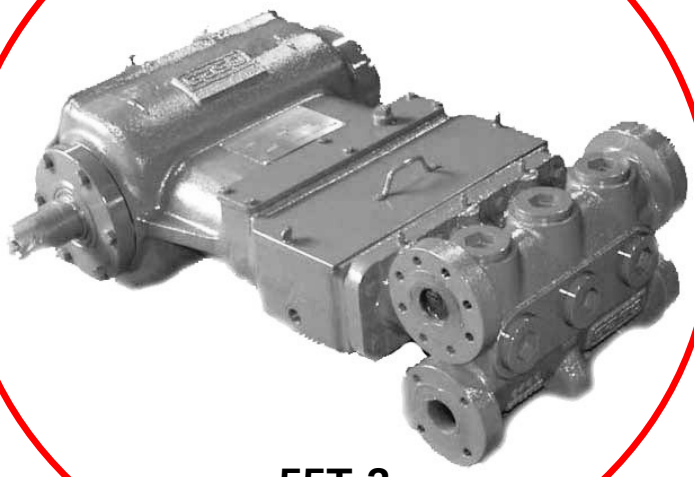
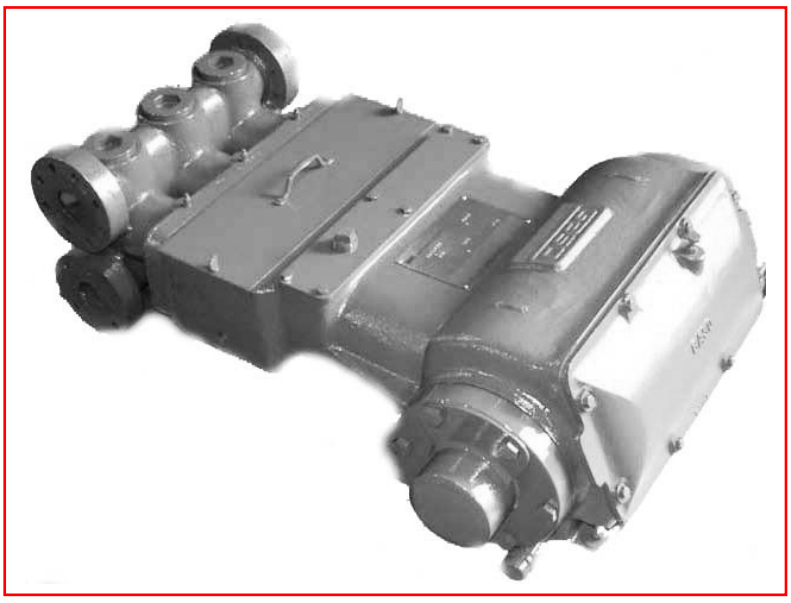
NATIONAL OILWELL VARCO

55T-3 Triplex Plunger Pump

Installation, Care and Operation Manual



55T-3



Types:

3364-1, 3364-1F
3364-2, 3364-2F
3364-3, 3364-3F
3364-4, 3364-4F
3364-5, 3364-5F
3364-6, 3364-6F
3364-7, 3364-7F
55T-3L
55T-3LF
55T-3LS
55T-3LSF
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REVISED: September 2, 2010
ISSUE: JANUARY 4. 2008

NATIONAL OILWELL VARCO

SUPPLEMENT FOR
ALL PUMP MANUALS

⚠! WARNING !⚠

PRESSURE

RELIEF

VALVES

⚠! NOTICE !⚠

Our technical publications relative to reciprocating pumps state that pressure relief valves must be installed in the discharge systems from these units. This supplement is issued to emphasize the importance of relieving the discharge system of all pressure which exceeds the rated working pressure applied by the manufacturer to the specific pistons and liners (or plungers and packing) in any particular unit.

! WARNING !

For the protection of persons and property the discharge system from each Reciprocating Pump must be equipped with a device which relieves the system of all pressures which exceed the pressure rating applied by the manufacturer to each particular piston or plunger diameter. Allowances will be made for pressure surges which are inherent with the reciprocating action of piston and plunger pumps. The percentage of pressure allowance appears later in this publication and in the "Standards of the Hydraulic Institute" (13th edition).

The relieving device must provide for instantaneous pressure relief, it may be a valve designed for automatic or manual resetting; however, if preferred, rupture discs or burst discs may be installed.

FAILURE to comply with the procedures outlined in the Warning may result in damage to the pump and related equipment and more importantly may cause serious bodily injury or death!

THE PRESSURE RELIEF VALVE:

1. This valve must be a full opening type.
2. It must have a working pressure rating, equal to or greater than, the maximum working pressure of the pump.
3. The through capacity of the valve, when fully opened, must be sufficient to relieve the full capacity of the pump without excessive overpressure.

RUPTURE DISC OR BURST DISC:

1. These discs must have a diameter which is not less than the pipe size of the pressure relief flange.
2. These discs must have a rupture or burst pressure rating consistent with the specifications tabulated later in this publication.

LOCATION OF THE RELIEF VALVE:

1. The relief valve must be placed in the discharge line as close as possible to the pump fluid end or it may be mounted on the pump discharge manifold.
2. The relief valve must be on the pump side of any discharge strainer.
3. The relief valve must be between the pump fluid end and any valve in the discharge system.
4. There must be no restricting device(s) between the relief valve and the pump fluid end.

THE RELIEF VALVE DISCHARGE LINE:

1. The relief valve discharge line should not terminate in the pump suction line.
2. The line should terminate in the supply tank, if possible.
3. The line must be securely anchored.
4. The line must be the same pipe size as, or may be larger than, the discharge connection on the relief valve.
5. If the line is of great length, this must be taken into consideration in sizing the relief valve.
6. There must be no restrictions or valves in the relief valve discharge line.

NOTE: Follow the foregoing instructions if rupture discs or burst discs are installed.

SUGGESTED SET PRESSURES FOR THE PUMP RELIEF VALVES:

PUMP TYPE:	OPERATING PUMP PRESSURE:
Double Acting – Duplex	Piston Pressure Rating – Plus 25%
Double Acting – Triplex	Piston Pressure Rating – Plus 10%
Double Acting – Quintuplex	Piston Pressure Rating – Plus 10%
Single Acting – Triplex	Piston Pressure Rating – Plus 10%
Single Acting – Simplex	Plunger Pressure Rating – Plus 25%
Single Acting – Duplex	Plunger Pressure Rating – Plus 20%
Single Acting – Triplex	Plunger Pressure Rating – Plus 10%
Single Acting – Quintuplex	Plunger Pressure Rating – Plus 10%
Single Acting – Septuplex	Plunger Pressure Rating – Plus 10%

Note: The above set pressures are to be observed when installing rupture discs or burst discs.

Foreword…

This manual is published as a guide for the normal operation of your **NATIONAL OILWELL VARCO** equipment. Because of the many factors, which contribute to the function or malfunction of this machinery, and not having complete knowledge of each factor or combination of factors, we cannot detail all facets of this subject. We must therefore confine the scope of this presentation and when situations encountered are not fully encompassed by complete, understandable instructions, these situations must be referred to the manufacturer.

When other than routine servicing is necessary, it can be most efficiently performed if the unit is removed to an area of adequate space where an over-head crane, hydraulic lift, bearing pullers, impact tools, etc., are accessible.

The dimension and tolerances specified in this publication are those desirable for the most efficient operations of the equipment. When components become worn or when new parts are introduced into a worn unit, it may not be possible or economically feasible to reestablish such strict alignment and correct all dimensional deviations.

Improvements in design, engineering, materials, production methods, etc., may necessitate changes in these products and result in inconsistencies between the content of this publication and the physical equipment. We reserve the right to make these changes without incurring any liability or obligation beyond that which is stipulated in the purchase contract.

The pictures, photographs, charts, diagrams, drawings, verbal contents and specifications are not to be construed as giving rise to any warranty on the part of NATIONAL OILWELL VARCO. National Oilwell Varco makes no warranty, either expressed or implied beyond that which is stipulated in the purchase contract.

NATIONAL OILWELL VARCO pumps are manufactured by National Oilwell Varco at the Tulsa, Oklahoma plant. The serial number, assigned each pump is stamped on the power end. Please refer to this serial number when ordering parts for the pump.

The right and left sides of the pump are determined by viewing the pump from the back of the power end, looking toward the fluid end. This position is also used to identify the plungers and their related parts as being number one, two and three, beginning at the left side of the pump.

! CAUTION! CAUTION! CAUTION!

EXERCISE SAFETY IN ALL PERFORMANCES: DO NOT IGNORE ANY WARNINGS; USE ONLY APPROVED METHODS, MATERIALS AND TOOLS. DO NOT PERMIT ANY FUNCTION OF QUESTIONABLE SAFETY; ACCIDENTS ARE CAUSED BY UNSAFE ACTS AND UNSAFE CONDITIONS. SAFETY IS YOUR BUSINESS AND YOU ARE INVOLVED.

! WARNING! WARNING! WARNING!

BEFORE PERFORMING ANY SERVICE FUNCTION, BE CERTAIN THAT THE UNIT IS SEPARATED FROM ITS POWER SOURCE OR THAT THE POWER SOURCE IS LOCKED-OUT TO PREVENT ANY FORM OF ENERGY FROM ENTERING THE EQUIPMENT. THIS WOULD INCLUDE ELECTRICAL OR MECHANICAL ENERGY INTO OR FROM THE PRIME MOVER(S), PNEUMATIC ENERGY FROM THE COMPRESSOR/AIR SYSTEM, ETC.

⚠! WARNING ! WARNING ! WARNING ! ⚠

FAILURE TO OBSERVE THE WARNINGS AND NOTES OF CAUTION IN THIS PUBLICATION CAN RESULT IN PROPERTY DAMAGE, SERIOUS BODILY INJURY, OR DEATH.

⚠! ATTENTION - NOTICE - IMPORTANT ! ⚠

THESE TERMS ARE USED TO DRAW ATTENTION TO ACTION THAT WILL CAUSE DAMAGE TO THE PUMP, COMPONENTS OR ATTACHMENTS.

⚠! ATTENTION ! ⚠

PUMP NOMENCLATURE:

ALL PUMP SIZES WITHIN THIS MANUAL WILL BE DESCRIBED WITH THE NEW OR CURRENT NOMENCLATURE. THE OLD PUMP NOMENCLATURES DESCRIBED ON THE FRONT COVER, BUT NOT INCLUDED IN THIS MANUAL EXCEPT AS NEEDED, ARE TO BE UNDERSTOOD AS BEING INCLUDED WITH THE NEW NOMENCLATURES.

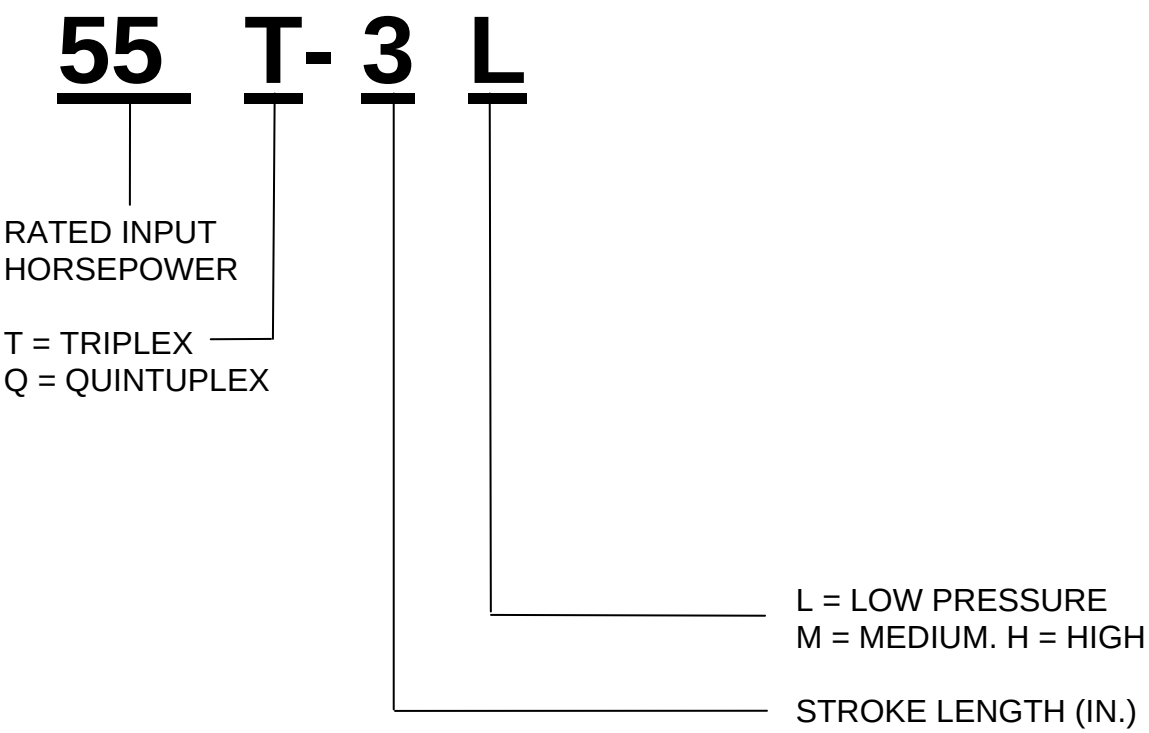
⚠! WARNING ! WARNING ! WARNING ! ⚠

BEFORE SERVICING PUMPS:

1. *SHUT DOWN OR DISENGAGE THE PUMP POWER SOURCE.*
2. SHUT DOWN ALL PUMP ACCESSORY EQUIPMENT.
3. RELIEVE OR “BLEED OFF" ALL PRESSURE FROM THE PUMP FLUID CYLINDER(S).

   FAILURE TO SHUT DOWN POWER AND RELIEVE PRESSURE FROM THE PUMP BEFORE SERVICING CAN RESULT IN SERIOUS PERSONAL INJURY AND PROPERTY DAMAGE.

Plunger Pump Nomenclature Example....



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PLUNGER PUMP VALVES

P-55U LUBRICATOR

Revisions effective September 2, 2010 – replaced the word multiplex with triplex.

Installation…

I. GENERAL

Careful planning of the plant layout will save considerable time and expense, both initially when the installation is made and later during the operation of the plant. In selecting the location for the pump, consideration should be given to the fact that a positive suction head at the pump inlet contributes toward the pump efficiency. However, the layouts of the piping, the arrangement of the fittings, and restrictions in the suction and discharge lines have even more effect. For this reason, all fittings and valves should be full opening; all bends should be of long radius or should be eliminated where possible. Long radius 45° ells should be used, particularly if installed near the fluid cylinder. The following points outline the basic requirements for an installation that will contribute greatly toward good pump operation.

A. SUCTION LINE

1. The suction line must not be smaller than the suction intake of the fluid cylinder and may be larger. The length of the suction line should be held to a minimum and should run straight from the supply tank to the pump.

2. When bends are required, they should be made with long radius 45° ells. Do not use a bend directly adjacent to the fluid cylinder. Avoid using any 90° bends if at all possible.

3. Provide a full opening gate valve in the suction line adjacent to the supply tank to permit the line to be drained when necessary. Do not use any type of restricting valve.

4. Do not use meters or other restrictions in the suction line. Eliminate any rise or summit in the suction line where air or vapor can collect.

5. Pulsation dampening devices are strongly recommended.

6. When necessary to manifold a number of pumps to a common suction, the diameter of the manifold and suction pipe leading from the supply tank must be such that it has a cross-sectional area equal to, or greater than, the area of the combined individual suction pipes.

7. When a charging or booster pump is used in the suction line, it must have a capacity equal to twice that of the pump output. This is necessary to provide a charging pump with an output great enough to meet the peak volume requirements of the plunger pump during the suction stroke and not act as a restriction in the line.

8. All piping, both suction and discharge must be solidly and independently supported. The first support must be as close to the pump as practical. This is necessary to prevent placing the pump in a strain and to keep any vibration in the system from acting directly on the pump.

B. DISCHARGE LINE

1. Use a pulsation dampener or a desurger in the discharge line. It should be placed in the line as near the fluid cylinder as possible and ahead of any bend in the line.

2. Do not reduce the size of the discharge line below that of the pump outlet until the line has passed through the desurger, and is away from the pump approximately 20 feet (6m).

3. Any bend in the discharge line should be made with a long radius 45° ell. Do not use a bend directly adjacent to the fluid cylinder, particularly a 90° bend.

Installation…

I. GENERAL

B. DISCHARGE LINE (Continued)...

4. A pressure relief valve should be installed in the discharge line. The relief valve should be set to operate at a pressure no greater than 25% above the maximum rated pressure for the plunger size being used. It should be installed in the line ahead of any valve and be piped so that any flow is returned to the supply tank rather than the suction line. This will prevent possible damage to the suction line and suction dampener.

5. A by-pass line should be installed to permit the pump to be started without load. This allows oil to circulate and reach all parts in the power end before they are loaded.

C. POWER END

1. The pump must be mounted level and should be grouted in and be free of strain. This applies to a skid-mounted pump or a pump mounted directly on a concrete base.

2. The sheave of a belt driven pump must be correctly aligned with the prime mover sheave. Care must be used to prevent over-tightening as this will shorten belt life, place the pump in a strain, and cause undue additional loads on the crankshaft and bearings. Sheave sizes should not be smaller than the minimum approved diameter.

3. When connecting a direct-driven pump, the shafts must be correctly aligned. Couplings should not be expected to compensate for avoidable misalignment. With Thomas Flexible Couplings, angular misalignment should not exceed one-half degree. Offset misalignment of the centerlines of the two shafts should not exceed .015" (.381 mm). Actually, misalignment should be as small as practical.

4. Provisions should be made to stop the pump automatically in the event of supply fluid failure. A pump should not be run dry, as this causes wear on the packing.

5. The pump has been drained of oil after testing at the factory and **MUST** be filled with the proper oil (see Lubrication section in this manual) before starting. The rust inhibiting oil coating inside the power end need not be removed before filling; however, it is recommended that the power end be checked to make sure dirt or contamination has not entered during shipment.

D. FLUID END

1. The fluid cylinder is shipped assembled to the pump complete with valves and cover plates. The stuffing boxes, plungers, and related items have also been assembled and tested with the pump (unless otherwise specified) and require no further assembly. Before the pump is started, these parts should be checked for tightness as well as for possible damage during shipment.

2. Thoroughly clean the suction line piping before starting the pump. Weld spatter, slag, mill scale, etc., will damage a pump in a short time.

Installation…

I. GENERAL (Continued)...

E. PLUNGER PACKING

The recommended style of packing has been installed and run at the plant. It does, however, require further "setting up" as the pump is started and brought up to pressure. Refer to Plunger Packing Installation section in this manual for correct procedure for packing used.

F. PLUNGER PACKING LUBRICATION

1. Automatic packing lubricators are beneficial on all installations and are required on pumps operating at high pressure (1200 psi [85kg/cm 2] and up) to obtain good packing life.

2. When an automatic lubricator is used in water and power oil service, use Rock Drill (Air Drill) oil of proper viscosity. For butane-propane service, use NATURAL castor oil. Set lubricator to feed 5 to 7 drops per minute.

G. SUCTION PULSATION DAMPENERS

1. Low Pressure - Plastic Body

a. Some National Oilwell Varco plunger pumps are equipped with suction pulsation dampeners. These dampeners do an excellent job when properly charged and should be kept filled during operation.

⚠! ATTENTION ! ⚠

At suction pressures over 10 psi (.7kg/cm2), the dampener should be deflated prior to bleeding off the suction pressure to prevent damage to the diaphragm.

b. The plastic dampener body has an instruction decal attached, which lists the following installation and charging procedures.

⚠! ATTENTION ! ⚠

HANDLE WITH CARE.
This is a plastic part and can be broken.

c. Tighten capscrews with 10 to 12ft-lbs. (13.5 to 16.3 N-M) of torque.

! ATTENTION !

Use thread-sealing compound on check valve and tighten until snug.
OVERTIGHTENING WILL DAMAGE BODY.

d. With pump operating - Charge dampener until bottom of diaphragm is visible through sight glass. Proper charge is when bottom of diaphragm is between center and top of sight glass.

Installation…

I. GENERAL

G. SUCTION PULSATION DAMPENERS (Continued)...

2. High Pressure - Aluminum Body

a. For pressures in excess of 20 psi (1.406 kg/cm2) and up to 70 psi (10.545 kg/cm2), it is necessary to use the National Oilwell Varco high-pressure suction dampener.

b. The high-pressure dampener is charged in a similar manner to the low-pressure plastic dampener, using air or nitrogen to charge the diaphragm and maintain its position in relation to the sight glass.

c. The following procedures should be used to service this dampener:

(1) The dampener is fitted to an adapter that may be either welded into an existing line or be a part of a separate dampener housing. Place a gasket on each side of the diaphragm retaining plate and place on the adapter.

(2) The dampener spacer is then placed on top of the retainer plate with the grooved side up and the flat side against the retainer gasket.

(3) The diaphragm fits into the groove on the spacer with the curved portion of the diaphragm above the spacer.

(4) Apply a continuous 1/8" (3-mm) diameter bead of silicone rubber on the outer edge of the diaphragm after it has been positioned into the spacer. This silicone rubber (GE Silicone Rubber or Dow-Corning Silastic) is readily available at most hardware stores. Assemble the body cover within ten minutes after applying the silicone rubber.

(5) Fit the dampener cover over the diaphragm and assemble the capscrews. Tighten these capscrews evenly to approximately 80 ft-lbs. (108 N-M) of torque.

(6) Install the sight glasses, one in each side of the cover. Be sure to seat the sight glass packing carefully into the groove on the cover, as this must be an airtight connection.

(7) The air check valve has a pipe thread and must be made up into the cover airtight. Use a good pipe thread sealant to promote sealing.

Lubrication…

I. GENERAL

NATIONAL OILWELL VARCO model 55T-3 triplex pump is "splash" lubricated. The main bearings and crankshaft bearings are fed by splash. Crossheads and crosshead pin bushings are fed through holes in the crossheads and splash through the crosshead weighs. Intermediate rods are lubricated from the splash they receive from the crosshead.

A. OIL

Use "extreme pressure" gear oil. The chart below shows the recommended grades for various temperatures surrounding the pump.

U.S. UNITS OF MEASURE	
Temperature	**AGMA Industrial EP Gear Oil**
+50°F to +155°F	AGMA No. 6 EP or ASTM/ISO Grade No. 320 (viscosity 1335 to 1632 SSU 100°F)
+20°F to +100°F	AGMA No. 5 EP or ASTM/ISO Grade No. 220 (viscosity 918 to 1122 SSU 100°F)
-20°F to + 60°F	AGMA No. 2 EP or ASTM/ISO Grade No. 68 (viscosity 284 to 347 SSU 100°F)

Approximate crankcase Capacity - Quarts: 10
(For exact amount observe dip stick provided with pump)

METRIC UNITS OF MEASURE	
Temperature	**AGMA Industrial Gear Oil**
+10°C to +68°C	AGMA No. 6 EP or ASTM/ISO Grade No. 320 (Viscosity 228-352 cSt at 37.8°C)
-7°C to +38°C	AGMA No. 5 EP or ASTM/ISO Grade No. 220 (Viscosity 198-242 cSt at 37.8°C)
-29°C to +16°C	AGMA No. 2 EP or ASTM/ISO Grade No. 68 (Viscosity 61-75 cSt at 37.8°C)

Approximate crankcase Capacity - Liters: 9.5
(For exact amount observe dip stick provided with pump)

Oil must pour freely at minimum operating temperature. Change oil every six months or as frequently as operating conditions require maintaining a clean, sludge-free oil of proper viscosity.

Operation…

I. GENERAL

! ATTENTION !

THE FOLLOWING POINTS SHOULD BE CHECKED FOR THE PREVENTION OF TROUBLE OR TO CORRECT TROUBLE THAT MAY ARISE.

A. OPERATION CHECKLIST

1. Pump must be a set level for proper lubrication.
2. Make sure pump is filled with clean oil of the proper viscosity (see Lubrication section in this manual).
3. Do **not** over-speed the pump.
4. Do **not** use a smaller diameter sheave than is recommended for the pump.
5. Make sure all safety shutdown switches are operating properly.
6. Keep all suction and discharge line valves fully open.
7. If a bypass is used to regulate output, make sure it is set properly.
8. Make sure the pressure relief valve is set properly.
9. Do **not** exceed the pressure rating of the pump for the particular plunger size.
10. Make sure the suction line is tight, as air entering the suction line will cause severe hammering and knocking of the pump.
11. Make sure plunger and intermediate rod connections are tight and locked.
12. Check the plunger packing for correct adjustment (see Plunger Packing Installation section in this manual).
13. Check the suction and discharge dampeners for proper charge, as this is very important for long life and good pump operation.
14. Make sure the fasteners holding the cylinder in place are tight.

Maintenance…

I. GENERAL

The following points are intended as a guide to be used in setting up a maintenance program. Good preventive maintenance will pay big dividends in the form of reliable service with a minimum of trouble.

A. DAILY MAINTENANCE

1. Check power end oil level daily. Do not attempt to check the oil with the pump running. Inspect the oil for dirt or contamination and change if necessary. An increase in oil level indicates fluid end leakage into power end. Change oil immediately and check intermediate rod wipers and surface smoothness of rod. Check for plunger packing leakage.

2. Lubricate plunger packing frequently. Packing life can be greatly increased by greasing every four (4) hours with a small amount of grease. Grease is not recommended at pressures above 1200 psi. Use an alternate packing lubricator to drip the proper oil on the plunger for lubrication. (See Plunger Packing Lubrication section in this manual for further details).

3. Check lubricator for proper level and operation.

4. Check plunger packing for excessive leakage. Replace packing as required.

5. Check stuffing box adjusting nuts for tightness.

6. Drain plunger leakage sump tanks if required.

7. Flush plunger chamber drain lines with kerosene on power oil pumps and fresh water on salt pumps. This may be done weekly unless salt and paraffin accumulation is severe.

8. Make sure suction and discharge line valves are fully open.

9. Check for leakage between the fluid cylinder and frame or stuffing box to fluid cylinder packing if required.

10. Check all seals for leakage.

11. Check belts or clutch for slippage. If either condition exists, correct immediately.

B. MONTHLY MAINTENANCE

1. Drain and refill crankcase every six (6) months or as often as required to maintain a clean, sludge-free oil of the proper viscosity.

2. Clean or replace crankcase air breather.

3. Check all studs, nuts and capscrews for tightness. Inspect gaskets for leaks; tighten or replace as required.

4. Clean pump. Good housekeeping is a prerequisite to good maintenance.

Maintenance…

I. GENERAL (Continued)…

C. STORAGE

If the pump is to be idle for longer than one (1) week, it should be prepared for storage as follows:

1. Drain and clean crankcase thoroughly. Leave drain open and install 90° elbow, pointing downward, to permit air circulation and prevent condensation build-up.
2. Coat all bearings, finished surfaces, and entire inside surface of crankcase with a rust inhibiting oil.
3. Remove plungers and packing, clean and coat with rust inhibiting oil.
4. Remove fluid cylinder valves allowing cylinder to be thoroughly cleaned and drained.
5. Coat entire cylinder, valves and parts, with a rust inhibiting oil.
6. Thoroughly inspect pump and rotate crankcase once each month. Re-coat with rust inhibiting oil where necessary.

D. START-UP AFTER STORAGE

Any pump that has been in storage, either after field use or as shipped from the plant, will need a thorough inspection to make sure it has not been damaged in any way and that all parts are properly in place.

⚠ ! ATTENTION ! ⚠

FAILURE TO OBSERVE THE FOLLOWING POINTS CAN RESULT IN SERIOUS DAMAGE.

1. Remove all covers on both power end and fluid end; thoroughly clean and inspect all parts and finished surfaces.
2. Check all bearings to make sure they are clean and in good condition.
3. Make sure valves, plungers and packing are properly installed and in good condition.
4. Carefully tighten all bolts, nuts, studs and working connections.
5. Fill power end to the proper level with clean oil of the proper viscosity. Make sure oil is poured into the hand hole area and is worked into all bearings.
6. Fill packing lubricator and pump lines full. Check by breaking connection at stuffing box, working lubricator plunger until oil appears.

Maintenance (Continued)...

II. TROUBLE SHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	CORRECTION
KNOCKING OR POUNDING IN FLUID END AND PIPING	SUCTION LINE RESTRICTED BY: (1, 2, 3, 4)	
	1. TRASH, SCALE BUILD UP, ETC.	LOCATE AND REMOVE
	2. PARTIALLY CLOSED VALVE IN SUCTION LINE	LOCATE AND CORRECT
	3. METERS, FILTERS, CHECK VALVES, NON-FULL-OPENING, CUT-OFF VALVE OR OTHER RESTRICTIONS	RE-WORK SUCTION LINE TO ELIMINATE
	4. SHARP 90° BENDS OR 90° BLIND TEES.	RE-WORK SUCTION LINE TO ELIMINATE
	AIR ENTERING SUCTION LINE THROUGH CUT-OFF VALVE	TIGHTEN OR REPACK VALVE STEM PACKING
	AIR ENTERING SUCTION LINE THROUGH LOOSE CONNECTION OR FAULTY PIPE	LOCATE AND CORRECT
	AIR OR VAPOR TRAPPED IN SUCTION LINE	LOCATE RISE OR TRAP AND CORRECT BY STRAIGHTENING LINE, PROVIDING ENOUGH SLOPE TO PERMIT ESCAPE AND PREVENT BUILD-UP
	LOW FLUID LEVEL	INCREASE SUPPLY AND INSTALL AUTOMATIC LOW LEVEL SHUT-DOWN SWITCH
	SUCTION DAMPENER NOT OPERATING	INSPECT AND REPAIR AS REQUIRED
	WORN VALVES	INSPECT AND REPAIR AS REQUIRED
	ENTRAINED GAS IN FLUID	PROVIDE GAS BOOT OR SCRUBBER FOR FLUID
	POOR INLET AND OUTLET ARRANGEMENT AT SUPPLY TANK	INLET TO BE AT TOP OF TANK AND BAFFLED TO BREAKOUT GAS AND PREVENT CHANNELING. OUTLET TO BE 12" FROM BOTTOM OF TANK AND AS FAR FROM INLET AS POSSIBLE, NEVER CLOSER THAN 90°.
	LOOSE PACKING ADJUSTING NUT	TIGHTEN AND/OR REPLACE PACKING
	INADEQUATE SIZED SUCTION LINE	REPLACE WITH INDIVIDUAL SUCTION LINE OF NEXT SIZE LARGER THAN INLET PUMP
	LEAKAGE PRESSURE RELIEF VALVE THAT HAS BEEN PIPED BACK INTO SUCTION LINE	REPAIR VALVE AND RE-WORK PIPING TO RETURN TO SUPPLY TANK - NOT SUCTION LINE.
	BY-PASS PIPED BACK TO SUCTION	REWORK TO RETURN BY-PASSED FLUID BACK TO SUPPLY TANK - NOT SUPPLY LINE
	BROKEN PLUNGER	INSPECT WHEN ROTATING PUMP BY HAND AND REPLACE AS REQUIRED

Maintenance…

II. TROUBLE SHOOTING GUIDE (Continued)…

PROBLEM	POSSIBLE CAUSE	CORRECTION
KNOCK IN POWER END	VALVE WEAR OR DAMAGE	CHECK FLUID END FOR BAD VALVES
	WORN MAIN BEARINGS	REPLACE AS REQUIRED
	LOOSE PLUNGER - INTERMEDIATE ROD CROSSHEAD CONNECTION	INSPECT FOR DAMAGE - REPLACE AS REQUIRED AND TIGHTEN
	WORN CROSSHEAD PIN, OR CONNECTING ROD	LOCATE AND REPLACE AS REQUIRED
RAPID VALVE WEAR OR FAILURE	CORROSION	TREAT FLUID AS REQUIRED
	ABRASIVES IN FLUID	FILTER AS REQUIRED
	IMPROPER INSTALLATION	INSPECT AND INSTALL PER INSTRUCTION SHEET IN PACKING BOX
	IMPROPER LUBRICATION (EITHER INSUFFICIENT OR EXCESSIVE OR INCORRECT TYPE)	CHECK INSTRUCTIONS IN MANUAL AND CORRECT AS REQUIRED
	LUBRICATOR NOT OPERATING	INSPECT AND CORRECT AS REQUIRED
	ADJUSTING NUT LOOSE	INSPECT AND REPACK PER INSTRUCTIONS
	SCALE OR BUILD UP ON PLUNGER	TREAT FLUID AS REQUIRED
SHORT PACKING LIFE	WORN OR PITTED PLUNGERS AND/OR STUFFING BOX	REPLACE AS REQUIRED
	ABRASIVES IN FLUID	FILTER AS REQUIRED
	PUMP OPERATED WITHOUT FLUID	CHECK SYSTEM FOR FAULTY LOW-LEVEL SHUTDOWN CONTROLS OR CLOSED VALVES AND CORRECT AS REQUIRED
	ABNORMALLY HIGH FLUID TEMPERATURES	CHECK WITH MANUFACTURER FOR RECOMMENDATIONS ON TYPE OF PACKING
	WRONG TYPE OF PACKING FOR PARTICULAR FLUID BEING HANDLED	CHECK WITH MANUFACTURER FOR RECOMMENDATIONS ON TYPE OF PACKING
	CAVITATION (KNOCKING AND POUNDING IN FLUID CYLINDER AND PIPING)	REFER TO CORRECTION OF "KNOCK IN POWER END" ABOVE

Maintenance…

II. TROUBLE SHOOTING GUIDE (Continued)…

PROBLEM	POSSIBLE CAUSE	CORRECTION
BROKEN OR PITTED FROM IMPLOSIONS CAUSED BY IN EXCESSIVE GAS OR AIR ENTRAINED FLUID.	PLUNGER CRACKED AT INSTALLATION	INSTALL NEW PLUNGER USING CARE TO AVOID ANY SHARP BLOW OR FORCE ON PLUNGER
	PLUNGER CRACKED FROM THERMAL SHOCK	CHECK SYSTEM TO ELIMINATE ANY SHARP OR SUDDEN TEMPERATURE DIFFERENCES. TEMPERATURE EXTREMES ON THE PLUNGER CAN OCCUR FROM PACKING AS DISCUSSED UNDER "SHORT PACKING LIFE" PROBLEM PR FROM TEMPERATURE CHANGES IN THE FLUID ITSELF.
	PLUNGER PITTED FROM IMPLOSIONS CAUSED BNY EXCESSIVE GAS OR AIR ENTRAINED IN FLUID	CHANGE SUCTION SYSTEM TO ELIMINATE OR CHECK WITH MANUF. REGARDING USE OF SPECIAL PACKING ARRANGEMENT
RAPID WEAR OF HARD-COATED PLUNGER	PACKING FAILURE	CHECK AND CORRECT PER RECOMMENDATIONS UNDER "SHORT PACKING LIFE" PROBLEM
	PLUNGER NOT SUITABLE FOR PARTICULAR SERVICE	CHECK WITH MANUFACTURER FOR RECOMMENDATION
OIL SEAL LEAKS	PLUNGER NOT SUITABLE FOR PARTICULAR SERVICE	CHECK AND CORRECT AS REQUIRED
	PUMP NOT LEVEL	CHECK AND CORRECT AS REQUIRED
	WORN, CORRODED, PITTED, OR OTHERWISE DAMAGED SEALING SURFACE	CHECK AND CORRECT AS REQUIRED
	WORN OR DAMAGED SEALS	CHECK AND CORRECT AS REQUIRED
	OIL LEVEL TOO HIGH	CHECK AND CORRECT AS REQUIRED

Overhaul and Repair…

I. GENERAL

The bearings and other working parts in the power end have been designed for continuous duty, and if properly lubricated, will provide years of trouble-free service. However, after the pump has been in service for a long period of time, the bearings and other working parts will gradually loosen, and if not corrected, will lead to more serious trouble. The time to overhaul the pump will vary; depending on the operating conditions, and is therefore a matter that must be left to the good judgment of the operator. Complete disassembly and assembly procedures are discussed in their respective sections.

A. TOOLS REQUIRED

Most of the tools required to overhaul the pump will be found in an ordinary set of mechanics hand tools. The special tools and equipment required and not furnished with the pump include a torque wrench, bearing puller, and a valve servicing kit. Also, a hot oil bath capable of reaching a temperature of 300°F (149°C) will be needed.

B. CHECK POINTS AND ADJUSTMENTS

The crankshaft main bearings are single row; shim adjusted, tapered roller bearings. They have been assembled and adjusted at the factory with proper clearance and will give long trouble-free service. The proper clearance is found by adjusting the amount of shims until the crankshaft has 0.001" to 0.003" (0.025 mm to 0.076 mm) endplay and will rotate freely.

PUMP	CRANKSHAFT PIN O.D		MAXIMUM CLEARANCE		MINIMUM CLEARANCE	
	in	mm	in	mm	in	mm
3364 Old Style	3.251 3.249	82.575 82.525	0.004	0.102	0.002	0.051
3364 New Style	3.499 3.498	88.875 88.849	0.005	0.127	0.002	0.051
55T-3	3.499 3.498	88.875 88.849	0.005	0.127	0.002	0.051

PUMP	CROSSHEAD PIN O.D.		MAXIMUM CLEARANCE		MINIMUM CLEARANCE	
	in	mm	in	mm	in	mm
3364 Old Style	1.5005 1.4995	38.1127 38.0873	0.003	0.076	0.002	0.051
3364 New Style	1.7505 1.7499	44.4627 44.4475	0.004	0.102	0.002	0.051
55T-3	1.7505 1.7499	44.4627 44.4475	0.004	0.102	0.002	0.051

Disassembly…

I. POWER END

It is not necessary to remove the fluid end when disassembling the power end. However, the plungers and (if applicable) intermediate rods should be removed through the fluid end cylinder heads.

! ATTENTION !

POWER END DISASSEMBLY AND OVERHAUL IS BEST PERFORMED IN A WELL EQUIPPED SHOP ENVIROMENT. IF THE PUMP IS DISASSEMBLED AT LOCATION ENSURE THE PRESSURE HAS BEEN REMOVED FROM THE FLUID END AND THE PUMP BLOCKED OUT WITH APPROPRIATE BLOCK VALVES. ENSURE THE FLUID END IS DRAINED AND ANY POWER SOURCE OR DRIVER IS LOCKED OUT BEFORE PROCEEDING!

A. PLUNGER/INTERMEDIATE RODS AND OIL WIPER RETAINERS

a. Remove the fluid end cylinder head.

b. Remove the fluid end valve covers.

c. If the pump is equipped with wing guided valves, remove the valve bodies and springs from both the suction and discharge valves.

d. If the pump is equipped with plate type valves, remove the retainer and spring from the suction valve assembly.

e. Remove the power end cradle cover.

f. Rotate the crankshaft until the knurl area of the plunger/intermediate rod is accessible in the cradle area of the pump.

g. Loosen the fluid end packing gland nuts.

h. Remove the hand hole cover.

i. Remove the two nuts holding the power end wiper box gland.

j. If the pump has intermediate rods a back-up wrench is required. The plunger and intermediate rod separate at the knurl area interface. Using the back-up wrench, break the plunger loose and unscrew from the intermediate rod. Remove the plunger through the fluid cylinder opening.

k. Insert the power end packing removal tool GAS-104077-F05 through the hand hole opening and lay it on the intermediate rod or adapter portion of the plunger.

l. Using crankshaft rotation tool GAS-103220-000, rotate the pump by hand and allow the packing removal tool to push the power packing/seal assembly out of the power end stuffing box.

m. Use a pipe wrench on the knurled area of the intermediate rod; remove it from the crosshead and power end.

n. If the pump does not have an intermediate rod, use a pipe wrench on the knurled area of the plunger and break it loose from the crosshead. Unscrew and remove through the fluid cylinder opening.

o. Repeat steps 9 through 14 above for the remaining plungers.

Disassembly…

I. POWER END (Continued)...

B. CRANKSHAFT ASSEMBLY

1. Remove the rear power end crankcase cover.
2. Remove connecting rod bolts and cap.

   NOTE: Connecting rods and caps are matched marked and must be kept together. Do not mix caps and rods.
3. Connecting rod and crosshead must be moved all the way forward to clear crankshaft.
4. Remove crankshaft bearing retainers, seals, and shims. These parts should be tied together and marked for reassembly at their original location.

! ATTENTION !

COVER KEYWAYS TO PROTECT OIL SEALS DURING REMOVAL.

5. Carefully remove the crankshaft out either side of the power frame. If reusing the end bearings remember, the crankshaft end bearing cones and cups are matched sets. Do not mix cones and cups.

C. CRANKSHAFT BEARINGS

The crankshaft main bearings may be inspected while on the crankshaft and should not be removed unless necessary. A puller is required when replacement is necessary.

NOTE: Keep the component parts of the bearings together if they are to be re-installed. They are match sets and must be correctly assembled as a unit.

Disassembly (Continued)...

II. FLUID END

⚠ ! ATTENTION ! ⚠

BEFORE WORKING ON THE FLUID END ENSURE THE PRESSURE HAS BEEN REMOVED FROM THE FLUID END AND THE PUMP BLOCKED OUT WITH APPROPRIATE BLOCK VALVES. ENSURE THE FLUID END IS DRAINED AND ANY POWER SOURCE OR DRIVER IS LOCKED OUT BEFORE PROCEEDING!

A. FLUID CYLINDER REMOVAL

1. Disconnect piping.
2. Remove the plungers as described below.
3. Install a proper lifting strap or chain around the fluid end.
4. Remove the hex nuts holding the fluid end to the power end and slide cylinder forward until free.

B. PLUNGER REMOVAL

1. Remove the fluid end cylinder head.
2. Remove the fluid end valve covers.
3. If the pump is equipped with wing guided valves, remove the valve bodies and springs from both the suction and discharge valves.
4. If the pump is equipped with plate type valves, remove the retainer and spring from the suction valve assembly.
5. Remove the power end cradle cover.
6. Loosen the fluid end packing gland nuts.
7. Rotate the crankshaft until the knurl area of the plunger/intermediate rod is accessible in the cradle area of the pump.
8. If the pump has intermediate rods a back-up wrench is required. The plunger and intermediate rod separate at the knurl area interface. Using the back-up wrench break the plunger loose and unscrew from the intermediate rod. Remove the plunger through the fluid cylinder opening.
9. If the pump does not have an intermediate rod, use a pipe wrench on the knurled area of the plunger and break it loose from the crosshead. Unscrew and remove through the fluid cylinder opening.
10. Repeat steps 7 through 9 above for the remaining plungers.

C. FLUID END VALVE REMOVAL

Refer to valve section of this manual.

Assembly…

I. POWER END

A. CONNECTING ROD AND CROSSHEAD ASSEMBLY

1. The crosshead (wrist) pin bushing is a slip fit in the connecting rod and a press fit in the crosshead.

2. Check the wrist pin to connecting rod fit per the specifications listed in the Check Points and Adjustments section in this manual. If necessary, ream to specifications. (If new service bushings are used, reaming will generally not be necessary.)

3. Assemble the connecting rod to the crosshead by pressing the crosshead pin into the crosshead or, to facilitate assembly, the crosshead may be heated to no more than 300°F (149°C) in an electric oven or bath.

   NOTE: Connecting rods and bearing caps are match marked as units. The marks should be stamped on the cap and rod at the split line. The rods also have a lube holes on the topside. **Install connecting rod and crosshead so the lube holes on the rod are facing up.** See figure 1.

4. Lubricate the crosshead bore and slide the connecting rod crosshead assembly into the power frame. Push the assemblies all the way forward.

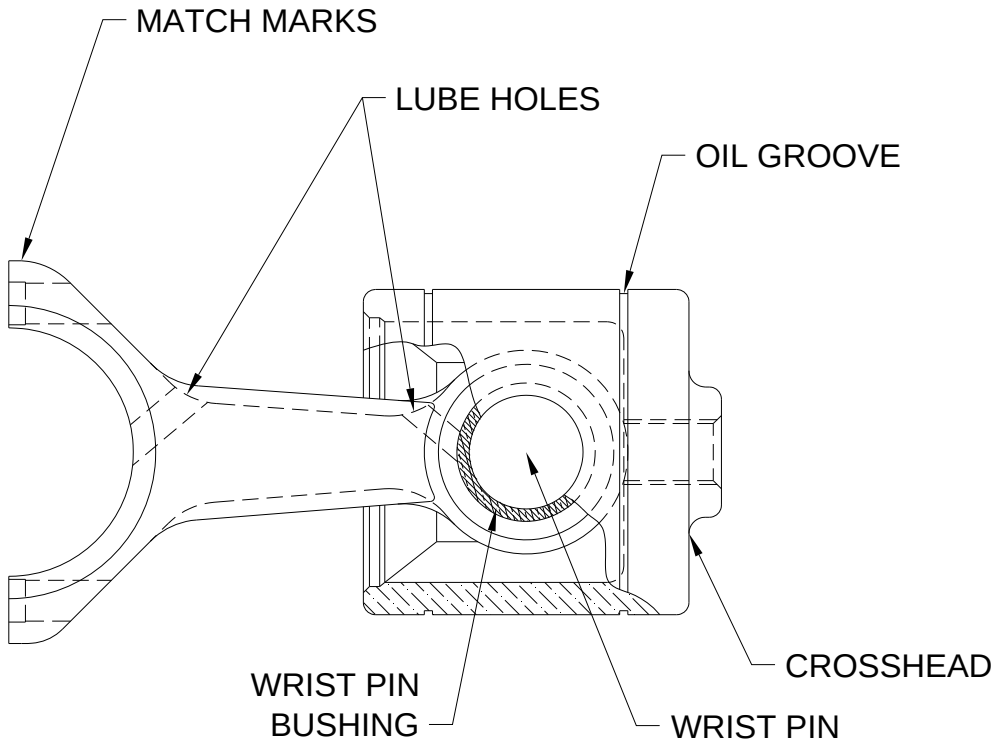


Figure 1

Assembly…

I. POWER END (Continued)…

B. CRANKSHAFT AND MAIN BEARINGS

1. Thoroughly clean and remove all burrs from the I.D. of the cone and roller assembly and from the bearing seating surfaces on the crankshaft.

2. Heat the cone and roller assembly in an electric oven or oil bath to 300°F (149°C). It is recommended that a thermometer be used to prevent overheating.

3. After the bearings have been brought up to temperature and with the crankshaft firmly supported, install the cone and roller assemblies on the crankshaft. *Make sure the cone and roller assemblies are firmly against the shoulders on the crankshaft.*

4. Heat the wear rings in an electric oven or oil bath to 300°F (149°C). It is recommended that a thermometer be used to prevent overheating.

5. Install the wear rings. Ensure they are fully seated.

6. Allow the crankshaft and bearing assembly to cool before installing in the power end.

7. Make sure the main bearing openings in the frame are clean and free of burrs.

   NOTE: The crossheads and connecting rods must be installed prior to replacing the crankshaft assembly.

8. Install the crankshaft main bearing outer races or cups in the main bearing housing. These races can be carefully driven into the housing with a brass rod. An alternative and easier way is to chill the races in a freezer or with CO_2 and place them in their respective bearing housings. Ensure the races are completely seated.

9. Place the crankcase main bearing shims on the crankshaft-bearing housing/retainers. *If the **old** bearings and retainers are being re-installed, use the same amount of shims as before.*

10. Install the off drive side bearing housing with shims in the power frame and tighten in place with the proper capscrews.

11. With the cone and roller assemblies of the main bearings in place on the crankshaft, slide the crankshaft through the main bearing openings in the power end frame with No. 1 throw forward. Slide the off drive side bearing into its bearing housing and race.

12. Assemble the drive side crankshaft-bearing housing/retainer and shims to the main frame and tighten in place with the proper capscrews.

    NOTE: The following steps (13a and 13b) are necessary only if new bearings are being installed. When the same crankshaft main bearings are being reassembled, use the same amount of shims as were previously used and use the steps as a check for adjustment.

Assembly…

I. POWER END

B. CRANKSHAFT AND MAIN BEARINGS (Continued)...

13. To determine the correct amount of shims when installing new bearings, the following steps are recommended.

    a. When first installing shims, use only enough shims to produce a slight drag when the crankshaft is rotated. Tap shaft on each end sufficiently to ensure that the bearing outer race is tightly against the retainer.

    1. Then, add enough shims to remove the slight drag or pre-load (approximately 0.005" [0.127 mm] to 0.007" [0.178 mm], depending on the amount of pre-load). *The bearings are correctly adjusted when the endplay of the crankshaft is per the specifications and the crankshaft will rotate freely.*

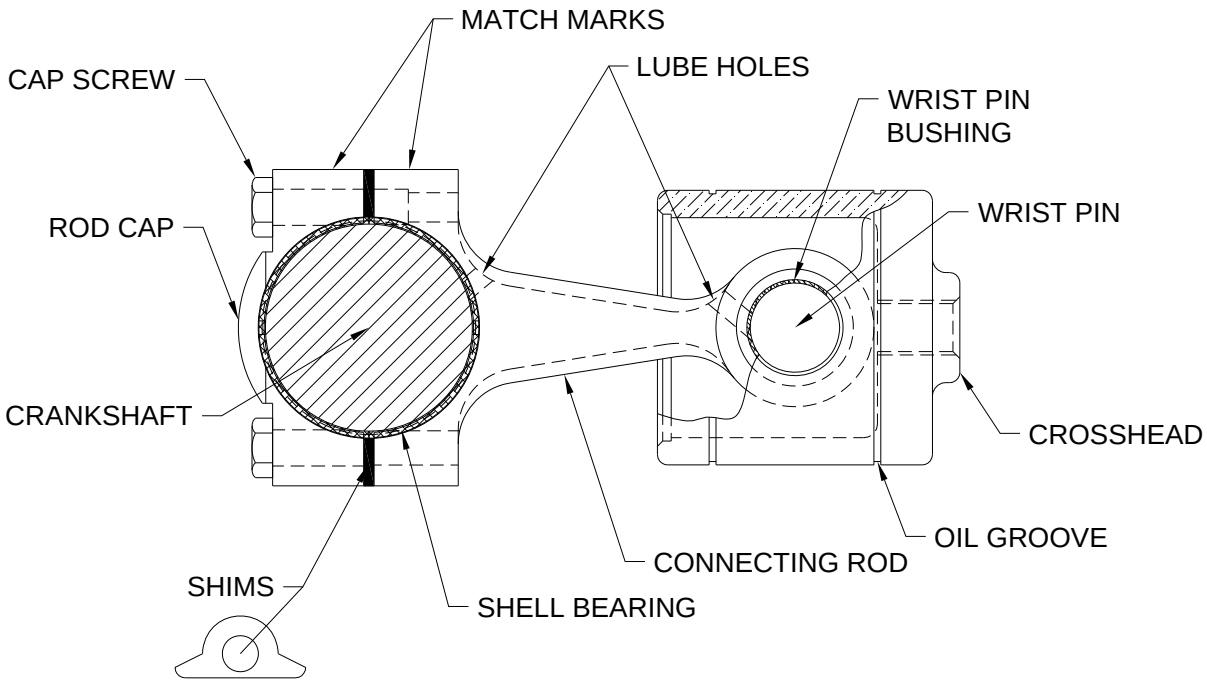
CRANKSHAFT END PLAY

PUMP	MAXIMUM END PLAY		MINIMUM END PLAY	
	in	mm	in	mm
3364	0.003	0.076	0.001	0.025
55T-3	0.003	0.076	0.001	0.025

Assembly…

I. POWER END (Continued)…

C. CONNECTING ROD TO CRANKSHAFT ASSEMBLY (Old Style Shim Adjustable)



Shim Style Connecting Rod Assembly
Figure 2

1. Thoroughly clean and remove all burrs and nicks from connecting rod and crankshaft journals.
2. Position the number 1 crankshaft throw to the rear.
3. Take a shell bearing half and carefully locate it in the rod half of the connecting rod assembly.
4. Lubricate the connecting rod pin and rod bearing.
5. Slide the connecting rod back over the crankshaft throw using caution so the outer surface of the insert is not damaged. Note the match numbers of the cap and rod to be certain the rod is assembled correctly.
6. Take the other shell half and install in the cap half of the rod.
7. Carefully install the cap half and shell bearing along with the lubricated connecting rod bolts and shim sets.
8. Torque the rod per the following chart.
9. Place a wrench on the top connecting rod bolt and shake the rod parallel to the crankshaft. (The pressure must be relieved from the fluid end so that the pump's mechanism is free to move.) The rod should move freely back and forth. If not, add shims until the rod moves freely back and forth.

Assembly…

I. POWER END

C. CONNECTING ROD TO CRANKSHAFT ASSEMBLY (Old Style Shim Adjustable) (Continued)...

10. Remove shims until you cannot shake the rod, and then add 0.005" (0.127 mm) shims one at a time until there is a little side movement.

11. Remove the cap and check the oil clearance with "Plastigage" (available in most parts stores). (Do not rotate pump during this process.)

    - Wipe crankshaft journal clean of any oil.
    - Place a strip of "Plastigage" on the crankshaft journal. "Plastigage" should be placed parallel (left to right) across the pin. Do not place the "Plastigage" around the pin diameter's circumference.
    - Torque rod cap to the specified torque.
    - Remove rod cap and measure oil clearance with scale provided with the "Plastigage".
    - Compare the clearance with the following chart.

12. Add or remove shims as necessary and repeat step 11 until the clearance is within specifications.

13. Use crankshaft rotation tool GAS-103220-000 and rotate the pump by hand. If there are any tight spots or hard drag, add another 0.005" (0.127mm) shim and re-torque.

14. Repeat these steps for the remaining connecting rods.

15. When finished, the pump should rotate freely without hard or tight spots.

CONNECTING ROD TORQUE

PUMP	Torque (ft-lbs.)	Torque (N-M)
Connecting rods	80-85	108-115

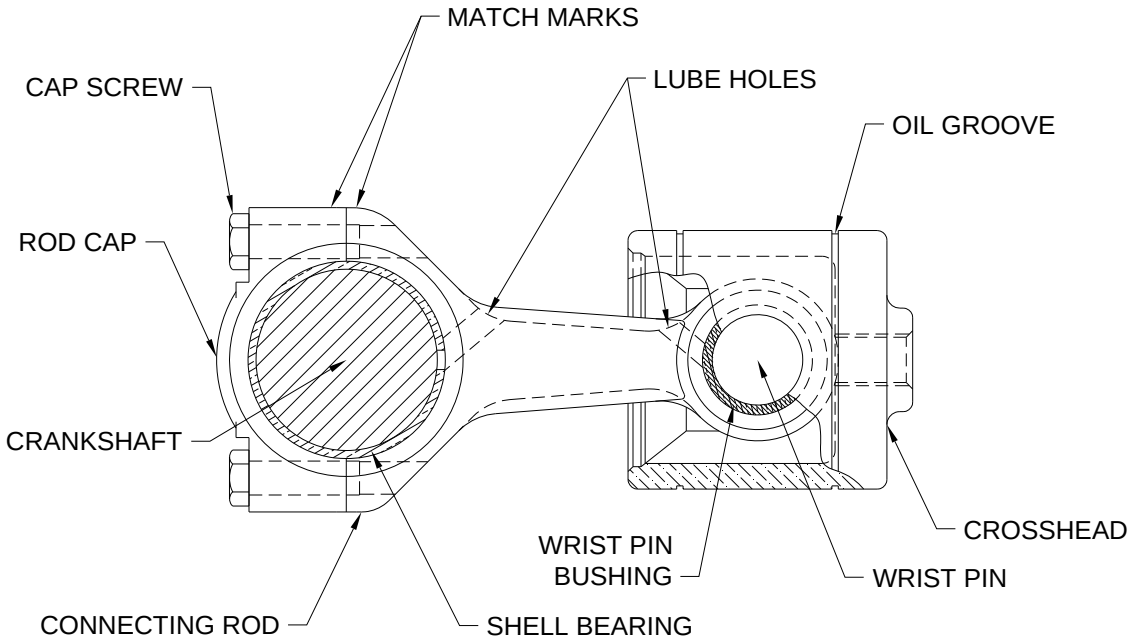
SHIM-ADJUSTABLE SHELL BEARING CLEARANCE

PUMP	CRANKSHAFT PIN O.D		MAXIMUM CLEARANCE		MINIMUM CLEARANCE	
	in	mm	in	mm	in	mm
3364 Old Style	3.251 3.249	82.575 82.525	0.004	0.102	0.002	0.051

Assembly…

I. POWER END (Continued)…

D. CONNECTING ROD TO CRANKSHAFT ASSEMBLY (New Style, Precision Shell Bearing)



Precision Shell Bearing Connecting Rod Assembly
Figure 3

1. Thoroughly clean and remove all burrs and nicks from connecting rod and crankshaft journals.
2. Position the number 1 crankshaft throw to the rear.
3. Take a shell bearing half and carefully locate it in the rod half of the connecting rod assembly.
4. Lubricate the connecting rod pin and rod bearing.
5. Slide the connecting rod back over the crankshaft throw using caution so the outer surface of the insert is not damaged. Note the match numbers of the cap and rod to be certain the rod is assembled correctly.
6. Take the other shell half and install in the cap half of the rod.
7. Carefully install the cap half and shell bearing.
8. Torque the rod per the chart below.
9. These are precision made shell bearings and no shims are required. If there are tight spots at this point something is out of specification.

Assembly...

I. POWER END

D. CONNECTING ROD TO CRANKSHAFT ASSEMBLY (New Style, Precision Shell Bearing) (Continued)...

10. As a check, use "Plastigage" (available in most parts stores) and check the oil clearance. Do not rotate the pump during this process.

    - Wipe crankshaft journal clean of any oil.
    - Place a strip of "Plastigage" on the crankshaft journal. "Plastigage" should be placed parallel (left to right) across the pin. Do not place the "Plastigage" around the pin diameter's circumference.
    - Torque rod cap to the specified torque.
    - Remove rod cap and measure oil clearance with scale provided with the "Plastigage".
    - Compare the clearance with the chart below.

CONNECTING ROD TORQUE

PUMP	Torque (ft-lbs.)	Torque (N-M)
Connecting rods	80-85	108-115

PRECISION SHELL BEARING CLEARANCE

PUMP	CRANKSHAFT PIN O.D		MAXIMUM CLEARANCE		MINIMUM CLEARANCE	
	in	mm	in	mm	in	mm
3364 New Style	3.499 / 3.498	88.875 / 88.849	0.005	0.127	0.002	0.051
55T-3	3.499 / 3.498	88.875 / 88.849	0.005	0.127	0.002	0.051

11. Use crankshaft rotation tool GAS-103220-000 and rotate the pump by hand. There should not be any hard or tight spots. If there are something is likely out of specification.
12. Repeat these steps for the remaining connecting rods.
13. When finished, the pump should rotate freely without hard or tight spots.

Assembly...

I. POWER END (Continued)...

E. POWER END STUFFING BOX SEALS

1. LIP TYPE PACKING

The power end wiper box is integral with power frame. The seals are held in place by two adjustment studs and the wiper box gland. There are two options available for power end stuffing box seals. The standard arrangement is lip type packing. To replace the standard seal arrangement follow these instructions.

a. Remove the old seals as explained starting in the Disassembly section of this publication.

b. Clean and inspect the stuffing box bore.

c. Apply a coat of lubricant to the stuffing box bore and the new seal rings.

d. Install one ring at a time. Ensure each ring is fully seated and in the correct orientation. See figure 4.

e. Once all rings have been installed, loosely install the gland. Do not tighten at this time.

f. Repeat for the remaining plungers.

g. Clean and inspect the plunger or adapter rod. Replace the rod if scored or damaged.

h. Coat the rod liberally with oil and insert it through the seals being careful to not damage the seal lips.

i. Thread the rod into the crosshead and tighten securely with a pipe wrench on the knurled portion of the rod.

j. Repeat for all plungers.

k. Carefully adjust the gland nut. The gland should be snug, but do not over tighten. There should be a small gap between the gland and the power frame.

l. Operate the pump and observe the seals. If they are leaking, stop the pump and adjust, but again do not over tighten. The pump may have to operate for a period to allow the seals to seat.

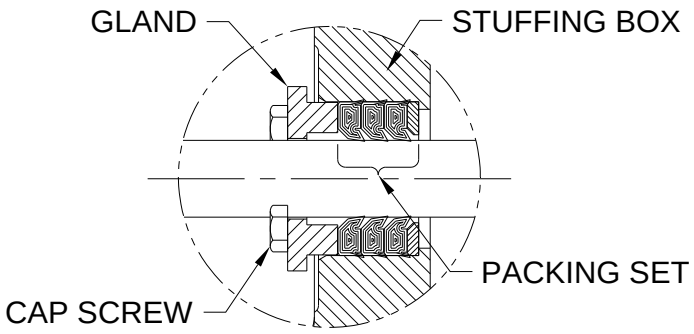


Figure 4

Assembly…

I. POWER END

E. POWER END STUFFING BOX SEALS (Continued)…

2. U-CUP STYLE SEAL

The optional power end stuffing box seal arrangement is a one piece molded U-Cup style seal. To replace the optional U-Cup seal see below.

a. Remove the old seals as explained starting in the Disassembly section of this publication.

b. Clean and inspect the stuffing box bore.

c. Apply a coat of lubricant to the stuffing box bore and the new U-Cup.

d. Carefully insert the one piece seal into the stuffing box. Ensure the seal is completely seated. See Figure 5.

e. Install and tighten the gland. For this seal the gland should pull up metal to metal. This is a non-adjustable seal.

f. Coat the rod liberally with oil and insert it through the seal being careful to not damage the seal lips.

g. Thread the rod into the crosshead and tighten securely with a pipe wrench on the knurled portion of the rod.

h. Repeat for all plungers.

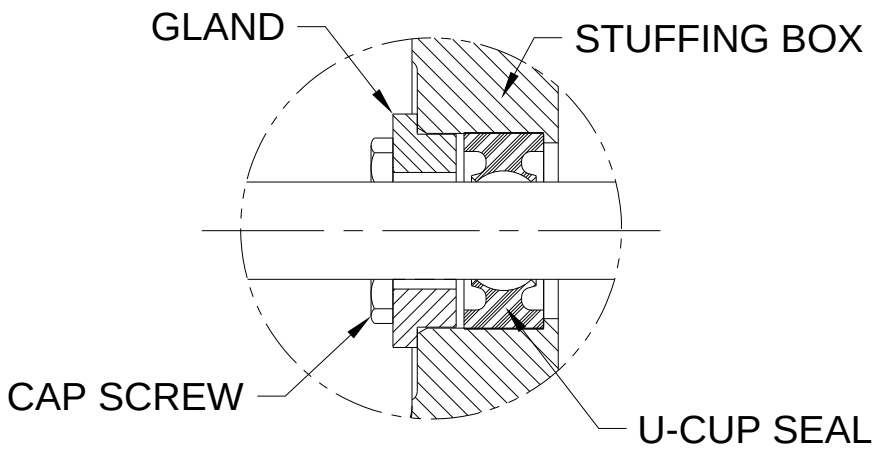


Figure 5

Assembly (Continued)...

II. FLUID END

A. PLUNGERS

Plungers are available in ceramic or hard coated steel.

! ATTENTION !

NATIONAL OILWELL VARCO DOES NOT RECOMMEND THE USE OF CERAMIC PLUNGERS FOR PUMPING FLAMMABLE OR HAZARDOUS LIQUIDS.

1. Plungers are installed in the reverse order of removal. See Disassembly, Plunger Removal section in this publication for removal instructions.
2. Ensure the plunger is clean and free of any dirt or debris.
3. Apply a liberal amount of lubricant to the plunger before installing.
4. Insert the plunger through the cylinder bore, while taking care to avoid damage of the seal lips in the fluid end and power end.
5. Insure the shoulder of the plunger is clean, dry, and free of burrs before tightening. The plunger locks into place by jamming against the crosshead and these surfaces must be clean and drive for an effective lock.
6. The pump will have to be rotated by hand until the knurled area of the plunger is accessible through the cradle opening.
7. If the pump has an intermediate rod, use a back up pipe wrench on the adapter knurl area and tighten the plunger into the adapter with a second pipe wrench on the plunger knurl area.
8. If the pump does not use an intermediate rod, thread the plunger directly into the crosshead and tighten with a pipe wrench on the plunger knurl area.
9. Repeat these steps for all plungers.
10. Adjust the power end packing (if applicable) and fluid end packing before placing pump back into service.

B. FLUID CYLINDER

1. Align the fluid end with the two dowel pins on the power frame face and carefully slide fluid end body into place.
2. Tighten nuts alternately while pulling fluid cylinder up evenly. Torque nuts to the following values:

THREADS	MODEL 55T-3
Lubricated (Ft-lbs)	140
Lubricated (N-M)	190

Assembly...

II. FLUID END (Continued)...

C. FLUID VALVES - TAPERED SEAT TYPE

See valve section of this manual.

D. PIPING INSTALLATION

1. Install flanges on fluid cylinder with special high carbon heat-treated cap screws or studs and nuts available from National Oilwell Varco.

2. Install suction and discharge lines to flanges.

E. PLUNGER PACKING INSTALLATION

1. 838 Packing

It is important that the following procedure be observed when replacing old packing to prevent rapid packing wear. Style 838 packing sets consist of a top and bottom adapter along with three (3) pressure rings. Also required will be a throat bushing and lantern ring, separate from the packing set. Pay attention to the arrangement of the old packing sets to ensure the new sets are installed correctly. Another check is the units are installed so the lantern ring is positioned under the lubrication port. If the lantern ring does not align with the lubrication port, the pump is not correctly packed.

a. Remove cradle cover, fluid end cylinder heads and valve covers.

b. If the pump is equipped with wing guided valves, remove the valve bodies and springs from both the suction and discharge valves.

c. If the pump is equipped with plate type valves, remove the retainer and spring from the suction valve assembly.

d. Rotate pump to bring the first plunger to the forward position.

e. Loosen the fluid end packing gland nuts.

f. If the pump has intermediate rods a back-up wrench is required. The plunger and intermediate rod separate at the knurl area interface. Using the back-up wrench break the plunger loose and unscrew from the intermediate rod. Remove the plunger through the fluid cylinder opening.

g. If the pump does not have an intermediate rod, use a pipe wrench on the knurled area of the plunger and break it loose from the crosshead. Unscrew and remove through the fluid cylinder opening.

h. Remove the gland nut, old packing, and packing adapters. Note the order of the packing and adapters. Clean the stuffing box and inspect for any damage.

i. Rotate the pump to bring the next plunger forward.

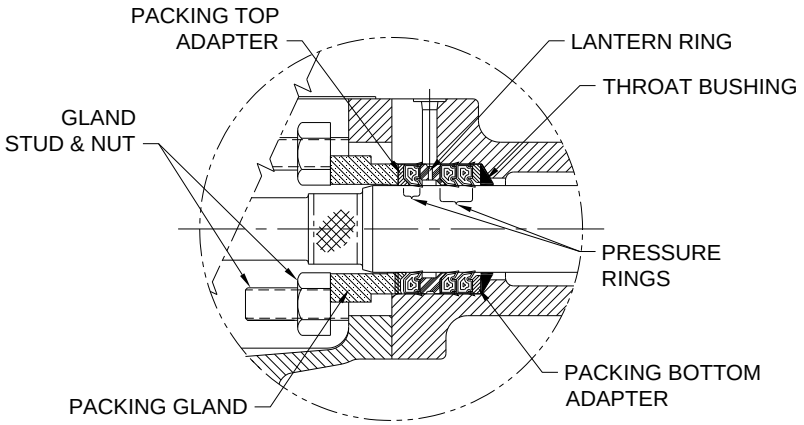
j. Repeat steps “d” through “h” above until all the plungers and packing have been removed.

Assembly…

II. FLUID END

E. PLUNGER PACKING INSTALLATION

1. 838 Packing (Continued)...



Style 838 Packing
Figure 6

k. Check the throat bushing, lantern ring, and follower (if used) for excessive wear. These items can often be reused, but if they are worn, replace them. Reusing worn trim will cause premature packing failure.

l. Thoroughly clean and inspect the stuffing box bore. New packing will not last long in a worn or washed stuffing box.

m. Lightly lubricate the stuffing box bore and install the throat bushing.

n. Lightly lubricate the packing set bottom adapter and install it ensuring it is fully seated at the bottom of the box before installing the next component. (**DO NOT GREASE.)**

o. Lightly lubricate a pressure ring and install ensuring it is fully seated at the bottom of the box; then repeat with a second pressure ring.

p. Install the lantern ring. Check to ensure the lubrication port is aligned with the lantern ring. If not, too few or too many components have been installed ahead of the lantern ring.

q. Install the last ring of packing.

r. Install the top adapter of the packing set and start the gland nut. Adjust the gland nut hand tight only.

s. Lightly oil the plunger and install it through the fluid cylinder while taking care to not damage the seal lips. Do not use worn plungers on new packing, as this will shorten packing life.

t. If using two-piece plungers, torque the adapter rod into crosshead to 150 ft.-lbs. (203 N-M). Then, use a back-up wrench on the adapter rod and torque the plunger into the adapter rod to 150 ft.-lbs. (203 N-M).

Assembly…

II. FLUID END

E. PLUNGER PACKING INSTALLATION

1. **838 Packing (Continued)…**

   u. If using one-piece plungers, thread the plunger into the crosshead and torque to 150 ft.-lbs (203 N-M).

   v. Repeat steps “k” through “u” above until all cylinders have been repacked.

   w. Install the valve components removed in steps “b” and “c” above.

   x. Use new gaskets and install the fluid end cylinder heads and valve covers.

   y. Tighten gland nut with the wrench provided. Pull snug by hand, but **DO NOT USE A CHEATER.**

   z. Install the cradle cover.

   aa. Start the pump and operate at pressure for two to three hours while observing for excessive leakage. If leakage is excessive, stop the pump and readjust. After the two or three hours, stop the pump and readjust. Again, **DO NOT USE A CHEATER.**

   bb. This style packing is considered non-adjustable and should be ready to go at this point. However, it may take as much as one or two days to fully seat. After a couple of days, stop the pump and check the packing again. After this adjustment the pump should be ready to run.

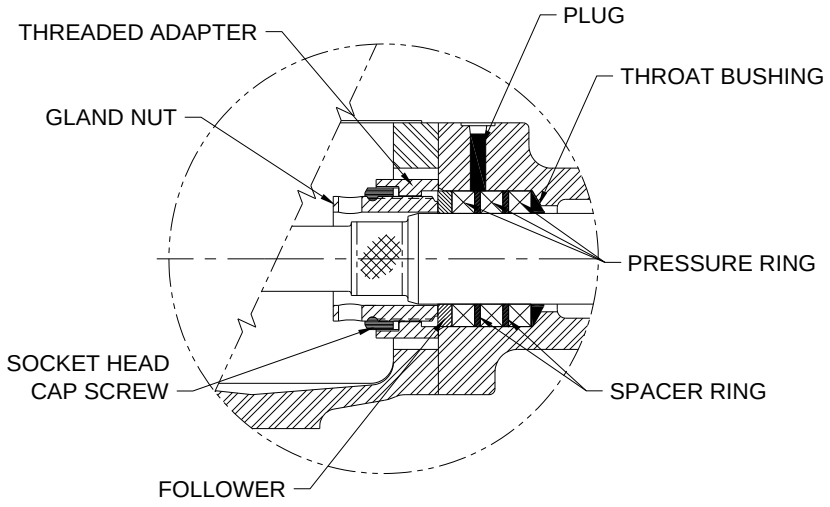
Assembly…

II. FLUID END

E. PLUNGER PACKING INSTALLATION (Continued)…

2. BRAIDED PACKING

It is important that the following procedure be observed when replacing old packing to prevent rapid packing wear. Braided packing sets consist of braided packing rings, spacer rings, and end rings (see figure 7). There will also be a throat bushing and in some cases a follower ring. ***Braided packing should only be used with the optional threaded gland nut.*** Use of bolt on glands with braided packing will usually lead to breakage of the gland studs. The composition and number of rings vary depending on the fluid compatibility, stuffing box depth, and plunger size.



Braid Style Packing
Figure 7

a. Remove cradle cover, fluid end cylinder heads, and valve covers.

b. If the pump is equipped with wing guided valves, remove the valve bodies and springs from both the suction and discharge valves.

c. If the pump is equipped with plate type valves, remove the retainer and spring from the suction valve assembly.

d. Rotate the pump to bring the first plunger to the forward position.

e. Loosen the fluid end packing gland nut.

f. If the pump has intermediate rods a back-up wrench is required. The plunger and intermediate rod separate at the knurl area interface. Using the back-up wrench break the plunger loose and unscrew from the intermediate rod. Remove the plunger through the fluid cylinder opening.

g. If the pump does not have an intermediate rod, use a pipe wrench on the knurled area of the plunger and break it loose from the crosshead. Unscrew and remove through the fluid cylinder opening.

Assembly…

II. FLUID END

E. PLUNGER PACKING INSTALLATION

2. BRAIDED PACKING (Continued)...

h. Remove the gland nut, old packing, and packing adapters. Note the order of the packing and adapters. Clean the stuffing box and inspect for any damage.

i. Rotate the pump to bring the next plunger forward.

j. Repeat steps “e” through “i” above until all the plungers and packing have been removed.

k. Check the throat bushing and follower for excessive wear. These items can often be reused, but if they are worn, replace them. Reusing worn trim will cause premature packing failure.

l. Insure the stuffing box lube port is plugged or has not been drilled completely through. Braided packing does not use a lantern ring and the port must be plugged or the packing can extrude through the port.

m. Thoroughly clean and inspect the stuffing box bore. New packing will not last long in a worn or washed stuffing box.

n. Lightly lubricate the stuffing box bore and install the throat bushing.

o. Install the first pressure ring into the box and ensure it is fully seated.

p. Install the first spacer and ensure it is fully seated.

q. Repeat this procedure until all the packing is installed and fully seated. **ENSURE THE SPLITS ON EACH PACKING RING ARE STAGGERED FROM THE PREVIOUS RING. DO NOT ALIGN THE SPLITS.**

r. Install the follower ring, if used, and loosely install the gland nut.

s. Lightly oil the plunger and install it through the fluid cylinder. Do not use worn plungers on new packing, as this will shorten packing life.

t. If using one-piece plungers, thread the plunger into the crosshead and torque to 150 ft.-lbs (203 N-M).

u. If using two-piece plungers, torque the adapter rod into the crosshead to 150 ft.-lbs. (203 N-M). Then, use a back-up wrench on the adapter rod and torque the plunger into adapter rod to 150 ft.-lbs. (203 N-M).

v. Repeat steps “k” through “u” above until all cylinders have been repacked.

w. Install the valve components removed in steps “b” and “c” above.

x. Use new gaskets and install the fluid end cylinder heads and valve covers.

y. Tighten the gland nut finger tight. Some braided packing is very sensitive to gland tightening. Do not over tighten.

z. Start the pump and bring up to pressure. Watch the packing carefully for signs of excessive heat. If the packing starts to smoke, loosen the gland nut a little. Braided packing does normally drip a small amount. This is by design and helps keep the packing from overheating.

Assembly…

II. FLUID END

E. PLUNGER PACKING INSTALLATION

2. BRAIDED PACKING (Continued)…

aa. Continue to slowly tighten the nut to reduce the leakage to an acceptable level. Remember this type of packing does leak a small amount and tightening the gland until all leakage has stopped will usually result in excessive heat and failed packing. This style packing is adjustable packing and will have to be inspected regularly to keep the nut tight and leakage to a minimum. If the pump is allowed to operate with too loose packing, the packing will prematurely fail and you run the risk of damaging the stuffing box bore.

bb. Install the cradle cover.

3. 805-4 PACKING

805-4 packing is spring loaded, molded V-ring style packing. It is available for some sizes in the 55T-3 series of pumps. It is normally used in high pressure services, but may be used in other selected applications. This is non-adjustable packing. See figure 8.

a. Remove cradle cover, fluid end cylinder heads, and valve covers.

b. If the pump is equipped with wing guided valves, remove the valve bodies and springs from both the suction and discharge valves.

c. If the pump is equipped with plate type valves, remove the retainer and spring from the suction valve assembly.

d. Rotate the pump to bring the first plunger to the forward position.

e. Loosen the fluid end packing gland nut.

f. If the pump has intermediate rods a back-up wrench is required. The plunger and intermediate rod separate at the knurl area interface. Using the back-up wrench break the plunger loose and unscrew from the intermediate rod. Remove the plunger through the fluid cylinder opening.

g. If the pump does not have an intermediate rod, use a pipe wrench on the knurled area of the plunger and break it loose from the crosshead. Unscrew and remove through the fluid cylinder opening.

h. Remove the gland nut, old packing, and packing adapters. Note the order of the packing and adapters. Clean the stuffing box and inspect for any damage.

i. Rotate the pump to bring the next plunger forward.

j. Repeat steps “e” through “i” above until all the plungers and packing has been removed.

k. Check the throat bushing and adapters for excessive wear. These items can often be reused, but if they are worn, replace them. Reusing worn trim will cause premature packing failure.

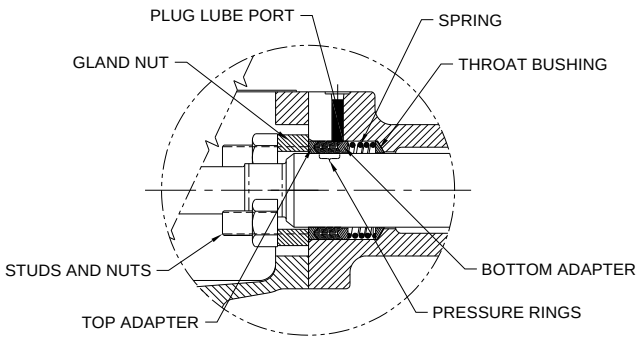
l. Insure the stuffing box lube port is plugged or has not been drilled completely through. 805-4 packing does not use a lantern ring and the port must be plugged or the packing can extrude through the port.

Assembly…

II. FLUID END

E. PLUNGER PACKING INSTALLATION

3. 805-4 PACKING (Continued)...



805-4 Packing Style
Figure 8

m. Thoroughly clean and inspect the stuffing box bore. New packing will not last long in a worn or washed stuffing box.

n. Lightly lubricate the stuffing box bore and install the throat bushing.

o. Install the packing spring.

p. Lubricate and install the packing set and adapters one ring at a time (see figure 8).

q. Install the follower ring (if used) and gland nut. Do not fully tighten the gland nut at this time.

r. Lightly oil the plunger and install it through the fluid cylinder. Do not use worn plungers on new packing, as this will shorten packing life.

s. If using one-piece plungers, thread the plunger into the crosshead and torque to 150 ft.-lbs (203 N-M).

t. If using two-piece plungers, torque the adapter rod into the crossed 150 ft.-lbs. (203 N-M). Then, use a back-up wrench on the adapter rod and torque the plunger into adapter rod 150 ft.-lbs. (203 N-M).

u. Repeat steps “k” through “t” above until all cylinders have been repacked.

v. Install the valve components removed in steps “b” and “c” above.

w. Use new gaskets and install the fluid end cylinder heads and valve covers.

x. Torque the gland stud nuts to 200 ft.-lbs. (271 N-M). This is a non-adjustable packing and the gland should pull up metal to metal.

y. Install the cradle cover and the pump should be ready to operate.

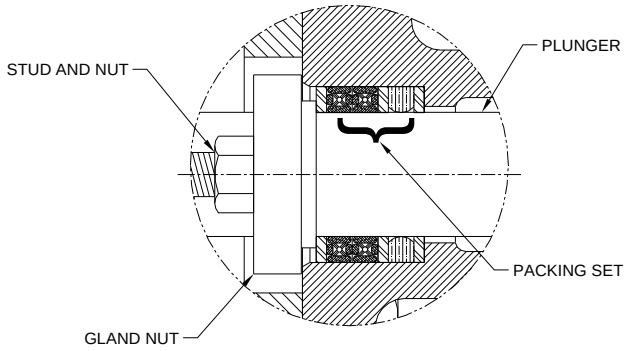
Assembly…

II. FLUID END

E. PLUNGER PACKING INSTALLATION (Continued)…

4. STYLE 242 PACKING

Style 242 packing is a rubber spring loaded packing with a special "Aramid" blend packing for use in special high pressure applications. At this time it is only available for the 55T-3SC and its unique applications. See figure 9 for a typical style 242 layout.



Style 242 Packing
Figure 9

a. Remove cradle cover, fluid end cylinder heads, and valve covers.

b. If the pump is equipped with wing guided valves, remove the valve bodies and springs from both the suction and discharge valves.

c. If the pump is equipped with plate type valves, remove the retainer and spring from the suction valve assembly.

d. Rotate the pump to bring the first plunger to the forward position.

e. Loosen the fluid end packing gland nut.

f. If the pump has intermediate rods a back-up wrench is required. The plunger and intermediate rod separate at the knurl area interface. Using the back-up wrench break the plunger loose and unscrew from the intermediate rod. Remove the plunger through the fluid cylinder opening.

g. If the pump does not have an intermediate rod, use a pipe wrench on the knurled area of the plunger and break it loose from the crosshead. Unscrew and remove through the fluid cylinder opening.

h. Remove the gland nut, old packing, and packing adapters. Note the order of the packng and adapters. Clean the stuffing box and inspect for any damage.

Assembly…

II. FLUID END

E. PLUNGER PACKING INSTALLATION

4. STYLE 242 PACKING (Continued)...

i. Rotate the pump to bring the next plunger forward.

j. Repeat steps “e” through “i” above until all plungers and packing have been removed.

k. Insure the stuffing box lube port is plugged or has not been drilled completely. This style packing does not use a lantern ring and the port must be plugged or the packing will prematurely fail.

l. Thoroughly clean and inspect the stuffing box bore. New packing will not last long in a worn or washed stuffing box.

m. Remove the new packing set from its wrapping while taking care to note the order.

n. Lightly lubricate the stuffing box bore and install the first bronze bushing, next to the rubber header ring/spring in the unwrapped packing set.

o. Install the rubber header/spring ring.

p. Install the second bronze bushing.

q. Install the spiral wrapped pressure rings.

r. Install the last bronze bushing.

s. Loosely install the gland nut.

t. Lightly oil the plunger and install it through the fluid cylinder. Do not use worn plungers on new packing, as this will shorten packing life.

u. If using one-piece plungers, thread the plunger into the crosshead and torque to 150 ft.-lbs. (203 N-M).

v. If using two-piece plungers, torque the adapter rod into the crosshead to 150 ft.-lbs. (203 N-M). Then, use a back-up wrench on the adapter rod and torque the plunger into the adapter rod to 150 ft.-lbs. (203 N-M).

w. Repeat steps “k” through “v” above until all cylinders have been repacked.

x. Install the valve components removed in steps “b” and “c” above.

y. Use new gaskets and install the fluid end cylinder heads and valve covers.

z. Torque the gland stud nuts to 200 ft.-lbs. (271 N-M). This is a non-adjustable packing and the gland should pull up metal to metal.

aa. Install the cradle cover and the pump should be ready to operate.

Plunger Pump Valves…

I. OPERATIONAL MAINTENANCE

A. SUCTION AND DISCHARGE

As with any plunger pump, the necessity for having an adequate suction head and proper piping design of both suction and discharge cannot be over emphasized.

! ATTENTION !

NOISY VALVES, DUE TO IMPROPER FILLING, CAN LEAD TO SHORT LIFE AND RAPID MECHANICAL WEAR OF THE POWER END PARTS.

B. VALVE COVERS

⚠ CAUTION ⚠

THE VALVE COVERS, AS USED WITH THE NATIONAL OILWELL VARCO PLUNGER PUMPS, **MUST** BE KEPT TIGHT AT ALL TIMES. DUE TO THE DISCHARGE PRESSURE APPLYING A CONSTANT LOAD TO THE COVERS, IT IS **NOT** POSSIBLE TO CHECK THEIR TIGHTNESS WITH THE PUMP RUNNING OR WITH PRESSURE IN THE CYLINDER.

Bleed off the discharge pressure and check the tightness of the covers as outlined under the assembly procedure for the type of cover used.

C. VALVE COVER SEALS

The cover seals should be replaced as required.

D. VALVE SPRINGS

The springs used with the NATIONAL OILWELL VARCO valves are made from a variety of materials. Material selection is based on fluid pumpage.

! ATTENTION !

THESE SPRINGS SHOULD BE CHANGED APPROXIMATELY ONCE A YEAR IN ORDER TO ASSURE PROPER VALVE ACTION AND ELIMINATE THE POSSIBILITY OF A SPRING BREAK.

E. VALVE AND SEAT

Tapered Seat Valves: There are three basic valve and seat assemblies available, depending on the type of service. They are the severe duty (abrasion resistant) tapered seat valves, the disc tapered seat valves, and the wing guided tapered seat valves.

Plunger Pump Valves (Continued)...

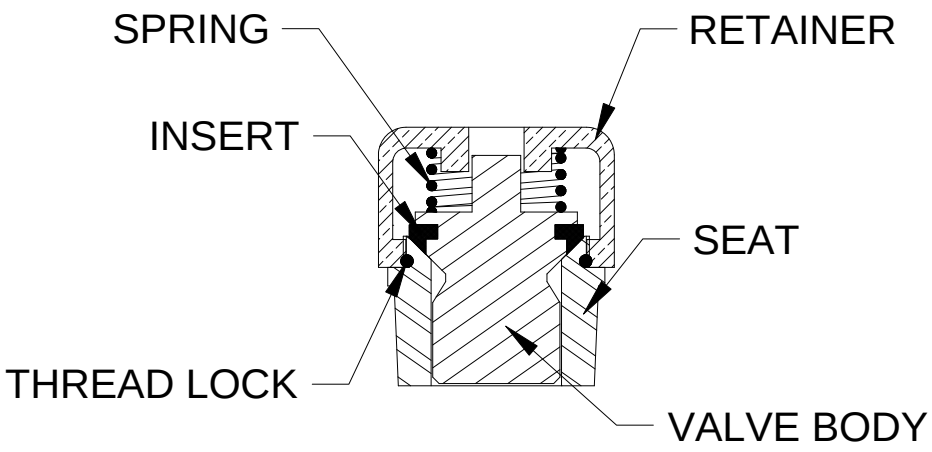
II. TAPERED SEAT VALVES

A. SEVERE DUTY TYPE VALVES

This section will assist in servicing the severe duty (abrasion resistant) valve in your National Oilwell Varco triplex pump.

1. NOMENCLATURE.

NOMENCLATURE



SEVERE DUTY VALVE ASSEMBLY

For part numbers and pullers see the following table.

SEVERE DUTY VALVE			
PUMP MODEL	**SUCTION VALVE ASSEMBLY**	**DISCHARGE VALVE ASSEMBLY**	**VALVE PULLER ASSEMBLY**
55T-3L, 55T-3LS, 55T-3SC,	100SD0502	100SD0502	998-3364AL-001
3364-4, 3364-5, 3364-6, 3364-7, 3364A-M, 3364A-L, 3364A-O, 3364-O	100SD0502	100SD0502	998-3364AL-001
55T-3M, 55T-3MS, 55T-3H	100SD0302	100SD0502	GAS-104959-000
3364-1, 3364-2, 3364-3, 3364-HU, 3364-S, 3364A-S	100SD0302	100SD0502	GAS-104959-000

Plunger Pump Valves

II. TAPERED SEAT VALVES

A. SEVERE DUTY TYPE VALVES (Continued)...

2. VALVE REMOVAL PROCEDURE

a. Ensure pressure is removed from fluid end and pump is **"LOCKED OUT"**.

b. The discharge valve is removed through the valve cover and the suction valve is removed through the cylinder head. Remove both covers.

c. Rotate the pump so the plunger for the cylinder you are working on is all the way back.

d. Starting with the discharge valve assembly use the cage wrench (see tools section of parts list for special tools and numbers) and remove the valve retainer by turning the wrench counter-clockwise.

e. Remove the valve spring.

f. Remove the valve body.

g. Use the special valve puller and remove the valve seat. See figure 10.

h. Repeat steps "c" through "g" above for the suction valve assembly.

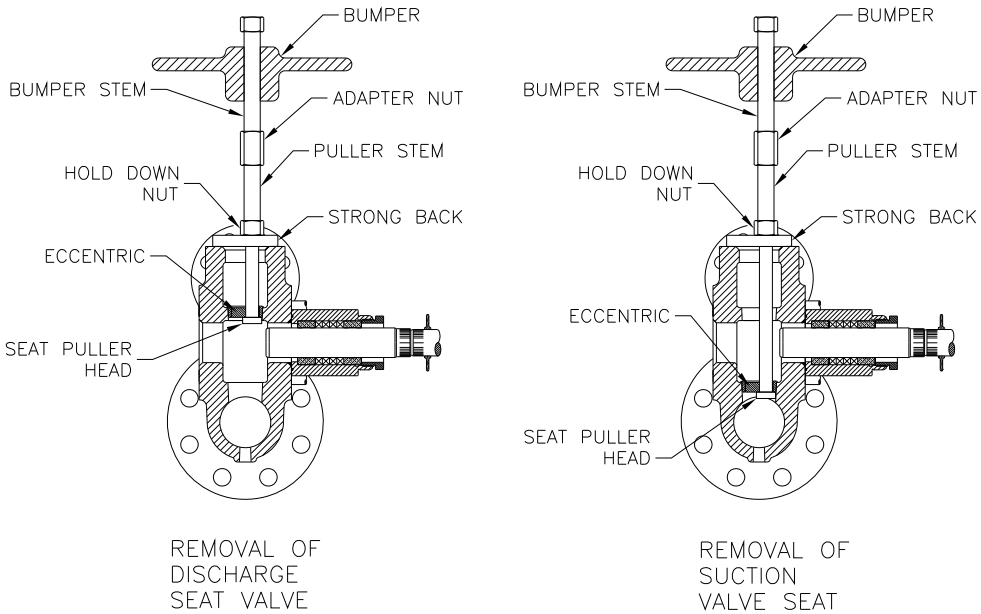


Figure 10

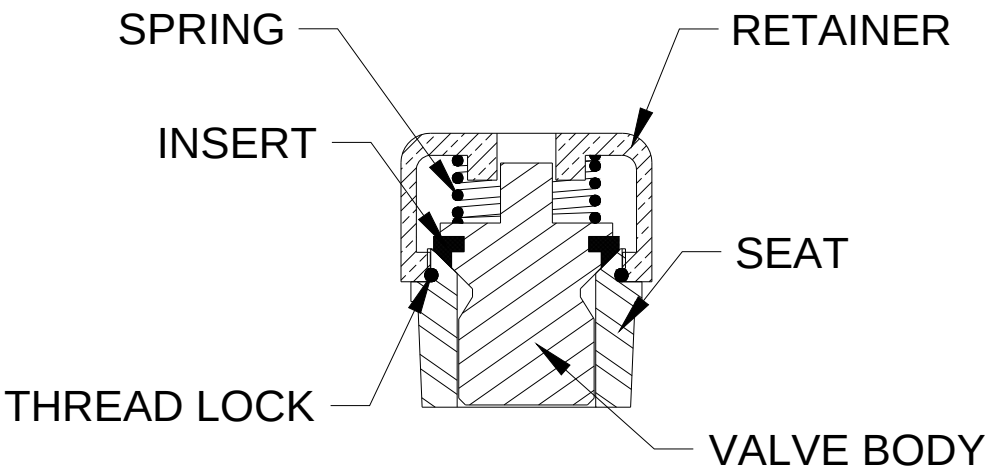
Plunger Pump Valves…

II. TAPERED SEAT VALVES

A. SEVERE DUTY TYPE VALVES (Continued)…

3. VALVE INSPECTION PROCEDURE

NOMENCLATURE



SEVERE DUTY VALVE ASSEMBLY

a. RETAINER

The retainer will not need to be replaced very often. It should be inspected for corrosion or to see if it has been warped or bent. If this is the case, replace the retainer because this can cause undue wear on the spring and improper valve action.

b. SPRING

The spring is made from inconel or other stainless steel and will work in most corrosive environments. It should be inspected for wear and/or nicks. If such evidence is apparent, the spring should be replaced.

Plunger Pump Valves…

II. TAPERED SEAT VALVES

A. SEVERE DUTY TYPE VALVES

3. VALVE INSPECTION PROCEDURE (Continued)…

c. INSERT

The valve insert is made from polyurethane. A good insert is vital for good sealing in slurries or dirty fluids. Inspect the insert for tears, nibbling, and extrusion. If the insert is worn, replace it. Generally you can replace the insert a couple of times before having to replace the valve body.

d. THREAD LOCK

The thread lock is a nitrile rubber. It is used to lock the retainer and prevent it from backing off during pump operation. If the thread lock is torn or damaged, replace it.

e. VALVE BODY

The valve body is heat-treated 17-4 PH stainless. Inspect the body for excessive wear, cracks, or washing. The guides should also be inspected for proper fit in the seat and any cracks or excessive wear. Replace the valve body when these conditions are present. If replacing the valve body, a new insert should also be used.

f. SEAT

The seat is also a heat-treated 17-4 PH stainless steel. Is should be inspected for excessive wear and/or wash on the seating surface. Also check the taper for signs of wash by or wear. If any of these conditions exist, the seat should be replaced. Do not use an old valve body with a new seat.

With the seat out of the pump also inspect the fluid end seating area for washing or excessive wear. The seats should fit in the fluid end with a small amount of stand off. If the fluid end seating area is washed or there is no stand off on the seats, the fluid end will have to be repaired. This type of repair will require the services of a machine shop.

4. VALVE INSTALLATION PROCEDURE

a. Thoroughly clean the fluid cylinder seat area with a cleaner that will not leave an oily residue. Do not oil the taper area of the seat or fluid cylinder seating area. **This will cause the seat to "jump out" of the bore and could cause major damage to the pump.**

b. Clean the taper on the suction seat using the same precautions as with the fluid cylinder bore. The two surfaces must be clean and dry before assembly.

c. Insert the suction seat into the fluid cylinder suction bore.

d. Using a metal plate or old worn valve body, drive the seat into place with several sharp blows from a hammer and bar. (See figure 11.)

e. Install the new valve body with insert.

Plunger Pump Valves…

II. TAPERED SEAT VALVES

A. SEVERE DUTY TYPE VALVES

4. VALVE INSTALLATION PROCEDURE (Continued)…

f. Install the spring.

g. Using the cage wrench (see parts list for special tools) install the retainer cage.

h. Repeat this procedure for the discharge valve.

i. Repeat until all valve assemblies have been installed.

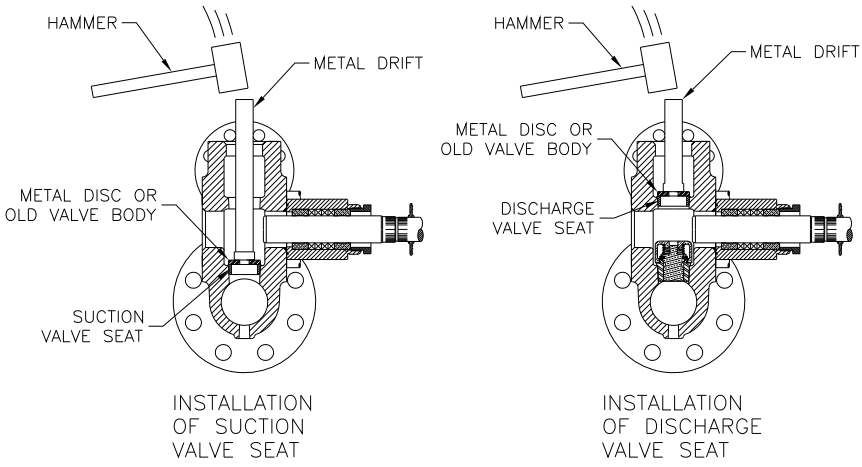


FIGURE 11

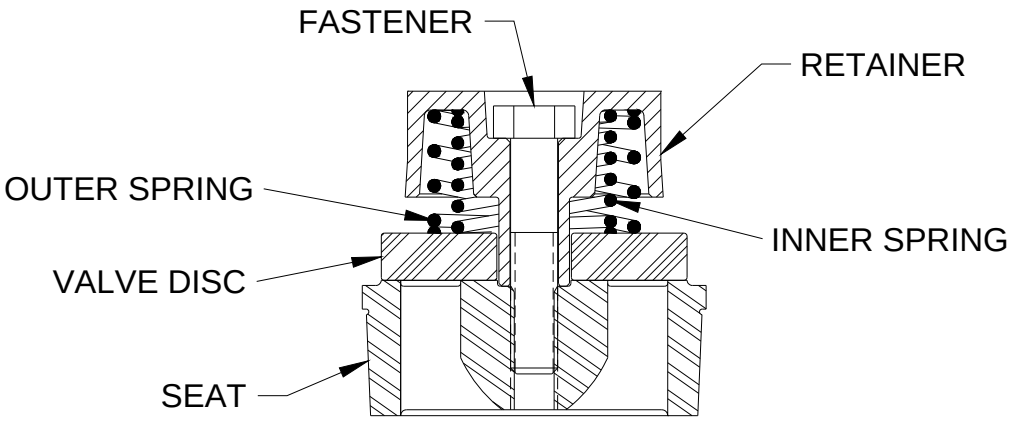
Plunger Pump Valves…

II. TAPERED SEAT VALVES (Continued)...

B. DISC STYLE VALVE

1. NOMENCLATURE

NOMENCLATURE



DISC STYLE VALVE ASSEMBLY

For part numbers and pullers see the following table.

DISC STYLE VALVE			
PUMP MODEL	**SUCTION VALVE ASSEMBLY**	**DISCHARGE VALVE ASSEMBLY**	**VALVE PULLER ASSEMBLY**
55T-3L, 55T-3LS, 55T-3SC, 3364-4, 3364-5, 3364-6, 3364-7, 3364A-L, 3364A-O, 3364-O	(Titanium Disc) 001TP0502	(Titanium Disc) 001TP0502	GAS-104939-000
55T-3L, 55T-3LS, 55T-3SC, 3364-4, 3364-5, 3364-6, 3364-7, 3364A-L, 3364A-O, 3364-O	(Delrin Disc) 001DP0502	(Delrin Disc) 001DP0502	GAS-104939-000
55T-3M, 55T-3MS, 55T-3H, 3364-1. 3364-2, 3364-3, 3364-HU, 3364-S, 3364A-S	(Titanium Disc) 001TP0302	(Titanium Disc) 001TP0502	GAS-104939-000
55T-3M, 55T-3MS, 55T-3H, 3364-1. 3364-2, 3364-3, 3364-HU, 3364-S, 3364A-S	(Delrin Disc) 001DP0302	(Delrin Disc) 001DP0502	GAS-104939-000

Plunger Pump Valves…

II. TAPERED SEAT VALVES

B. DISC STYLE VALVE (Continued)…

2. VALVE REMOVAL PROCEDURES

a. Ensure pressure is removed from the fluid end and pump is "**Locked out".**

b. The discharge valve is removed through the valve cover and the suction valve is removed through the cylinder head. Remove both covers.

c. Rotate the pump so the plunger for the cylinder you are working on is all the way back.

d. Starting with the discharge valve assembly remove the capscrew holding the retainer in place.

e. Remove the retainer and valve springs.

f. Remove the valve disc.

g. Use the special valve puller and remove the seat. See Figure 12.

h. Repeat steps "c" through "g" above for the suction valve assembly.

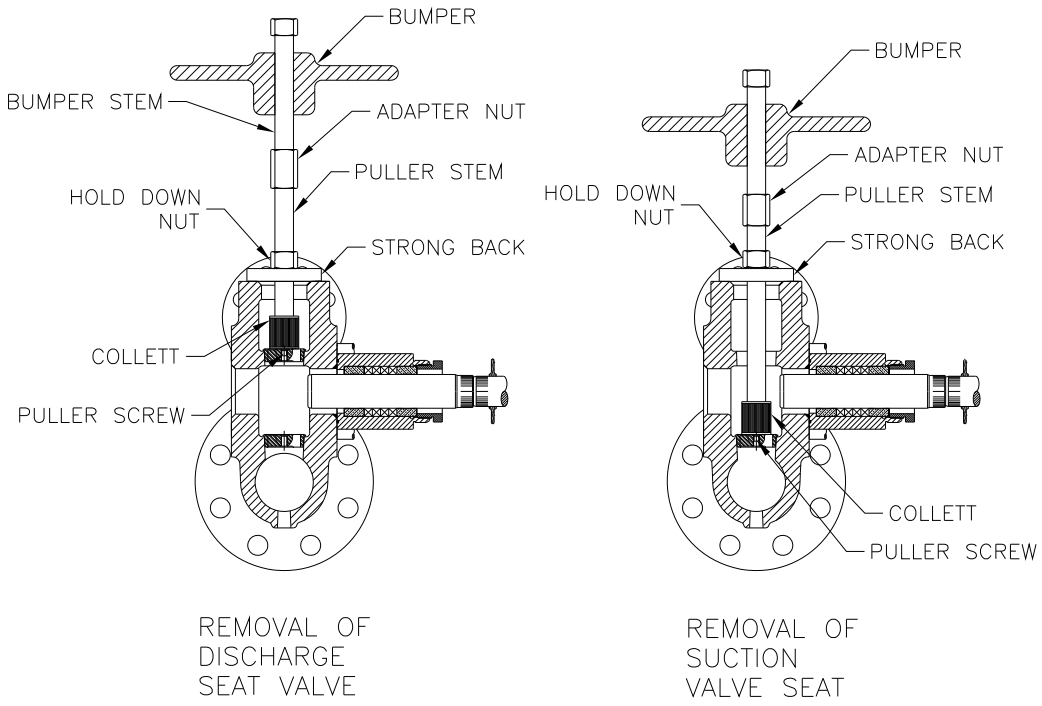


FIGURE 12

Plunger Pump Valves…

II. TAPERED SEAT VALVES

B. DISC STYLE VALVE (Continued)...

3. VALVE INSPECTION PROCEDURE

a. FASTENER

The fastener has a nylon lock tab or a lock patch. Inspect the fastener for corrosion, damaged threads, straightness, and condition of the locking tab. If the fastener is damaged, replace it. The locking tab can be used more than once. However, if the resistance when the tab engages the thread is minimal, replace it.

b. RETAINER

The retainer will not need to be replaced very often. It should be inspected for corrosion or to see if it has been warped or bent. If this is the case, replace the retainer because this can cause undue wear on the springs and improper valve action.

c. SPRING

The springs are made from inconel or other stainless steel and will work in most corrosive environments. It should be inspected for wear and/or nicks. If such evidence is apparent, the springs should be replaced.

d. VALVE DISC

The valve disc is either “Delrin” or “Titanium”. Inspect the disc for excessive wear, cracks, or washing. If any of these conditions exist, replace the disc.

e. SEAT

The seat should be inspected for excessive wear and/or wash on the seating surface. Also check the webs for any cracks and the thread for any tears or damaged threads. Check the taper for any signs of wash. Replace the seat if these conditions exist.

4. VALVE INSTALLATION PROCEDURE

a. Thoroughly clean the fluid cylinder seat area with a cleaner that will not leave an oily residue. **Do not oil the taper area of the seat or fluid cylinder seating area. This will cause the seat to “jump out” of the bore and could cause major damage to the pump.**

b. Clean the taper on the suction seat using the same precautions as with the fluid cylinder bore. The two surfaces must be clean and dry before assembly.

c. Insert the suction seat into the fluid cylinder suction bore.

d. Using a metal plate or old worn valve body, drive the seat into place with several sharp blows from a hammer and bar. (See Figure 13.)

Plunger Pump Valves…

II. TAPERED SEAT VALVES

B. DISC STYLE VALVE

4. VALVE INSTALLATION PROCEDURE (Continued)...

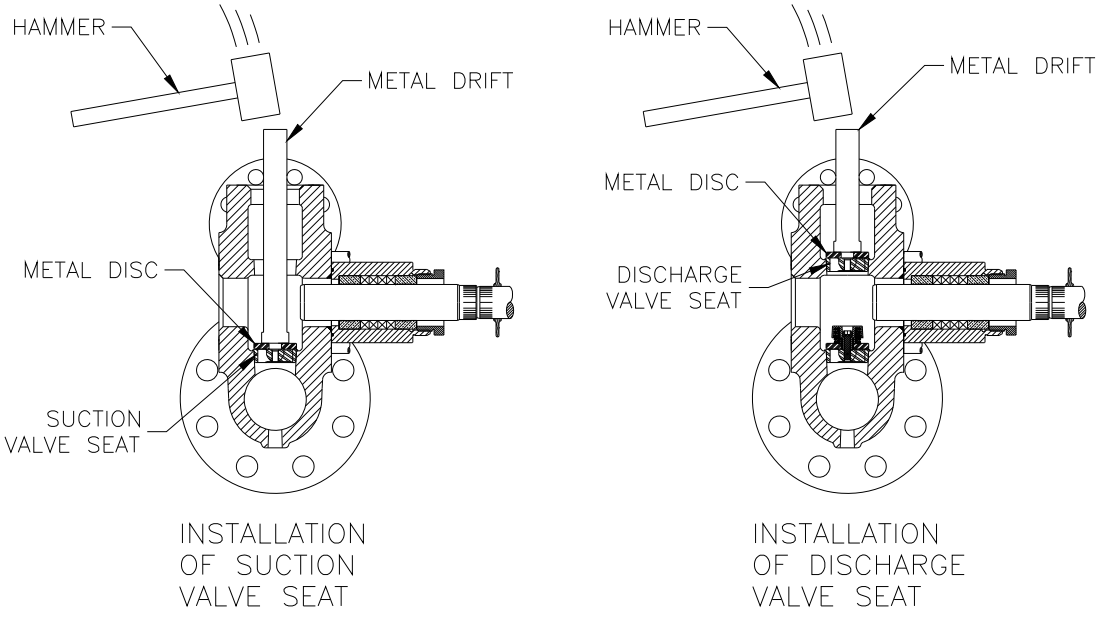


FIGURE 13

e. Install the valve disc.

f. Install the valve springs.

g. Install the retainer.

h. With one hand push the retainer down to compress the springs and start the neck of the retainer through the valve disc. Hand start the fastener.

i. Tighten the fastener while ensuring the retainer pulls down against the seat and does not clamp the disc down. The disc has to move up and down on the retainer neck.

j. Repeat this procedure for the discharge valve.

k. Repeat for the remaining cylinders.

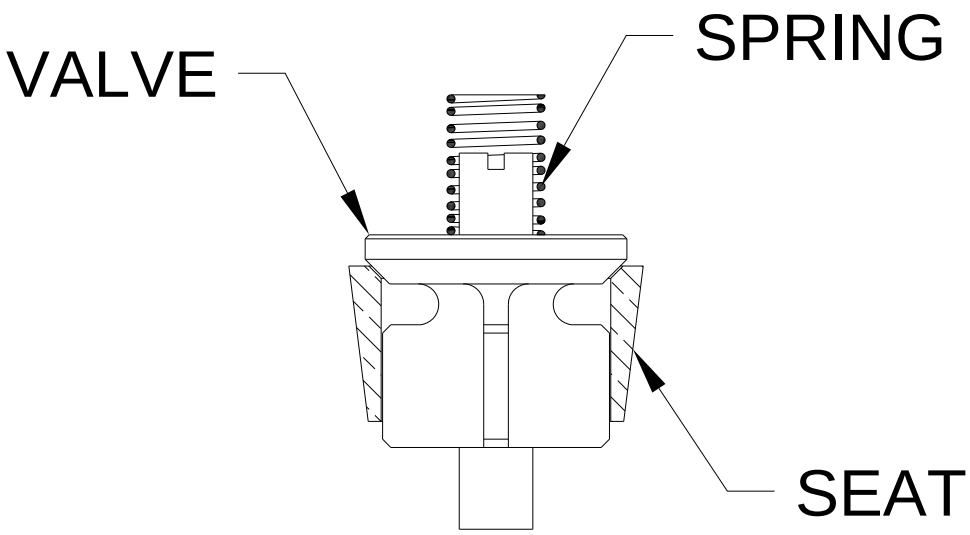
Plunger Pump Valves…

II. TAPERED SEAT VALVES (Continued)...

C. WING GUIDED VALVE

1. NOMENCLATURE

NOMENCLATURE



WING GUIDED VALVE ASSEMBLY

For part numbers and pullers see the following table.

DISC STYLE VALVE			
PUMP MODEL	**SUCTION VALVE ASSEMBLY**	**DISCHARGE VALVE ASSEMBLY**	**VALVE PULLER ASSEMBLY**
55T-3L, 55T-3LS, 55T-3SC, 3364-4, 3364-5, 3364-6, 3364-7, 3364A-L, 3364A-O, 3364-O	(Carbon Steel) GAS-110796-000	(Carbon Steel) GAS-110792-000	GAS-104959-000
55T-3L, 55T-3LS, 55T-3SC, 3364-4, 3364-5, 3364-6, 3364-7, 3364A-L, 3364A-O, 3364-O	(Stainless Steel) GAS-110795-000	(Stainless Steel) GAS-110790-000	GAS-104959-000
55T-3M, 55T-3MS, 55T-3H, 3364-1. 3364-2, 3364-3, 3364-HU, 3364-S, 3364A-S	(Carbon Steel) GAS-100548-000	(Carbon Steel) GAS-100538-000	GAS-104855-000
55T-3M, 55T-3MS, 55T-3H, 3364-1. 3364-2, 3364-3, 3364-HU, 3364-S, 3364A-S	(Stainless Steel) GAS-100547-000	(Stainless Steel) GAS-100537-000	GAS-104855-000

Plunger Pump Valves…

II. TAPERED SEAT VALVES

C. WING GUIDED VALVE (Continued)...

2. VALVE REMOVAL PROCEDURE

1. Ensure pressure is removed from the fluid end and pump is "**Locked out".**
2. The discharge valve is removed through the valve cover and the suction valve is removed through the cylinder head. Remove both covers.
3. Rotate the pump so the plunger for the cylinder you are working on is all the way back.
4. Starting with the discharge valve assembly remove the valve spring and valve body.
5. Use the special valve puller and remove the seat. See Figure 14.
6. Repeat steps "c" through "e" above for the suction valve assembly.

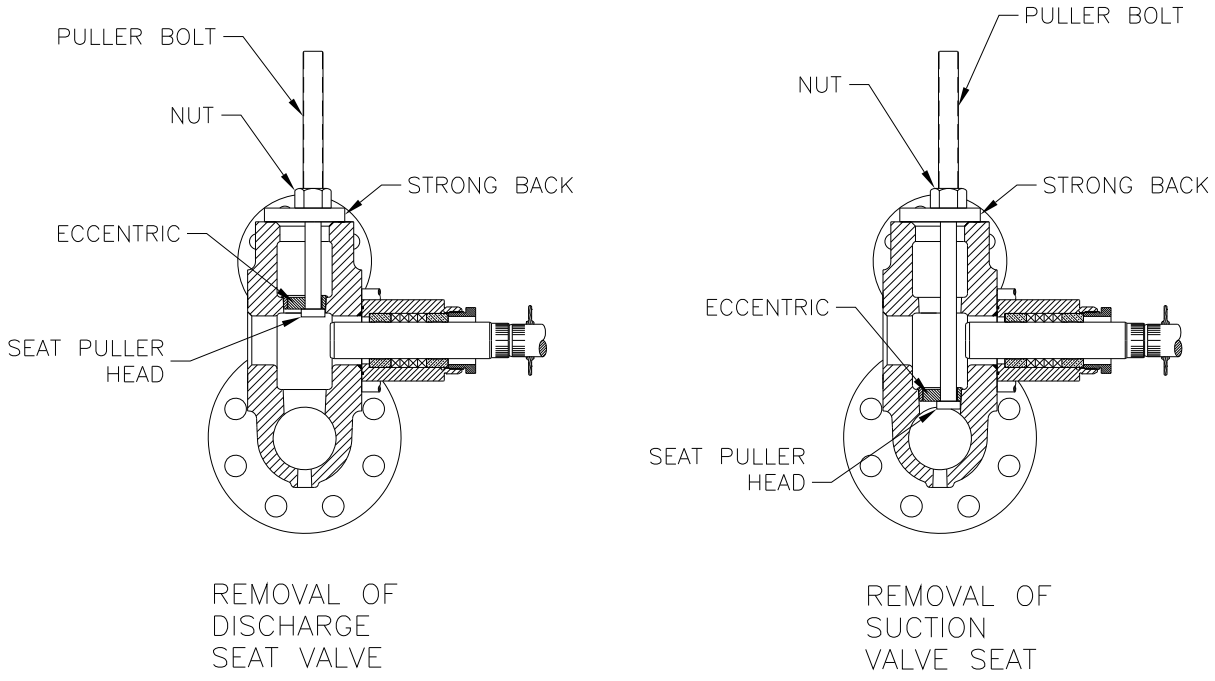


FIGURE 14

Plunger Pump Valves…

II. TAPERED SEAT VALVES

C. WING GUIDED VALVE (Continued)…

3. VALVE INSPECTION PROCEDURE

a. SPRING

The springs are made from inconel, steel, or stainless steel depending on the fluid being pumped. It should be inspected for wear and/or nicks. If such evidence is apparent, the springs should be replaced.

d. VALVE BODY

The valve is either hardened carbon steel or stainless steel. Inspect the valve for excessive wear, cracks, or washing. If any of these conditions exist, replace the valve.

e. SEAT

The seat should be inspected for excessive wear and/or wash on the seating surface. Check the taper for any signs of wash. Replace the seat if these conditions exist.

4. VALVE INSTALLATION PROCEDURE

a. Thoroughly clean the fluid cylinder seat area with a cleaner that will not leave an oily residue. **Do not oil the taper area of the seat or fluid cylinder seating area. This will cause the seat to "jump out" of the bore and could cause major damage to the pump.**

b. Clean the taper on the suction seat using the same precautions as with the fluid cylinder bore. The two surfaces must be clean and dry before assembly.

c. Insert the suction seat into the fluid cylinder suction bore.

d. Using a metal plate or old worn valve body, drive the seat into place with several sharp blows from a hammer and bar. (See Figure 15)

e. Install the valve body.

f. Install the valve springs.

g. Repeat this procedure for the discharge valve.

h. Repeat for the remaining cylinders.

Plunger Pump Valves…

II. TAPERED SEAT VALVES

C. WING GUIDED VALVE

4. VALVE INSTALLATION PROCEDURE (Continued)...

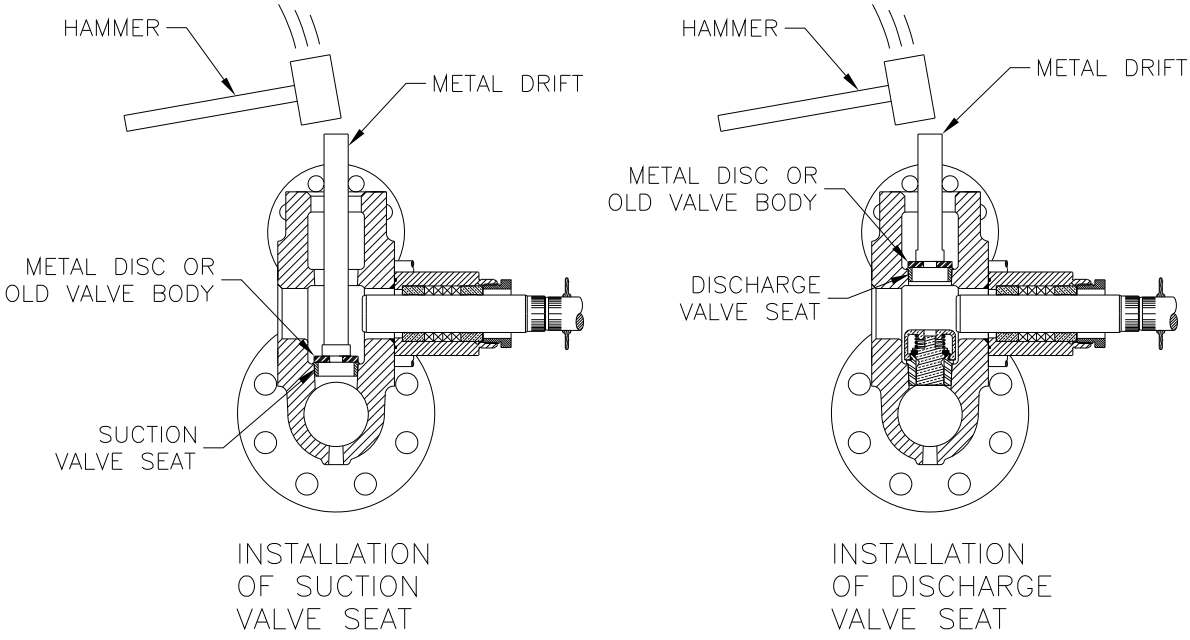


FIGURE 15

P-55U Pump…

A. OPERATING INSTRUCTIONS

1. BOX SUCTION PUMPS (VACUUM FEED)

- Fill reservoir with oil.
- Loosen union nut on pump outlet.
- Remove the vent screw and fill the sight glass with oil. Prime by manually pumping flushing unit until air free oil is observed from the drip tube and oil level drops in the sight glass.
- Replace vent screw and tighten union nut.
- Maintain oil level in sight glass below the drip tube so drops can be observed.

2. FLOW RATE ADJUSTMENT

- Loosen locknut on flushing unit.
- Turn flushing unit counter-clockwise to increase flow.
- Turn flushing unit clockwise to decrease flow.
- Tighten locknut when desired flow rate is achieved.

3. SIGHT GLASS

In a vacuum type sight feed, it is not uncommon for oil level in the sight glass to drop during operation. Absence of a level indicates air is being taken in with the oil and some oils, due to viscosity conditions, will release air faster than others. When the quality of air becomes excessive, it can eventually air lock the pump.

For this reason it is recommended that an oil level in the sight glass be maintained.

When level drops, remove the vent screw and fill sight glass to top; replace vent screw and operate flushing unit manually, observing that an oil in the sight glass is free from air. If air is not expelled, it may be necessary to loosen union nut (on pump outlet) and expel air at this point. It is desirable to maintain level below the drip tube so drops can be seen during operation.

4. OVERFILLING OF SIGHT GLASS

In a vacuum type sight feed, it is not uncommon to see a reverse action whereas sight glass fills with oil and the drops cannot be observed. Overfilling is caused by oil absorbing air in the sight glass and normally does not affect the operation of the pump. Remove the vent screw from sight glass and allow level to drop below drip tube. Tighten vent screw and check to see that air free oil from drip tube can be observed in the sight glass. If overfilling continues, it may be caused by plunger wear and oil slippage is being drawn back to sight glass. If this is the problem, the feed setting in drops per stroke will then automatically be reduced by the amount of slippage.

5. RESERVOIR OIL LEVEL (LOSS OF PRIME)

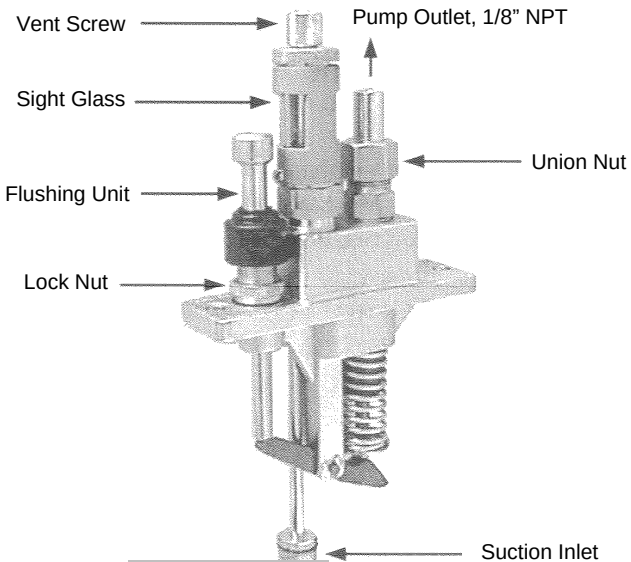
If reservoir runs low on oil (at a point below the suction inlet of the pump) it may be necessary to prime individual pumps after filling, using procedure listed above.

6. PUMP DISPLACEMENT

Maximum output (per stroke):

1/4 Plunger = .018 Cubic Inches
3/8 Plunger = .038 Cubic Inches

The cubic volume for a pint of oil is 28.9 cubic inches and average drop size is .002 cubic inches.



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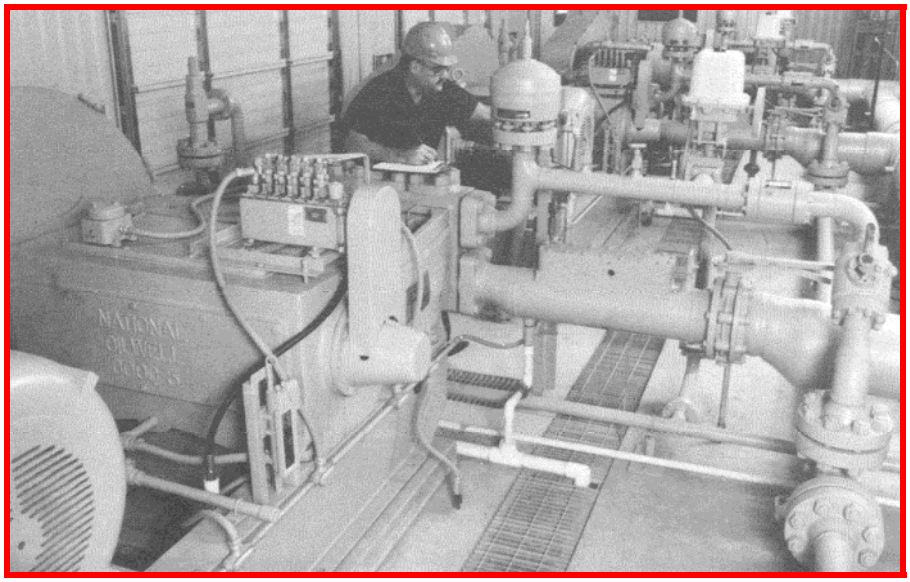

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