coat the inside of the liner bushing and the pilot diameters on the outside of the liner with a heavy-duty, copper-based drill collar compound.

If necessary, rotate the pump using the wrench adapter provided for the end of the pinion shaft until the crosshead extension rod is at the back of the rod chamber. Ensure you secure the liner packing to the counterbore at the end of the liner. Slip the liner and piston assembly into the liner bushing and against the cylinder wear plate.

Coat the clamping surfaces of the liner clamp with a heavy-duty, copper-based drill collar compound. Lift the liner clamp into place and clamp the liner and bushing together. Two T-handle bolts make liner clamp handling easier.

Tighten the liner clamp bolts evenly, alternating from one bolt to the other. The clamp faces must not touch. Use the following torque values as a guide:

Pump Model	Torque Ft.-Lbs.
7-P-50	100
8-P-80	100
9-P-100	150
10-P-130	150
12-P-160	250
14-P-220	250

If you do not change the liner, install the piston and rod with the liner in place. Rotate the pump as previously described to move the crosshead extension rod to the back of the liner chamber. Liberally grease the outside of the piston and liner bore. Use a pry bar to install the piston rod assembly against the stops at the bottom of the liner chamber. This will pry the piston into the liner.

Getting the Most From Your Liner

When single-acting pumps are not operating, the back end of the liner is exposed to the atmosphere, so it is easy to inspect the liner bores and detect an imminent failure. Replacement is more convenient rather than necessary during critical drilling. When a piston fails, change it immediately to save the liner. Remove the sub-rod and piston, leaving the liner in place. Check the full liner bore to determine if the liner is still usable.

While the life of liner life primarily depends on pump speed and cooling efficiency, the recommended allowable wear will vary with pressure:

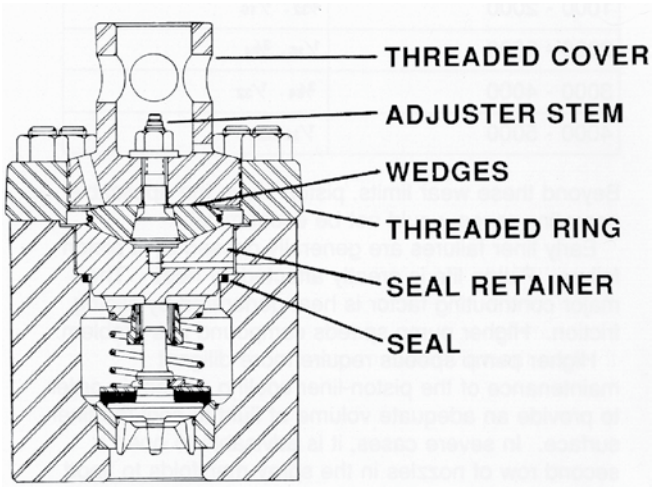
Operating Pressure PSI	Liner Wear Limits - Inches
1000 - 2000	3/32 - 1/16
2000 - 3000	1/16 - 3/64
3000 - 4000	3/64 - 1/32
4000 - 5000	1/32 Max

Beyond these wear limits, piston life in the applicable operating range would not be economical. A piston failure generally causes early liner failures. Heat greatly affects piston life. The major contributing factor is heat generated by sliding friction. Higher pump speeds compound this problem. Higher pump speeds require more diligent maintenance of the piston-liner cooling system to provide an adequate fluid volume to cool the liner surface. Whenever a liner is changed, particularly if dropping to a smaller bore size, examine the face of the wear plate carefully to be sure the new liner packing can affect a seal. Change the wear plate if it is fluid cut or badly eroded in the area where the new packing will sit.

TAPR-LOK Valve Covers

Some pumps come with TAPR-LOK valve covers. Tightening the stem nut on the tapered adjuster spreads a ring of wedges between the threaded valve cover and the valve cover seal retainer.

This simultaneously loads the threads and traps and compresses the valve cover seal making the valve cover assembly a metal-to-metal connection. Breathing of the threaded cover is virtually eliminated when tightened properly.



Cover Removal

1. Loosen the adjuster stem nut five or six turns and drive the adjuster down.
2. Knock locking wedges loose with a heat-treated bar inserted through the six holes on the edge of the cover.
3. Pass a 2-or 3-ft-long bar through the valve cover holes and bump the cover loose with a sledgehammer.
4. Lift off the valve cover assembly.
5. Screw the T-handled puller into the tapped hole on top of the seal retainer and lift out.

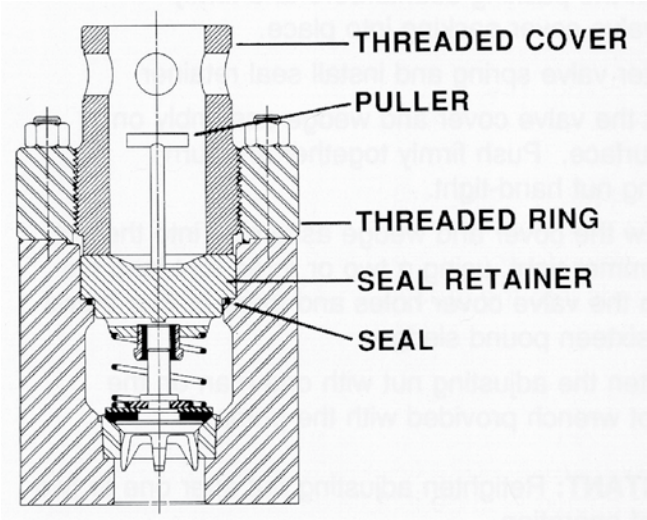
Cover Installation

1. Remove dirt and scale from the valve cover and other parts with a wire brush. Clean out all tell-tale holes in the fluid cylinder.
2. Check the upper valve stem guide bushing. Install a new polyurethane insert if necessary.
3. Coat valve cover threads and both sides of tapered wedges with a generous application of a heavy-duty, copper-based drill collar compound.
4. Clean the packing counterbore and firmly press the valve cover packing into place.
5. Center the valve spring and install the seal retainer.
6. Rest the valve cover and wedge assembly on a flat surface. Push firmly together and turn the adjusting nut hand-tight.
7. Screw the cover and wedge assembly into the pot and hammer tight, using a 2- or 3-ft-long bar through the valve cover holes and three or four blows with a 16-lb sledgehammer.
8. Tighten the adjusting nut with one man on the 5½-ft wrench provided with the pump.

IMPORTANT: Retighten the adjusting nut after one to two hours of operation.

FAST-CHANGE Valve Covers

The FAST-CHANGE valve covers have a simple screw-type arrangement with no locking wedges for quick removal and installation. The FAST-CHANGE valve covers are available on the 14-P-220, 12-P-160, 10-P-130, 9-P-100, 8-P-80, and 7-P-50 mud pumps. They can be installed in the field on existing pumps. This valve cover is standard on the 14-P-220 pump. Modules require different studs to convert to FAST-CHANGE covers.



Cover Removal

1. Pass a 2-ft or 3-ft-long bar through the valve cover holes and bump the cover loose with a sledgehammer.

2. Insert and lift out the seal retainer using the supplied puller.

Cover Installation

1. Remove dirt and scale from the valve cover and other parts with a wire brush. Clean out all tell-tale holes in the fluid cylinder.

2. Coat the valve cover threads with a generous application of a heavy-duty, copper-based drill collar compound.

3. Clean the packing counterbore and firmly press the valve cover packing into place.

4. Center the valve spring and install the seal retainer.

5. Reset the valve cover into the threaded ring and tighten.

6. Using a 2-ft-long bar through the valve cover, tighten with 4 blows of a 16-lb sledge.

Liner Spray Manifold

For the 12-P-160, 10-P-130, 9-P-100, 8-P-80, and 7-P-50 NOV Triplex Mud Pumps, install each liner spray manifold so that its hose crosses under the piston rod. This will help position the manifold properly on the end of the liner. Tighten the thumbscrews to center the manifold and extend the screw ends into the groove outside the liner.

Do not over-tighten thumbscrews! Over-tightening can damage the manifold. Also, keep the thumbscrews on the manifold well-greased.

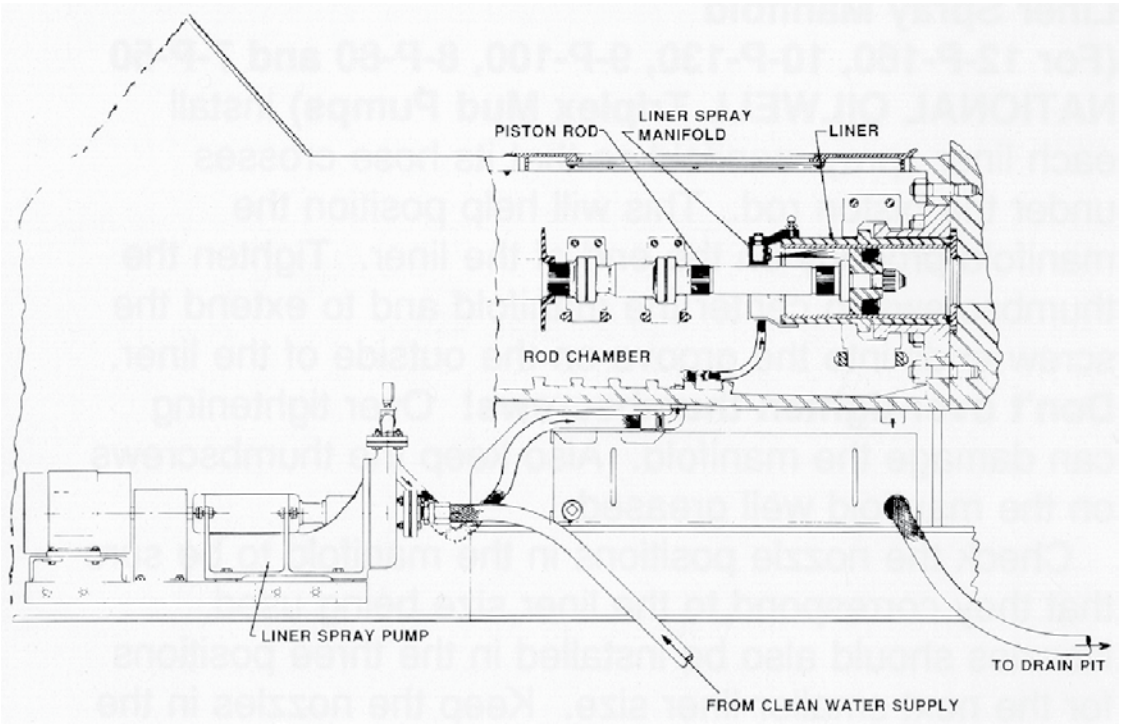
Check the nozzle positions on the manifold to ensure they correspond to the liner size. Install the nozzles in the three positions for the next smaller liner size. Keep the nozzles in the spray manifold clean and open to provide a full continuous spray of coolant and check daily.

The 14-P-220 pump uses a drill-type piston rod. Check daily and keep exhaust holes in the rod clean and open to provide a full continuous spray to the liner.

Piston-Liner Coolant Systems

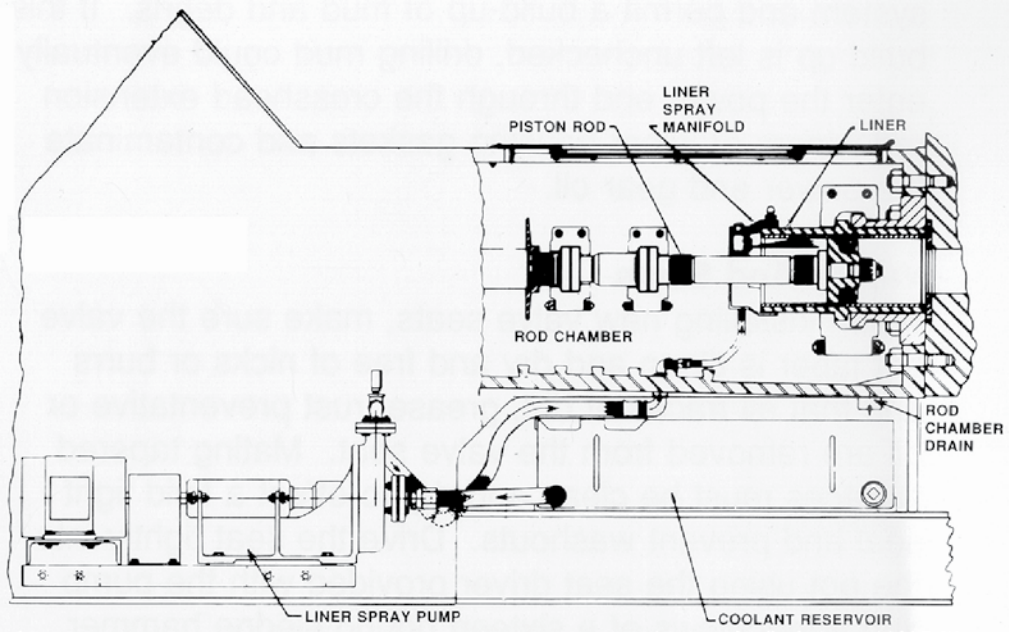
Nonrecirculating System

A nonrecirculating piston liner coolant system spraying cool, clean, fresh water into the liner provides the best overall liner and piston service. This single-pass system eliminates coolant overheating problems. Also, the coolant is not contaminated with drilling mud and debris, which can wear the piston and liner.



Recirculating System

When single-pass fresh water cooling of the liners is not practical, use recirculating piston-liner coolant systems that utilize mixtures of diesel and oil, water and soluble oil, or water plus detergent. However, exercise special care to keep these coolant mixtures clean and cool.



Drain the coolant reservoir incorporated into the pump and flush out all drilling mud, sand, and trash as frequently as required to maintain the coolant in an acceptable condition. A general rule of thumb is to change the coolant and clean the reservoir anytime a piston fails. Also, flush out the coolant header pipe beneath the rod chamber and behind the coolant sump. This header is a 2-in. pipe positioned between the pump side plates and has hose connections for each rod chamber spray manifold. Remove the liner spray pump discharge hose and header drain plug to flush out the header pipe.

Rod Chamber Cleanliness

Swab clean the bottom of the liner-piston rod chambers each time the liner coolant reservoir is serviced. These chambers collect the liner coolant (and any mud bypassing the piston) and direct it to a drain line or back into the coolant reservoir.

Failure to clean the rod chambers will lead to contamination of the liner coolant in a recirculating-type system and permit a build-up of mud and debris. If unchecked, drilling mud could eventually enter the power end through the crosshead extension rod wipers or wiper housing gaskets and contaminate the gear oil.

Valves and Seats

When installing new valve seats, make sure the valve pot taper is clean, dry, and free of nicks or burrs. Also, remove all traces of dirt, grease, rust preventative, or oil from the valve seat. Mating tapered surfaces must be clean and dry to produce a fluid-tight seal and prevent washouts. Drive the seat tightly into the pot using the seat driver provided with the pump and a few blows of a 16-lb sledgehammer. If the driver is lost, substitute a used valve and bar.

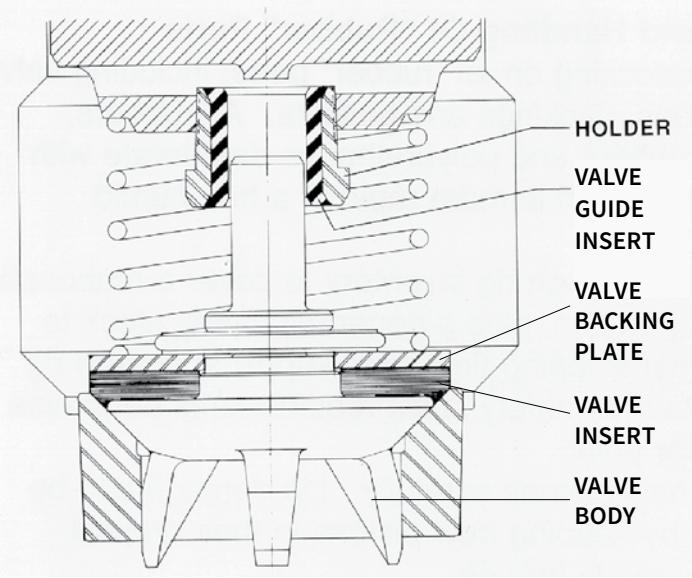
Pumps include bottom-shouldering seats to control the amount the seat can be forced down the taper during high-pressure operations. It is not always possible to drive the seat to the shoulder with the seat driver. Therefore, do not be alarmed by a nonrecurring loud noise from the valve pot soon after pump startup. It is just the seat shouldering under the fluid pressure on top of the valve.

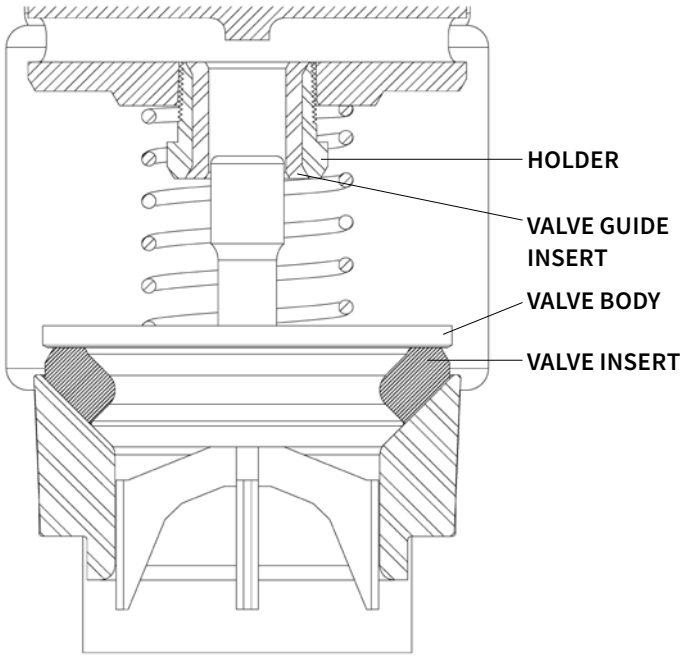
Do not put an old valve in a new seat. The valve would be partially worn out, and chances are that its normal failure would damage the seat prematurely. This causes extra downtime to pull and replace the seat again. Inspect valves regularly for fluid cuts and pitting in the sealing area of the disc and replace worn discs before fluid washing cuts the valve body or seat. If valves and discs are in good condition, remove sand or mud lodged between the disc and valve body before returning the valve to the pump.

Inspect valves regularly for fluid cuts and pitting in the sealing area of the disc and replace worn discs before fluid washing cuts the valve body or seat. If valves and discs are in good condition, remove sand or mud lodged between the disc and valve body before returning the valve to the pump.

After routine inspection or disc replacement, always return the valve to the same seat from which it was taken. Valves and seats tend to “wear in” with matching wear patterns. Keeping them together until they wear out will result in longer service.

Polyurethane valve discs are recommended for almost all conditions due to the exceptional toughness and abrasion resistance of polyurethane. They are adversely affected by very high temperatures, extreme caustic concentrations, or high acid concentrations. Though not equal in physical properties, BUNA-N valve discs may provide better service in these unusual conditions; being less expensive, they may be preferred for low-pressure drilling.

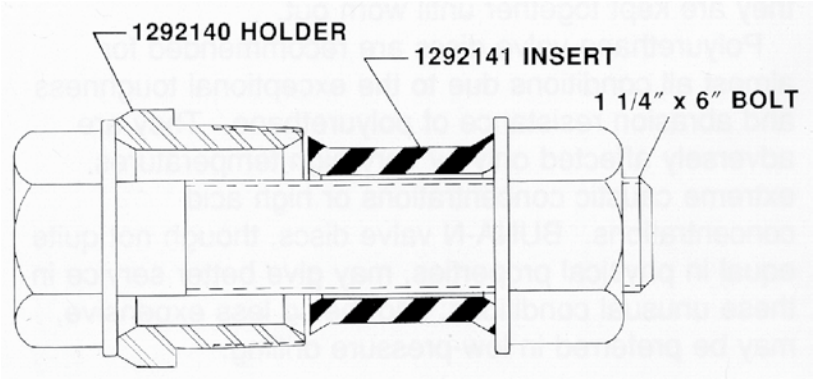




Valve Stem Guide Bushing

Always check the condition of the valve stem guide bushing in the bottom of the valve cover seal retainer before installing the retainer. If the polyurethane insert in the guide bushing looks worn or damaged, replace the insert. Cut and pull out the old insert with pliers.

Press the new insert into the holder with a vise or use a bolt and nut arrangement to force this insert into the holder, as shown below.



Storage and Handling of “Rubber” Parts

Avoid overstocking on all “rubber and polyurethane” parts, including valve discs, pistons, packings, and gaskets. All rubbers, synthetic rubbers, and polyurethanes deteriorate with age.

Deterioration is more rapid in a hot, humid climate.

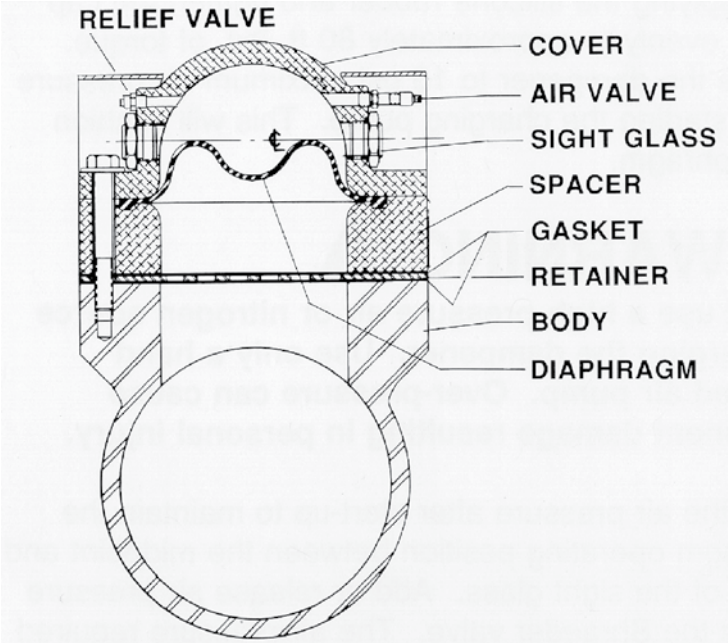
Keep enough rig inventory to cover a reasonable period of operation, plus a generous safety stock to cover normal shipping time from the supply source to the rig location. Let the safety stock requirements determine your reorder point.

Handle new pistons carefully. Keeping new pistons in their original boxes until ready for use can prevent lip damage.

Do not lay a piston on its side for days at a time, as the weight of the piston itself can cause permanent distortion of the lips. To store pistons on rods, construct a special rack to support the rods in a vertical position. Clean and grease the rod and piston assemblies before placing them in storage.

Suction Dampener

NOV Triplex Pumps include an optional in-line, nitrogen or air-charged suction pulsation dampener. The dampener is fitted to an adapter that may be welded or bolted into an existing line or be part of a separate dampener housing.



The dampener incorporates a perforated retainer plate, gasketed on both sides, that rests on top of the adapter and prevents an over-pressured diaphragm from entering the suction line, thus restricting flow. It also limits the deflection of the diaphragm at rest. A spacer between the retainer and diaphragm is grooved on the top side to accept a rib molded around the outside of the diaphragm above the spacer. The dampener cover fits over the diaphragm, and the assembly is held together with 9/16- x 4-in. cap screws. The dampener cover includes two opposing sight glasses for checking the position of the diaphragm, plus a Schrader valve for pressurizing the diaphragm with air.

When replacing the diaphragm, position it into the spacer and apply a continuous ⅛-in. diameter bead of silicone rubber on the outer edge of the diaphragm. This silicone rubber is readily available at most supply stores. Assemble the body cover within 10 minutes after applying the silicone rubber and tighten the cap screws evenly to approximately 80 ft.-lbs. of torque. Change the dampener to 15 psi maximum air pressure before starting the charging pump. This will cushion the diaphragm.

WARNING

Do not use a high-pressure air or nitrogen source to charge the dampener. Use only a hand-operated air pump. Over-pressure can cause component damage resulting in personal injury.

Adjust the air pressure after start-up to maintain the diaphragm operating position between the midpoint and bottom of the sight glass. Add or release air pressure through the Schrader valve. The air pressure required will differ for “charged suction” and “natural suction” conditions.

Check the operating level of the diaphragm daily. Maintain the proper charge pressure in the dampener for smooth, efficient pump operation. It is essential to keep the sight glasses clear.

If spray painting in the area, coat the sight glasses with petroleum jelly to prevent paint from adhering. If it is necessary to replace a sight glass, be sure to seat the sight glass packing carefully into the groove on the cover, as this must be an air-tight connection.

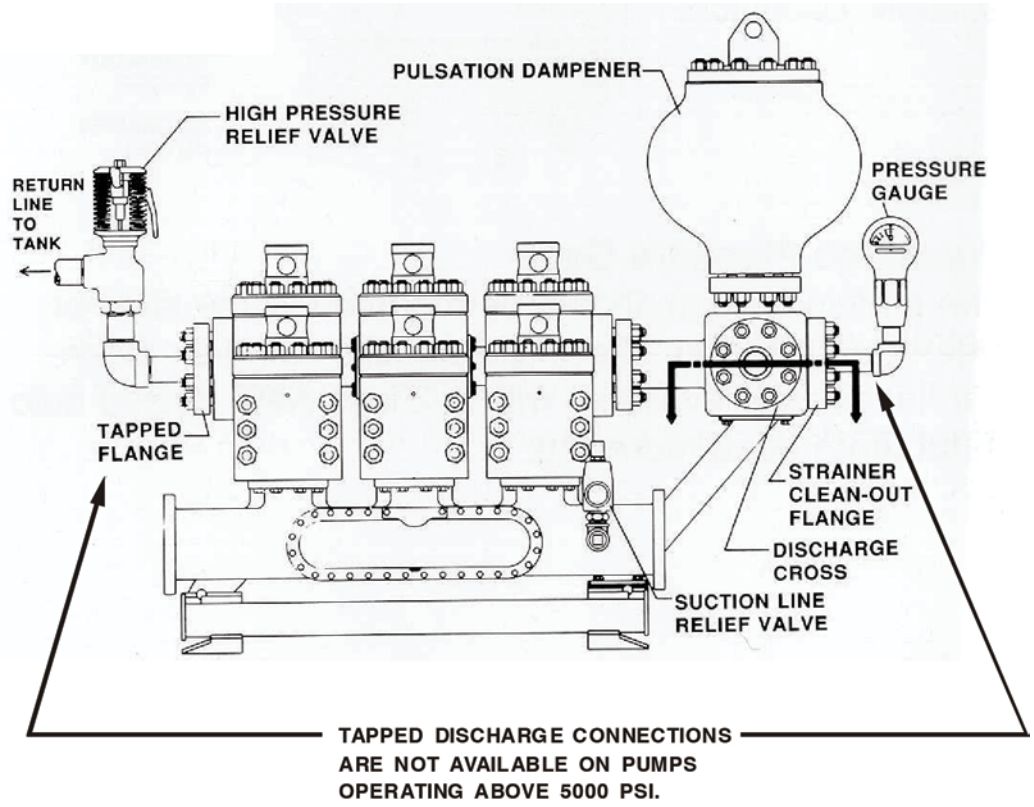
Suction Line Relief Valve

To protect the charging pump and the suction line dampener, install the pressure relief valve in the suction line near the dampener. Mount the relief valve on the top of the line to prevent it from becoming “muddied up” when the system is shut down. This valve has a 2-in. seat opening and is normally adjusted at 70 psi relieving pressure.

The suction line relief valve is necessary because a high backflow or pressure surge entering the suction line from the triplex pump can damage the charging pump and/or suction line dampener.

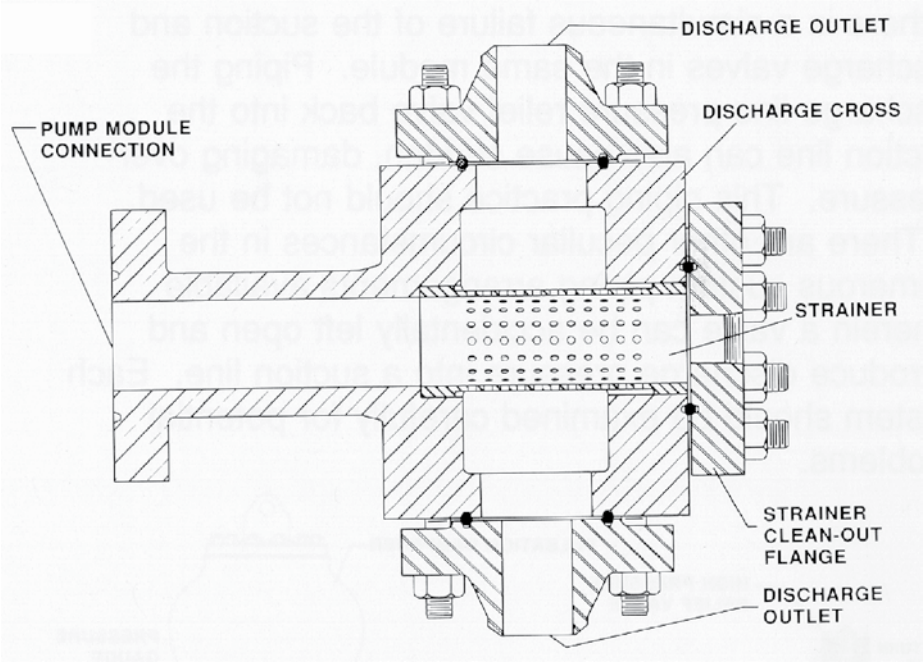
This can happen if there is a simultaneous failure of the suction and discharge valves in the same module. Piping the discharge line pressure relief valve back into the suction line can also cause sudden, damaging overpressure. Do not use this piping practice.

Other peculiar circumstances exist in the numerous custom piping arrangements where a valve can be accidentally left open and introduce discharge pressure into a suction line. Examine each system carefully for potential problems.



Discharge Strainer

Check and clean the discharge strainer pipe at least once every month. Pumping of lost circulating materials may also necessitate inspection and cleaning of the strainer immediately following the completion of pumping operations. Failure to perform routine strainer maintenance can lead to higher-than-normal pump pressures and wash-out areas in the strainer pipe. Remove the stud nuts that secure the strainer clean-out flange to the discharge cross (eight bolts, while the 10K connections use 12 bolts) to access the strainer pipe easily.



Discharge Pressure Gage

Mount the pressure gage to the strainer clean-out flange, as shown previously. Strainer cleanout flanges are available with a 2-in. NPT tapped hole to facilitate gage mounting. Available only on pumps operating at 5,000 psi or less.

High-Pressure Relief Valve

Always provide a pressure-relieving type valve to protect the mud pump and system against damage from overpressure. Install the relief valve on the discharge side of the pump opposite the discharge cross. Do not connect the relief valve to the discharge cross because:

1. A plugged strainer could prevent the relief valve from sensing and relieving excessive pump discharge pressures.

2. The relief valve and its by-pass line could interfere with and inconvenience the removal of the strainer clean-out flange for periodic cleaning of the strainer.

WARNING

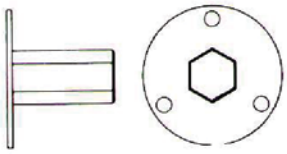
Do not pipe the relief valve by-pass line into the pump suction system piping. High-pressure surges could cause damage to components, resulting in personal injury.

Flanges tapped with 2- or 3-in. **NPT** holes are available for use on the pump side opposite the cross for mounting the pressure relief valve. This is for use on pumps operating at 5,000 psi or less.

Special Tools

The following are sketches of the special tools and wrenches provided with NOV Triplex Pumps. Provide a storage area, cabinet, or chest for these tools convenient to the pumps to minimize the chance of losing them. These tools are valuable, not just in dollars, but in the amount of time and trouble saved in doing the work for which they were designed.

Power End Tools



Adapter for Pinion Rotating

7-P-50 Part No. 1294140

8-P-80 Part No. 1291225

9-P-100 Part No. 1290140

10-P-130 Part No. 1290140

12-P-160 Part No. 1290140

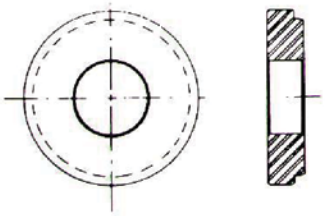
14-P-220 Part No. 1290140

Wrench for Pinion

Rotating Adapter

Part No. 2402290

Liner Chamber Tools



Puller Plate for Liner Bushing

7-P-50 Part No. 1294164

8-P-80 Part No. 1291164

9-P-100 Part No. 1290164

10-P-130 Part No. 1290164

12-P-160 Part No. 1292164

14-P-220 Part No. 1295164

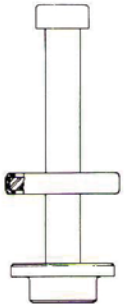
Tee Handle Bolt

For Liner Clamp Lifting

Part No. 1290206 (Short)

Part No. 1290207 (Long)

Valve Pot Tools



Driver for Valve Seat

7-P-50 Part No. 1294153

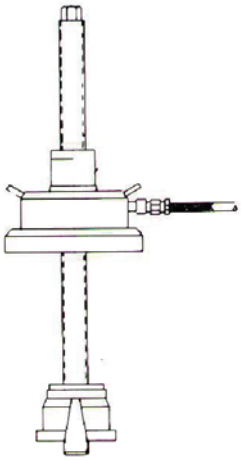
8-P-80 Part No. 1291181

9-P-100 Part No. 1291181

10-P-130 Part No. 1291181

12-P-160 Part No. 1292127

14-P-220 Part No. 1295127



Puller for Valve Seat

7-P-50 Part No. M1060 & M1120

8-P-80 Part No. M1060 & M1160

9-P-100 Part No. M1060 & M1160

10-P-130 Part No. M1060 & M1160

12-P-160 Part No. M1060 & M1098

14-P-220 Part No. M1060 & M1087

Bar For Loosening Wedges

Part No. 1710270

Wrench for Valve Cover

TAPR-LOK Adjusting Screw

7-P-50 Part No. 2409010

8-P-80 Part No. 2409010

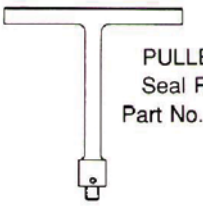
9-P-100 Part No. 2409010

10-P-130 Part No. 2409010

(fits 1“ Heavy Hex Nut)

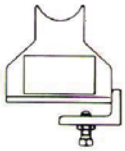
12-P-160 Part No. 2409013

(fits 1 ⅛” Heavy Hex Nut)



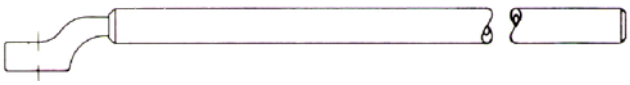
Puller for Seal Retainer

Part No. 1290183



Holder for Seal Retainer

Part No. 1292278



Extended Handle Wrench

For Use With 2409010 & 2409013

Part No. 2409011

Pump Knocking

The following lists the more frequently found causes of knocking or fluid hammer. Most pump knocking problems are fluid end related; perform all checks on the fluid end of the pumps before attempting major investigative work on the power end.

Fluid end causes:

1. Improper pre-charge or operation of suction and discharge line pulsation dampeners.
2. Loose valve seats, washed out valves, and/or valve seats, valves cocked or binding in seats.
3. Piston hubs loose on piston rods.
4. Charging pump output too low. Charge pressure in the triplex mud pump suction manifold should hold a steady pressure range of 20 to 50 psi with the triplex pump operating.
5. Charging pump shaft packing loose or worn out, permitting air into the suction line.
6. Restrictions in suction lines.
7. Air or gas in the pumped fluid.
8. Piston rod clamps loose or worn out.
9. Strainer in discharge cross plugged with trash.
10. Swollen upper valve stem guide inserts.

Power end causes:

1. Burr or deformation on a gear or pinion tooth.
2. Loose crosshead pin is not shouldered tightly in the crosshead.
3. Burr or upset or crosshead liner.
4. Excessive bearing clearance (more than .018-in.) in crosshead or connecting rod bearing.
5. Extensive crack in the crankshaft.
6. Excessive clearance between the crosshead and the liner.

For models 12-P-160, 10-P-130, 9-P-100, 8-P-80, and 7- P-50, the new clearance between the top of the crosshead and liner should measure .010 in. to .015 in.

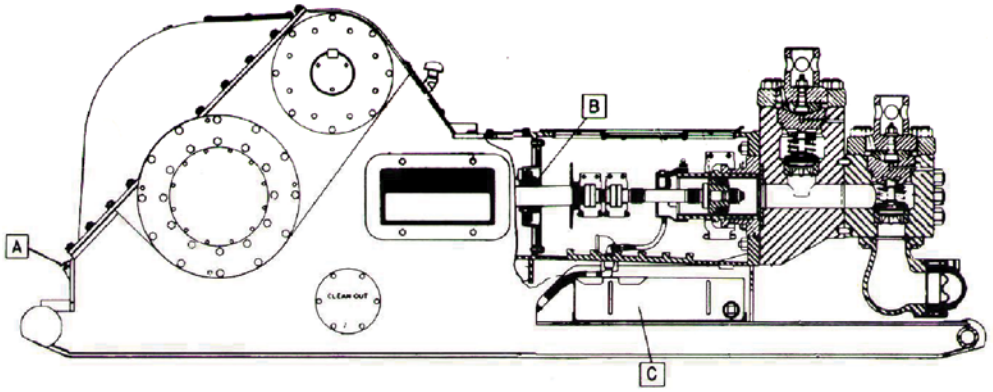
For model 14-P-220, the new clearance between the top of the crosshead and liner should measure .015 to .020 in.

Adjust the worn clearance whenever it exceeds .030 in.

IADC Maintenance Checklist

• Standard IADC maintenance fact sheet for NOV Series P Triplex Mud Pumps. Copies are available from NOV.

MAINTENANCE CHECKLIST	"P" SERIES SLUSH PUMPS



LUBRICATION SCHEDULE

FREQUENCY	CHECK POINT	TYPE	PROCEDURE
Daily	A	AGMA EP Gear Lubricant*	Check oil level with pump at rest
Daily	B	NLGI No. 1 Multipurpose lithium base grease	Two strokes of a hand grease gun
Daily	C	50% water + 50% soluble oil	Check fluid level in sump
Six Months	D	AGMA EP Gear Lubricant**	Change oil and clean oil sump

***Surrounding Air Temperature Lubricant Selection.**

50°F. (10° C.) to 155° F. (68° C.) - AGMA Mild EP #7 Viscosity 414-506 CST @ 100° F. (38° C.)
20°F. (- 7°C.) to 100° F. (38° C.) - AGMA Mild EP #6 Viscosity 288-352 CST @ 100° F. (38° C.)
-20° F. (-29° C.) to 60° F. (16° C.) - AGMA Mild EP #2 Viscosity 61- 75 CST @ 100° F. (38° C.)

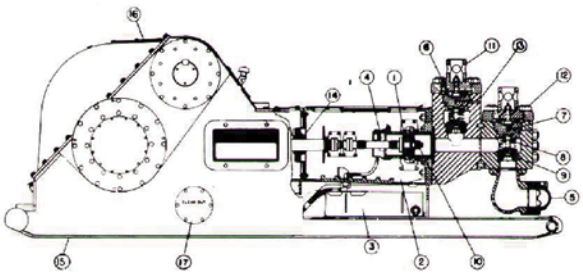
****Oil Capacities-**

7-P-50 - 70 U.S. Gal (265 Liters)
8-P-80 - 85 U.S. Gal (322 Liters)
9-P-100 - 95 U.S. Gal (360 Liters)
10-P-130 - 90 U.S. Gal (341 Liters)
12-P-160 - 130 U.S. Gal (492 Liters)
14-P-220 - 175 U.S. Gal (662 Liters)

IADC APPROVED FORMAT

MAINTENANCE CHECKLIST	"P" SERIES SLUSH PUMPS

OPERATING MAINTENANCE



FREQUENCY	CHECK POINT	PROCEDURE
Daily	①	Observe the condition of liners and pistons, they should be run until fluid bypass is visible on each stroke or becomes excessive.
Daily	②	Clean liner chambers as required.
Daily	③	Clean and refill sump after excessive contamination.
Daily	④	Check liner manifold wing nuts for tightness and be sure spray nozzles are not clogged.
Daily	⑤	Check dampener for proper charge. Instructions are in Service Manual and on dampener next to sightglass.
Weekly	⑥	Clean both sides of locking wedges and coat with a heavy duty lead base thread compound.
Weekly	⑦	Clean and coat the tapered portion of the plug with the same thread compound used on locking wedges. Inspect the packing, clean and coat the cylinder before reinstallation.
Weekly	⑧	Inspect the insert in the upper valve stem guide and replace if worn.
Weekly	⑨	Check valves and seats for wear. Replace cut or worn discs and valve locks if loose or worn.
Weekly	⑩	Replace piston rod lock nut if it has been damaged, corroded or if locking fiber has lost its effectiveness. Any nut used three times should be replaced.
Two Weeks	⑪	Remove covers and clean threads on cover screw and in bolt on ring. Coat the threads with heavy duty lead base thread compound.
Monthly	⑫	Check all cylinder studs and nuts for tightness.
Monthly	⑬	Remove and clean strainer from discharge cross.
Monthly	⑭	Check condition of intermediate rod wipers, replace if worn.
Six Months	⑮	Clean magnet on drain plug during oil change.
Six Months	⑯	Clean magnets in oil trough-access through inspection cover.
Six Months	⑰	Clean oil sump during regular oil change. On the 14-P-220, change the oil filter.

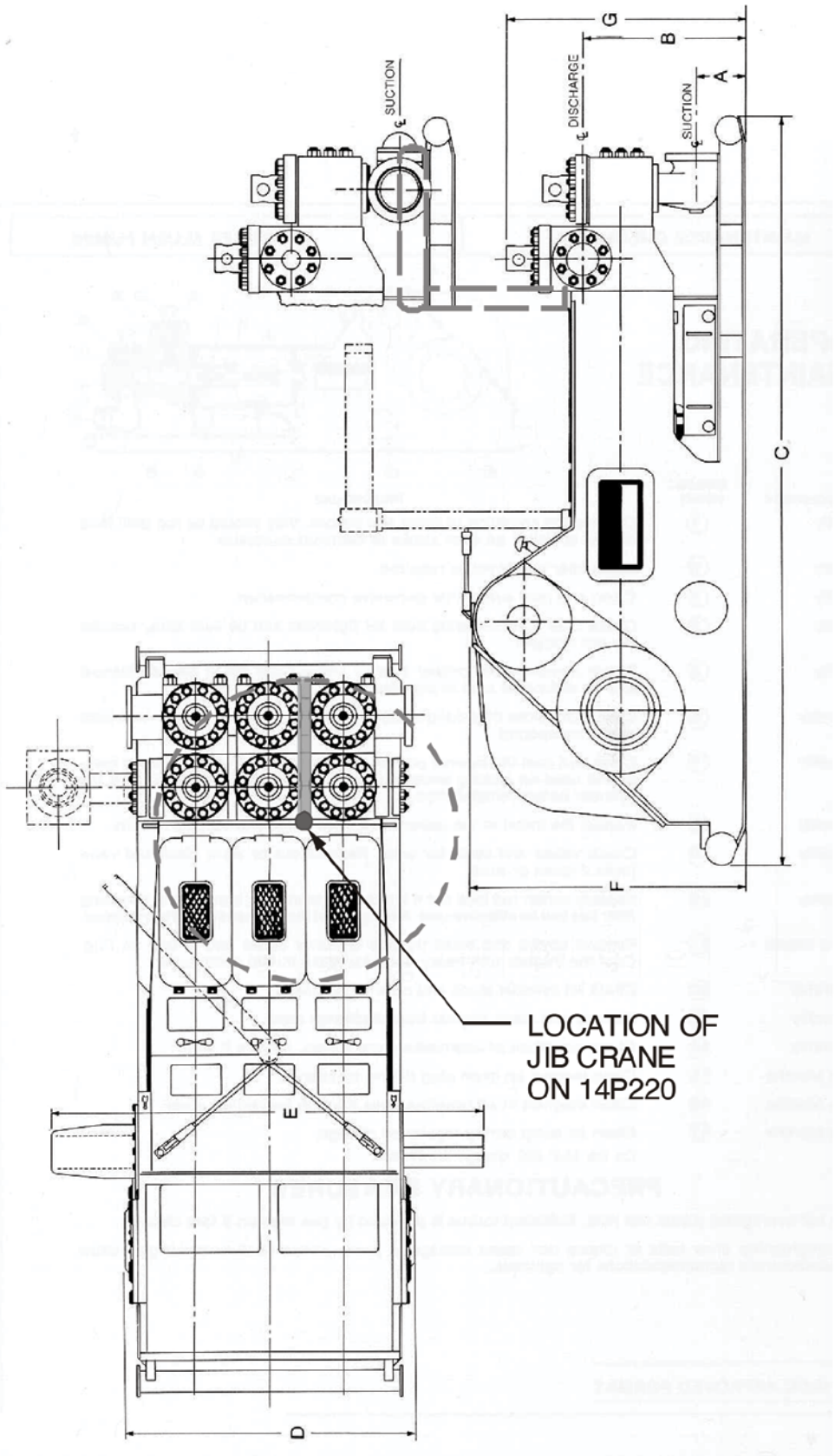
PRECAUTIONARY MEASURES

Do not overtighten piston rod nuts. Sufficient torque is provided by one man on 5 foot cheater.

Overtightening drive belts or chains can cause damage to pump pinion shaft or bearings. Follow manufacturer's recommendations for tightness.

IADC APPROVED FORMAT

Pump Specifications and Performance Tables



Dimensions inches (mm)	7-P-50	8-P-80	9-P-100	10-P-130	12-P-160	14-P-220
A. Height, floor to center of front inlet suction	10⅝ (270)	10¾ (273)	13¼ (337)	13¼ (337)	16½ (419)	19⅛ (486)
B. Height, floor to center of discharge	33½ (851)	35¼ (895)	38¼ (972)	39¼ (997)	45¼ (1149)	49¼ (1251)
C. Overall length over skids	142¼ (3613)	161⅝ (4105)	176¼ (4477)	186⅝ (4740)	209 (5309)	218¼ (5544)
D. Width over frame	54½ (1384)	62⁹⁄₁₆ (1589)	67⅛ (1705)	71⅜ (1813)	78⅝ (1997)	86½ (2197)
E. Width over pinion shaft	81⁷⁄₁₆ (2069)	93⅞ (2384)	101¼ (2572)	107 ¼ (2724)	113¾ (2889)	125¾ (3194)
F. Height, floor to top of gear case	54½ (1384)	60 (1524)	64 (1626)	67 (1702)	75 (1905)	84¼(2139)
G. Height over fluid cylinders	48⅞ (1241)	51⅞ (1318)	54⅞ (1394)	55⅞ (1419)	62¹⁵⁄₁₆ (1599)	69⅛ (1756)

Model	7-P-50	8-P-80	9-P-100	10-P-130	12-P-160	14-P-220
Max. input horsepower	500	800	1000	1300	1600	2200
Rated pump speed, spm	165	160	150	140	120	105
Maximum fluid cylinder liner bore, inches (mm)*	6¼ (158.8)	6¼ (158.8)	6¾ (171.5)	6¾ (171.5)	7¼ (184.2)	9 (228.6)
Stroke, inches (mm)	7¾ (196.9)	8½ (215.9)	9¼ (235.0)	10 (254.0)	12 (304.8)	14 (355.6)
Hydrostatic test pressure of fluid cylinder, psi (kg/cm²)	10,000 (703)	10,000 (703)	10,000 (703)	10,000 (703)	10,000 (703)	12,000 (844)
Ratio of gears	2.742	2.463	2.658	2.853	3.439	3.969
Suction connection, ASA-150 lb. R.J. flange, inches	8	8	8	8	10	10
Discharge connection, cross w/API-5000 lb. R.J. flange, inches	4	4	5	5	6	6
Valve pot, API number	MOD. 5.5	MOD. 6	MOD. 6	MOD. 6	MOD. 7	MOD. 8
Weight - complete, less sheave, lb. (kg.)	16,750 (7600)	26.970 (12,235)	33.200 (15,060)	42,550 (19,300)	54,700 (24,810)	86,000 (39,007)

*Refer to the following performance charts for other liner bores.

How to Treat Your Type P Triplex Mud Pump

7-P-50 Performance Chart

Liner size, inches (mm)			6¼	(158.8)	6	(152.4)	5½	(139.7)	5	(127.0)	4½	(114.3)	4	(101.6)	3½	(88.9)
Max. dischg. pressure, psi (kg/cm²)			1515	(106.5)	1645	(115.7)	1955	(137.4)	2365	(166.3)	2920	(205.3)	3695	(259.8)	4830	(339.6)
Pump Speed SPM	**Max Input HP**	***Hydraulic HP**	***GPM**	***(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**
185	560	504	571	(2162)	526	(1993)	442	(1674)	366	(1384)	296	(1121)	234	(886)	179	(678)
†165	†500	450	510	(1929)	470	(1777)	395	(1493)	326	(1234)	264	(1000)	209	(790)	160	(605)
145	439	395	448	(1695)	413	(1562)	347	(1312)	287	(1085)	232	(879)	183	(694)	140	(531)
120	363	327	371	(1403)	341	(1293)	287	(1086)	237	(898)	192	(727)	152	(574)	116	(440)
100	303	273	309	(1169)	285	(1077)	239	(905)	198	(748)	160	(606)	126	(479)	97	(367)
80	242	218	247	(935)	228	(862)	191	(724)	158	(598)	128	(485)	101	(383)	77	(293)
Vol./stroke, gal. (liters)			3.088	(11.688)	2.846	(10.772)	2.391	(9.051)	1.976	(7.480)	1.601	(6.059)	1.265	(4.787)	.968	(3.665)

* Based on 90% mechanical efficiency and 100% volumetric efficiency. † Rated speed and input horsepower.

8-P-80 Performance Chart

Liner size, inches (mm)			6¼	(158.8)	6	(152.4)	5½	(139.7)	5	(127.0)	4½	(114.3)
Max. dischg. pressure, psi (kg/cm²)			2280	(106.3)	2470	(173.7)	2940	(206.7)	3560	(250.3)	4395	(309.0)
Pump Speed SPM	**Max Input HP**	***Hydraulic HP**	***GPM**	***(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**
180	900	810	610	(2308)	562	(2127)	472	(1787)	390	(1477)	316	(1196)
†160	†800	720	542	(2051)	500	(1890)	420	(1588)	347	(1313)	281	(1063)
140	700	630	474	(1795)	437	(1654)	367	(1390)	303	(1149)	246	(930)
120	600	540	406	(1538)	375	(1418)	315	(1191)	260	(984)	211	(797)
100	500	450	339	(1282)	312	(1182)	262	(993)	217	(820)	176	(665)
80	400	360	271	(1026)	250	(945)	210	(794)	173	(656)	140	(532)
Vol./stroke, gal. (liters)			3.386	(12.820)	3.121	(11.815)	2.622	(9.927)	2.167	(8.204)	1.755	(6.645)

* Based on 90% mechanical efficiency and 100% volumetric efficiency. † Rated speed and input horsepower.

9-P-100 Performance Chart

‡ Liner size, inches (mm)			6¼	(158.8)	6	(152.4)	5½	(139.7)	5	(127.0)	4½	(114.3)
Max. dischg. pressure, psi (kg/cm²)			2790	(196.2)	3030	(213.0)	3605	(253.5)	4360	(306.5)	5000	(351.5)
Pump Speed SPM	**Max Input HP**	***Hydraulic HP**	***GPM**	***(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**
170	1133	1020	627	(2372)	577	(2186)	485	(1837)	401	(1518)	325	(1229)
†150	†1000	900	553	(2093)	509	(1929)	428	(1620)	354	(1339)	287	(1085)
130	867	780	479	(1814)	442	(1671)	371	(1404)	307	(1161)	248	(940)
110	733	660	405	(1535)	374	(1414)	314	(1188)	259	(982)	210	(796)
90	600	540	332	(1256)	306	(1157)	257	(972)	212	(804)	172	(651)
70	467	420	258	(977)	238	(900)	200	(756)	165	(625)	132	(506)
Vol./stroke, gal. (liters)			3.685	(13.951)	3.396	(12.857)	2.854	(10.803)	2.358	(8.928)	1.910	(7.232)

* Based on 90% mechanical efficiency and 100% volumetric efficiency.
† Rated speed and input horsepowe
‡ 6¾ (171.5) and 6½ (165.1) sizes available in regular liners.

10-P-130 Performance Chart

‡ Liner size, inches (mm)			6¼	(158.8)	6	(152.4)	5½	(139.7)	5	(127.0)
Max. dischg. pressure, psi (kg/cm²)			3595	(252.8)	3900	(274.2)	4645	(326.6)	5000	(351.5)
Pump Speed SPM	**Max Input HP**	***Hydraulic HP**	***GPM**	***(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**
160	1486	1337	638	(2413)	588	(2224)	494	(1869)	408	(1544)
†140	†1300	1170	558	(2111)	514	(1946)	432	(1635)	357	(1351)
120	1114	1003	478	(1810)	441	(1668)	370	(1401)	306	(1158)
100	929	836	398	(1508)	367	(1390)	309	(1168)	255	(965)
80	743	669	319	(1207)	294	(1112)	247	(934)	204	(772)
60	557	501	239	(905)	220	(834)	185	(701)	153	(579)
Vol./stroke, gal. (liters)			3.984	(15.082)	3.671	(13.900)	3.085	(11.679)	2.549	(9.652)

* Based on 90% mechanical efficiency and 100% volumetric efficiency.
† Rated speed and input horsepowe
‡ 6¾ (171.5) and 6½ (165.1) sizes available in regular liners.

How to Treat Your Type P Triplex Mud Pump

12-P-160 Performance Chart

Liner size, inches (mm)			7¼	(184.2)	7	(177.8)	6¾	(171.57)	6½	(165.1)	6	(152.4)	5½	(139.7)
Max. dischg. pressure, psi (kg/cm²)			3200	(225.0)	3430	(241.1)	3690	(259.4)	3980	(279.8)	4670	(328.3)	5000	(351.7)
Pump Speed SPM	**Max Input HP**	***Hydraulic HP**	***GPM**	***(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**
140	1867	1680	901	(3410)	840	(2178)	781	(2955)	724	(2741)	617	(2335)	518	(1962)
†120	†1600	1440	772	(2922)	720	(2724)	669	(2533)	621	(2349)	529	(2002)	444	(1682)
100	1333	1200	643	(2435)	600	(2270)	558	(2111)	517	(1958)	441	(1668)	370	(1402)
80	1067	960	515	(1948)	480	(1816)	446	(1689)	414	(1566)	353	(1334)	296	(1121)
60	800	720	386	(1461)	360	(1362)	335	(1267)	310	(1175)	264	(1001)	222	(841)
40	533	480	257	(974)	240	(908)	223	(844)	207	(783)	176	(667)	148	(561)
Vol./stroke, gal. (liters)			6.433	(24.354)	5.997	(22.703)	5.576	(21.110)	5.171	(19.575)	4.406	(16.680)	3.702	(14.015)

* Based on 90% mechanical efficiency and 100% volumetric efficiency. † Rated speed and input horsepower.

14-P-220 Performance Chart

Liner size, inches (mm)			**9	(228.6)	8	(203.2)	7½	(190.5)	7	(177.8)	6½	(165.1)	‡6	‡(152.4)	‡5½	‡(139.7)	‡5	‡(127.0)
Max. dischg. pressure, psi (kg/cm²)			2795	(196.5)	3535	(248.5)	4025	(283.0)	4615	(324.5)	5360	(376.8)	6285	(441.9)	7475	(525.5)	7500	(527.3)
Pump Speed SPM	**Max Input HP**	***Hyd raulic HP**	***GPM**	***(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**	**GPM**	**(LPM)**
†105	†2200	1980	1215	(4600)	960	(3634)	843	(3191)	735	(2782)	633	(2396)	540	(2044)	454	(1718)	375	(1419)
80	1676	1509	925	(3501)	731	(2767)	643	(2434)	560	(2120)	483	(1828)	411	(1556)	346	(1309)	286	(1082)
60	1257	1131	694	(2627)	548	(2074)	482	(1824)	420	(1590)	362	(1370)	308	(1166)	259	(980)	214	(810)
40	838	754	462	(1748)	366	(1385)	321	(1215)	280	(1060)	241	(912)	206	(780)	173	(654)	143	(541)
Vol./stroke, gal. (liters)			11.57	(43.797)	9.14	(34.598)	8.03	(30.397)	7.00	(26.498)	6.03	(22.826)	5.14	(19.457)	4.32	(16.353)	3.57	(13.514)

* Based on 90% mechanical efficiency and 100% volumetric efficiency.
† Rated speed and input horsepower.
‡Plungers and packing recommended over 6000 psi. Premium modules required over 6,000 psi.
**g" liners - special.

12-P-160 High Pressure Performance Chart												
Liner size, inches			7¼	7	6¾	6½	6¼	6	5¾	† 5½	† 5	† 4½
Max. discharge pressure, psi			3200	3430	3690	3980	4305	4670	5085	5555	6720	7500
Pump Speed SPM	**Input HP**	***Hydraulic HP**	***Gallons Per Minute**									
**120	**1600	1440	‡	‡	669	621	574	529	486	444	367	297
100	1333	1200	643	600	558	517	478	441	405	370	306	248
80	1067	960	515	480	446	414	383	353	324	297	245	198
60	800	720	386	360	335	310	287	264	243	222	184	149
40	533	480	257	240	223	207	191	176	162	148	122	99
Volume/stroke, gallons			6.433	5.997	5.576	5.171	4.781	4.406	4.046	3.702	3.068	2.478

† Plungers and Packing Available

‡ Operation over 675 pm could result in reduced valve life

* Based on 90% Mechanical Efficiency and 100% Volumetric Efficiency

**Rated Speed and Input Horsepower

*** CG (Center of Gravity) is for Complete Pump Less Sprocket

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